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GROWTH AND PRODUCTIVITY RESPONSE TO IRRIGATION LEVELS AND SPRAYING WITH AMINO ACID (GLYCINE) SOLVATION ON FENNEL PLANTS

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ABSTRACT

The experiment trial was consummated throughout two successive seasons (2017 and 2018) at the Agriculture Research center (Dhamar-Yemen) to study effect of amino acid (glycine), irrigation levels on growth and productivity of fennel plants. Results emphasized the beneficial effect of applying or the highest irrigation levels with the mastery of the highest level in raising plant height and number of leaves/plant both seasons. Supplying plants with the highest irrigation level (75% and 100% of field capacity) proved its mastery in improving flowering parameters in both seasons as well as the beneficial effect of the highest (glycine) level (500ppm) on improving of some chemical composition. From the aforementioned results, it could be recommended to use either the moderate or the highest irrigation level (75 and 100% of field capacity) with treating plant and the height (glycine) level (500ppm) for improving fennel, generally with significant differences between the other rates under study.

Keywords: Irrigation, Amino acid levels, Fennel.

Introduction

Fennel (Feoniculum vulgare, Mill) winter herbaceous plant of the parsley family (Apiaceae). Fennel fruits have a burning sweet taste, spicy odor and pleasant as well as it has food flavoring, perfumery and pharmaceutical utilized [1]. It is an aromatic plant whose fruits contain volatile oil which is utilized for several objectives by humans and animals [2, 3]. The volatile oil of fennel relieves rheumatic and muscular pains, relieves the spasms of intestines and regulates the peristaltic functions of the gastrointestinal tract [4]. In addition, antimicrobial, in secticidal and antioxidant activity of fennel has also been demonstrated [5, 6]. Quantifying the water requirements of every crop is very necessary to reduce the amount of used water in the agriculture production in Yemen. However, the little in formations is available in this concern especially in the field of ornamental plants. Water in Yemen is obliged to rationalize our methods of irrigation the worst uses. A lot of authors discussed the problem of diminishing water resources and impact on our life. **Lucia et.al** [7], remarked that knowledge of plant performance under reduced irrigation has the potential to reduce drastically the amounts of the applied container irrigation water. **Iersel et al** [8], reported that more efficient irrigation practices are needed for ornamental plants production to reduce the amount of water used for production as well as runoff of fertilizer. **Amoroso et al** [9], outlined that water stress is one of the primary constraints to plant productivity world-wide. Water availability for irrigation in the agriculture and nursery industry will be reduced in the forthcoming years. **Alvares et al** [10], declared that irrigation water requirements and sensitivity to water deficits of ornamental plants is of great interest to horticulture producers for planning irrigation strategies. Evapotranspiration of a crop is the sum of transpiration by the crop and evaporation from the soil surface during plant life [11]. Various workers on different plants such as salvia splendens [12], begonia [13], strelitziareginae [14], roses [15], and polianthes tuberose cv, where they concluded that the water availability was associated with the increase of vegetative growth and flowering of the plants, whereas soil stress caused decrease in plant performance. A decline in water potential would decrease the internal plant processes, such as net photosynthesis, cell division and enlargement and reduce epidermal cell turgor as noticed [16-18]. Little information is available on the effect of irrigation levels on fennel plant [19, 20]. Moreover, amino acids is a well-known biostimulant which has positive effects on growth quality and quantity of yield at all plants and safely alleviates the injuries caused by a biotic stresses [21]. It can influence the physiological activities in plant healthy growth [22]. **Saeed et al** [23], found that treatments of amino acids significantly increased growth components such as fresh weight of shoot and root as well as pod yield of soybean. **Sadak et al** [24], reported the exogenous treatment of

amino acids (alleviated by amino acid application as foliar spray) on the fava bean resulted in the reductions in shoot length, a number of leaves/plant, fresh and dry weight total carbohydrates caused by the irrigation of saline water (3.13 and 6.25dsm). Recently, **Ali et al** [25], demonstrated that tyrosine or/and glutamine acids significantly increased roselle plant growth and yield components compared to control (sprayed with tab water). Therefore, the present experiment was performed to find out the individual and the combined effect of different irrigation levels and glycine treatments on growth and productivity of fennel plants.

