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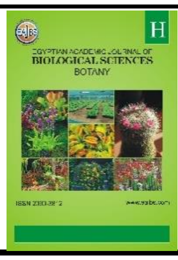

Response of Wheat Plants to Seaweed Extracts and Fluvic Acid under Irrigation with Drainage Water

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ABSTRACT

Two field experiments were conducted at the Rosetta region, El_Behira Governorate, Egypt, during 2017/2018 and 2018/2019 growing seasons to study the effect of water quality, fulvic acid and seaweed extracts on the yield, its components and quality characters of wheat plant (Giza 168), in split-split plot design with three replications. The main plots included irrigation water quality (Nile water and Agricultural drainage water), while seaweed extracts (control, 50 and 100 g SW/fed) was arranged in the subplot. While fulvic acid application (control, 1, 2 kg FA/fed) occupied the sub-subplot. The results concluded that application of water quality, seaweed extracts and their interaction affected significantly wheat yield and its components, where yield and its components of wheat crop increased with using Nile water (high quality water), or drainage water with foliar application of seaweed extracts (SWE) at the rate of 100 g/fed and soil application of fulvic acid at the rate of 2 kg/fed

INTRODUCTION

Wheat is the first important and strategic cereal crop for the majority of the world's populations as well as Egypt. It is the most vital staple food of about two billion persons (36% of the world population). Wheat is the principal crop in winter season and the most important grains crop in the world and in Egypt (Abo Soliman *et al*., 2008). Cereals are an important dietary source throughout the world. Because the cereals constitute the main protein and energy supply in most countries (Boss *et al*., 2005).

Currently, irrigation water resources are limited to meet the needs of crop irrigation. Hence, non-conventional water resources i.e., drainage water, underground water and treated municipal wastewater are recycled especially for agricultural use. Under the limitation of high-quality water resources and the importance of the crop. So, using low-quality water in the agricultural sector will be a must mainly in areas which lie at the tail end of the Nile River. A million faddans in the Nile Delta depends upon drainage water in irrigation (El-Hawary, 2003). Irrigation with Nile water gave wheat grain yield of 2.29 t/fed as compared to 2.26 t/fed and 2.21 t/fed for drainage and sewage water, respectively (Mostafa, 2001a). Using low-quality water in agriculture has bad impacts on soil properties and sowing crop by either increasing their contents of heavy metals or increasing salinity levels, whereas increasing water salinity level reduced wheat production (Mostafa, 2001b). Drainage water for irrigation increased EC_e, SAR, soluble Na^+, Mg^{++}, $SO4^=$ and Cl^- in soil, total and available Pb, Cd and Ni than that of mixed and Nile water. Heavy metal toxicity is one of the major current environmental health problems and potentially dangerous due to bioaccumulation. Therefore, heavy metals contamination of soils and plants has become an increasing problem, so it could be decreased crop production (Zein *et al*., 2012, Atwa *et al*., 2013 and Sahay *et al*., 2013).On the other hand, Nassar *et al.* (2014) revealed that the highest mean values of grain, straw yields, and grain quality of wheat, and good character of soil before and after wheat planting were recorded under Nile water irrigation comparing with the other water irrigation qualities which decreasing wheat yield and increasing salinity, and heavy metals toxicity in the soil.

Seaweeds (SW) benefits as sources of organic matter and fertilizer nutrients have been used as soil conditioners for centuries (Blunden and Gordon, 1986). Approximately 15 million metric tons of seaweed products are produced yearly (FAO, 2006), a significant portion of which used for nutrient supplements and as biostimulants to increase plant growth and yield. Biostimulants are definite as ‘‘materials, other than fertilizers, that encourage plant growth when applied in small quantities’’ and are also raised to as ‘‘metabolic enhancers’’ (Zhang and Schmidt, 1997). Seaweeds (SW) extract provides an excellent source of bioactive compounds such as essential fatty acids, vitamins, amino acids, minerals, and growth-promoting substances to improve salt tolerance in plants (Bhasker and Miyashita, 2005). Seaweed extract (SW) had a wide range of beneficial impacts on plants, as early grain germination and establishment, improved crop performance and yield, elevated resistance to biotic and abiotic stresses (Norrie and Keathley, 2006). Seaweed concentrate improved seedlings growth of okra under nutrient deficiency. It can overawe nutrients stress in crop plants and minimizing the use of expensive chemical fertilizers (Papenfus *et al*., 2013). Applications of SW extract types have been stated to rise plant’s tolerance to a wide range of abiotic stresses, such as salinity, drought, and temperature extremes (Battacharyya *et al*., 2015).