Experimental

Materials and Methods

- The current work focused to improve the vegetative growth and yield components as well as volatile oil production of fennel plants by utilizing glycine acid level (0.0,100,300 and 500ppm) under different irrigation rates (50,75 and 100% of field capacity) or more properly pot capacity of growing medium used, (sand/clay1:1,v/v) on growth and productivity of fennel plant.
- The experiment was performed throughout two successive seasons (2017 and 2018) at the agriculture research station, Dhamar,Yemen.

Table 1: The physical and chemical analysis of soil.

Physical properties		Chemical analysis	
Parameters	**Values**	**Parameters**	**Values**
Coarse sand	7.33 %	Organic matter	1.66%
Find sand	16.8 %	$CaCO_3$	0.95%
Silt	27.2 %	Available nitrogen	0.98%
Clay	57.3%	Available phosphor	0.66%
Textural class	Clay loam	Available potassium	0.67%
Ec (ds/m)	0.93%	pH	7.75

Procedure

Fruits of fennel were sown on 2th October of both seasons under open field condition in 25cm. Plastic filled with the mixture of sand+clay (1:1 v/v) and divided in to three groups for studying the effect of irrigation levels (50,75 and 100% of field capacity). For the growing media used every group of Irrigation levels was re-divided again in to four groups for studying the effect of the different levels of foliar application of glycine (control, 100, 300 and 500ppm). The plants received the different treatments of irrigation levels commencing from planting day. Whereas, the foliar application of glycine was started

on Novmber 6th and then at 15 days intervals, and the plants received glycine treatments 3 times throughout the growing season. The quantities of irrigation were applied for every pot of the different irrigation levels used as (128.97, 257.92, 386.90 and 515.90 cm^3 /pot).

Representing 50, 75 and 100% of field capacity of the growing medium used (sand/clay,1:1, v/v).The plants were irrigated using the above mentioned allocation of water at three days interval during on October and Novmber and at two days interval during December, January and February. Around 12 treatments were carried out in the two seasons (3 irrigation ×4 glycine treatments).

A factorial experiment type in randomized complete block design (RCBD) with three replicates was employed in both seasons. The main target was irrigation levels whereas the second sub-target was glycine levels.

Date recorded:

Plant growth: plant height (cm), branch number/plant and total plant fresh and dry weights (g) were estimated at after 120 days from sowing date.

Fruit yield components: At harvest stage, number of umbels/plant, fruit yield/ plant (g) was tabulated, and then fruit yield/feddan (kg) was studied.

Volatile oil production: A sample of fennel dry fruit was possessed randomly of each treatment. Hydro distillation for 3h was utilized to extract the volatile oil percentage from air dried fruits of fennel as described earlier [26].Then, volatile oil yield per plant (ml) and volatile oil yield per feddan (L) was calculated.

Chemical constituents:

Total carbohydrates percentage of fennel fruits was determine according to the methods substantive through AOAC (1990).

Total chlorophyll contents (a+b) as (mg/100g, fresh weight) according to Wettstein [27].

Statistical Analysis

Data were analyzed according to Gomez and Gomez [28]. Least significance difference (LSD) was used to differentiate means at 5% level probability. The means were compared utilizing computer program of statistics version 9 (Analytical software, 2008).

Results and discussion

The effect of irrigation and glycine levels on plant height of fennel plants during 2017 and 2018 seasons was summarized in Table 2.

Table 2: Irrigation and glycine levels on plant height (cm) of Fennel plants

Glycine (ppm)	Irrigation levels			
	50%	75%	100%	Mean
Control	184.83	193.90	197.85	192.20
100	186.88	195.95	199.90	194.25
300	189.25	198.32	202.27	196.61
500	191.17	200.24	204.19	198.53
Mean	188.03	197.10	201.05	
L.S.D 5%	A=1.545	B=1.785	A*B=3.091	
C.V.%	0.9			

Amino acide type (glycine) treatments on other side improved plant height amino acide than that gained from control, with the superiority of applying the highest level (500ppm) giving (198.53cm) against (188.03cm) of control means season. Similar effects on the same parameters recorded else [29]. In the matter of the interaction, it's evident from 2nd values that the mastery of receiving plant has the highest irrigation level with applying the highest glycine level (500ppm) in elevating plant height it gave the Utmost high value in season, registering (201.05cm). In control the lowest means were obtained from plants which received the lowest irrigation level (50% of field capacity) and untreated with glycine, scoring (184.83cm) in season. In literature [30], the utilized amino acid at 1000 ppm enhanced the growth and yield components of Roselle plants such as plant height, number of Branches.

Besides, the effect of irrigation and glycine levels on number branches/plant of Fennel plants was recorded in Table 3. Data of season in Table 3 shows that plant height and branch number per plant of fennel plant revealed that prevalence of using the high and to some extent the moderate irrigation levels in increasing these parameters in two seasons. **EL-Shakhs et al** [31], stated that on Dahlia pinnata an increasing quality of water improved plant height and leaf number/plant. However, the effect of Irrigation periods (at 1.3, 5.7 and 9 days intervals) on the growth of the plant showed that using the shortest irrigation period (at daily interval) proved its superiority in improving vegetative growth high and number of leaves/plant [32]. Higher effective on vegetative growth due to supplying plants with either moderate or high level in irrigation was also noticed [20, 33].

Table 3: Irrigation and glycine levels on no. branches/plant of Fennel plants

Glycine (ppm)	Irrigation levels			
	50%	75%	100%	Mean
Control	11.545	13.158	14.468	13.057
100	11.953	13.567	14.877	13.466
300	12.313	13.927	15.237	13.826
500	12.885	14.498	15.808	14.397
Mean	12.174	13.788	15.098	
L.S.D 5%	A=0.4703	B=0.5431	A*B=0.9406	
C.V.%	4.1			

Additionally, the effect of irrigation and glycine levels on dry weight/plant (g) of fennel plants during 2017 and 2018 seasons was listed in Table 5. Data of both seasons in Table 5 shows that dry weights of plant (branches + leaves of plants) of fennel were the highest irrigation level (75,100% of filed capacity) and treated with the highest glycine level (500 ppm) was the best treatment compared to the control and lowest level under study. While, the effect of irrigation and glycine levels on Umbles number per plant of fennel plants during 2017 and 2018 seasons was gavin in Table 6.

Table 5: Irrigation and glycine levels on dry weight/plant (g) of fennel plants

Glycine (ppm)	Irrigation levels			
	50%	75%	100%	Mean
Control	32.93	33.83	34.98	33.91
100	33.72	34.62	35.77	34.70
300	34.65	35.55	36.70	35.63
500	35.80	36.71	37.86	36.79
Mean	34.27	35.18	36.32	
L.S.D 5%	A=0.563	B=0.651	A*B=1.127	
C.V.%	1.9			

Table 6: Irrigation and glycine levels on Umbles number per plant of fennel plants

Glycine (ppm)	Irrigation levels			
	50%	75%	100%	Mean
Control	39.12	41.62	45.74	42.16
100	42.25	44.75	48.87	45.29
300	45.58	48.08	52.20	48.62
500	49.20	51.70	55.82	52.24
Mean	44.03	46.54	50.66	
L.S.D 5%	A=1.053	B=1.216	A*B=1.127	
C.V.%	2.6			

The aforementioned results in Table 6 shows the superiority of using the highest irrigation level (100% of filed capacity) for improving plant parameters, whereas the lowest level of 50% declined to some extranet parameters. However, a decline in water potential for tuberose would decrease the internal plant processes, such as net photosynthesis, cell division and enlargement and reduce the epidermal cell turgor [34]. Further, the effect of irrigation and glycine levels on Volatile oil percentage % of fennel plants during 2017 - 2018 seasons was tabulated in Table 7.

Table 7: Irrigation and glycine levels on volatile oil percent % of fennel plants

Glycine (ppm)	Irrigation levels			
	50%	75%	100%	Mean
Control	2.671	2.836	2.945	2.817
100	2.730	2.895	3.00	2.876
300	2.825	2.990	3.098	2.971
500	2.970	3.135	3.243	3.116
Mean	2.799	2.964	3.072	
L.S.D 5%	A=0.0424	B=0.0490	A*B=0.0489	
C.V.%	1.7			

Obviously data registered in Table 7 proved the superiority of receiving plants the highest irrigation level (100% of filed capacity) and treated with the highest glycine level (500ppm) in elevating the 2nd values in season. In contrast, the least scores were gained as a result of plant which received the lowest irrigation level (50%filed capacity) and untreated with glycine in season. Similarly effect on the some parameters was reported for Roselle plants [35]. Besides, the effect of irrigation and glycine levels on Volatile oil yield/plant (ml) percentage % of fennel plants during 2017 - 2018 seasons was given in Table 8.