Fulvic acid (FA) has smaller molecules and more acidic groups than humic acids. Application of Fulvic acid on wheat increased labeled P uptake by roots (Xudan, 1986). P fertilizer and soil application FA are fertilized together may be considered as an optimum choice for the improvement of P availability and soil physicochemical conditions (Yang *et al*., 2013). Fulvic acid is applied to the soil enhancement of root initiation and increased root growth (Pettit, 2004).

Therefore, the present study was carried out to study the effect of water quality, seaweed extracts and fulvic acid on the productivity and quality characters of wheat plants.

MATERIALS AND METHODS

To investigate the effect of irrigation water quality, fulvic acid and seaweed on productivity, chemical compositions, and quality of wheat. Two field experiments were conducted at a private farm in Rosetta zone, El- Behera during 2017/2018 and 2018/2019 growing seasons.

A split-split-plot design with three replicates was used. The treatments can be illustrated as follows:

Main plots (water quality) were as follows,

- Nile water.
- Agricultural drainage water.

While sub-plots (Seaweed extracts) were as follows,

Control (water).

Foliar application of Seaweed extracts at the rate of 50 g/ (200 L water)/fed.

Foliar application of Seaweed extracts at the rate of 100 g/ (200 L water)/fed.

Foliar applications of SW were at 45 and 75 days after sowing (DAS).

While sub-sub-plots (Fulvic acid) were as follows,

Control (without application)

Soil application of fulvic acid at a concentration of 70 % at the rate of 1 kg/fed with irrigation.

Soil application of fulvic acid at a concentration of 70 % at the rate of 2 kg/fed with irrigation.

Nitrogen fertilizer at a rate of 70 kg N/fed was added in three doses. The first dose was added at sowing time, the second dose was added with the first irrigation (25 days after sowing) and the third dose was added (25 days after the first sowing). In the two experiments N- fertilizer was added on the form of urea (46.5 % N). Super phosphate fertilizer was applied before sowing at rates of 200 kg/fed (the recommended dose). Potassium fertilizer was applied before sowing (during seedbed preparation) at the rate of 50 kg/ha in the form of potassium sulphate (48 % K_2O) (the recommended dose).

The preceding crop was maize in the two growing seasons. Soil samples of the experimental sites were taken at the depth of (0-30 cm). Physical and chemical analysis are presented in Table (1) were done according to the method described by Chapman and Pratt (1978).

Table 1. Some Physical and chemical properties of the experimental soil in both seasons

Soil characteristics		
Properties	Seasons	
	2017/2018	2018/2019
Soil texture (%)	Clay loam	
Clay %	56.99	58.22
Silt %	9.63	8.92
Sand %	33.38	32.86
pH (1: 2.5 water suspension)	8.30	8.00
EC (dSm^{-1})	0.958	0.988
Cations (meq/L.)		
Ca^{++}	1.87	1.77
Mg^{++}	3.27	2.98
Na^{+}	5.50	5.31
K^{+}	5.10	4.98
Anions (meq/L.)		
HCO_3^-	2.00	1.95
Cl^-	3.85	3.77
$SO4^{--}$	10.50	12.20
O.M. (%)	1.85	1.90
$CaCO_3$ (%)	0.198	0.192
Available Mineral N(mg/kg)	69.40	78.60
Available P (mg/kg)	20.12	28.50

Sowing dates were 12th and 15th of November in both seasons, respectively, while, seeding rate was 75 kg grains/fed first irrigation was applied at 25 days after sowing and then plants were irrigated every 25 days till the dough stage.

The chemical analysis of Nile and drainage water as shown in Table (2) were done according to method described by Chapman and Partt (1978)

Table 2. Chemical analysis of Nile and drainage water.

Water qualities	Anion (meq/L)				Cations (meq/L)				EC, dS/m	pH
	CO3=	HCO_3-	Cl-	SO4=	Ca++	Mg++	Na++	K+		
Nile water	-	3.54	0.94	0.78	1.68	1.60	1.76	0.22	0.43	7.25
Drainage water	-	5.25	12.91	4.37	4.88	3.35	13.76	0.54	1.89	6.87

At harvest time one square meter was taken randomly from each sub-sub plot in the three replications to determine yield and its components, chemical composition and quality of wheat grains.