Table 8: Irrigation and glycine levels on volatile oil yield/plant (ml) of fennel plants

Glycine (ppm)	Irrigation levels			
	50%	75%	100%	Mean
Control	0.494	0.528	0.596	0.539
100	0.546	0.580	0.648	0.591
300	0.585	0.619	0.687	0.630
500	0.633	0.667	0.735	0.679
Mean	0.564	0.599	0.667	
L.S.D 5%	A=0.0159	B=0.0184	A*B=0.0319	
C.V.%	3.1			

The result in Table 8 presents the superiority of receiving plants the highest irrigation level (100% of filed capacity) and treated with the highest amino acid type (glycine) level (500 ppm) in elevating the scored values in season. In contrast, the least scores were gained as a result of plants

which received the lowest irrigation level (50% field capacity) and untreated with threonine acid in season. Similarly was the effect on the some parameters for longiflorum plant was recorded else [36]. The effect of irrigation and glycine levels on volatile oil yield/ faddan (L) of fennel plants during 2017 and 2018 seasons was recorded in Table 9. The aforementioned results showed the superiority of using the highest irrigation level (100% of field capacity) for improving plant parameters, whereas the lowest level of 50% declined to some extranet plant parameters. Similar effect on the some parameters on rosemary plant recorded in literature [37].

Table 9: Irrigation and glycine levels on volatile oil yield/ faddan (L) of fennel plants

Glycine (ppm)	Irrigation levels			
	50%	75%	100%	Mean
Control	12.788	14.027	14.405	13.740
100	13.317	14.555	14.933	14.268
300	14.028	15.267	15.645	14.980
500	14.992	16.230	16.608	15.943
Mean	13.781	15.020	15.398	
L.S.D 5%	A=0.0983	B=0.1135	A*B=0.1965	
C.V.%	0.8			

Meanwhile, the effect of irrigation and glycine levels on total carbohydrates percentage of fennel plants during 2017 and 2018 seasons was given in Table 10. The data shows the high or the moderate levels for increasing total carbohydrates % in new bulbs. However, other studied concluded that the spraying celeriac plants with amino acid at 750ppm significantly increased total sugars content [38]. Furthermore, the effect of irrigation and glycine levels on chlorophyll content (a+b) as (mg/100g fresh weight) fennel plants during 2017 and 2018 seasons was listed in Table 11.

Table 10: Irrigation and glycine levels on total carbohydrates percentage of fennel plants

Glycine (ppm)	Irrigation levels			
	50%	75%	100%	Mean
Control	11.942	12.817	13.110	12.623
100	12.388	13.263	13.557	13.069
300	13.118	13.993	14.287	13.799
500	13.555	14.430	14.723	14.236
Mean	12.751	13.626	13.919	
L.S.D 5%	A=0.192	B=0.222	A*B=0.384	
C.V.%	1.7			

Table 11: Irrigation and glycine levels on total chlorophyll content (a+b) as (mg/100g fresh weight) of fennel plants

Glycine (ppm)	Irrigation levels			
	50%	75%	100%	Mean
Control	24.702	26.043	27.338	26.028
100	25.653	26.995	28.290	26.979
300	26.897	28.238	29.533	28.223
500	28.317	29.658	30.953	29.6643
Mean	26.392	27.734	29.029	
L.S.D 5%	A=0.136	B=0.157	A*B=0.272	
C.V.%	0.6			

It is evident from data registered in Table 11 that the highest records of chlorophyll (a+b) were a result of receiving plants the highest irrigation level (100% of field capacity). It occupied the 1st rank, followed in the 2nd rank by plants which

treated with the moderate rate (75% of field capacity), then came the effect of the lowest irrigation level (50% of field capacity), which scored the lowest means in this regard. Referring to the effect of glycine treatments it is obvious from data that the highest level (500 ppm) was the best treatment used in raising pigments content in the leaves, and the opposite was the right by using the lowest level (200 ppm) which gave the least scores in season.

Conclusion

Conclusively, from the obtained results, it could be recommended that irrigation fennel plants rate (100% and 75% of field capacity) combined with glycine acid each at (500 ppm) in season as foliar spraying is suitable for improve the growth, yield components, volatile oil production of fennel (feoniculum vulgare Mill) plants.

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