Number of spikes/m^2, spike length (cm), number of spikelets /spike, number of grains/spike, 1000-grains weight (g), grain yield (t/fed), straw yield (t/fed), biological yield (t/fed), harvest index, and grain protein content (%) were recorded in both seasons.

Data obtained was exposed to the proper method of statistical analysis of variance as described by Gomez and Gomez (1984). The treatment means were compared using the least significant differences (L.S.D.) test at 5% level probability by using the split- split model as obtained by CoStat 6.311, 1998-2005 as a statistical program.

RESULTS AND DISCUSSION

The obtained results showed a significant effect of water quality, seaweed extracts, fulvic acid and their interaction on wheat yield and its components during both seasons (Tables 3 and 4).

Regarding the effect of water quality, the results in Table (3) revealed that the highest mean values of all yield and its components as spike length (14.2 and 14.0 cm), number of spikes/m^2 (325.8 and 332.7), number of spikelets/spike (21.7 and 22.1), number of grains/spike (50.5 and 51.9), 1000- grain weight (48.0 and 49.4 g), straw yield (4.1 and 4.2 t/fed.), grain yield (2.8 and 2.9 t/fed.), biological yield (6.9 and 7.1 t/fed.), harvest index (40.6 and 40.8 %) and grain protein (9.3 and 9.6 %) were produced by irrigating wheat plant by Nile river water as compared with agricultural drainage water in both seasons . These results might be taken place due to the grain yield, in fact, are the out product of its main components. Therefore, the increase in grain yield owing to Nile water was the logical result of the achieved increase in components. These results are in agreement with those reported by Mostafa (2001a), Zein *et al.* (2012), Atwa *et al.* (2013), Sahay *et al.* (2013) and Nassar et al (2014) who recorded that using Nile water for crop irrigation caused an increase in yield and its components of wheat as compared with the other water as lowest quality (drainage water).On the other hand, using low-quality water in agriculture has bad impacts on soil properties and sowing crop by either increasing their contents of heavy metals or increasing salinity levels, whereas increasing water salinity level reduced wheat production (Mostafa, 2001b).

With respect to the effect of seaweed extracts on wheat yield and its components, the obtained results are shown in Tables (3 and 4). It could be concluded that foliar application of seaweed extracts at the rate of 100 g/fed encourage the increase of spike length (14.3 and 14.2 cm), number of spikes/m^2 (322.4 and 329.3), number of spikelets/spike (22.4 and 23.3), number grains/spike (50.5 and 51.3), 1000- grain weight (47.9 and 48.4 g), straw yield (4.4

and 4.3 t/fed.), grain yield (3.0 and 3.0 t/fed.), biological yield (7.4 and 7.3 t/fed.), harvest index (40.8 and 41.1 %) and grain protein content (9.4 and 9.6 %) when compared with the other treatments. On the other hand, spray water (control) recorded the lowest mean values of traits in both seasons. This finding may be taken place due to the effect of seaweed extracts (SW) which plays an important role in the assimilation of wheat plants that, reflected on enhancing these characteristics under the study conditions. These findings are in the same line with those recorded by Bhasker and Miyashita (2005), Norrie and Keathley (2006), Papenfus *et al*. (2013) and Battacharyya *et al*. (2015) who cleared the role of seaweed extracts for improving crop performance, yield and rise plants tolerance to abiotic stress like salinity, drought and high temperature.

Table 3. Plant attributes of wheat as affected by water quality, seaweed extracts, fulvic acid and their interaction during 2017/2018 and 2018/2019 seasons.

Treatments	Spike length (cm)		Number of spikes/m^2		Number of spikelets /spike		Number of grains/spike		1000- kernel weight (g)	
	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019
A) Water quality:										
Nile water	14.2	14.0	325.8	332.7	21.7	22.1	50.5	51.9	48.0	49.4
Drainage water	13.3	13.1	282.4	289.3	19.2	20.1	44.1	44.4	42.9	42.7
LSD at 0.05	0.5	0.2	12.1	10.9	0.4	1.0	2.5	4.6	1.9	4.9
B) Foliar application of Seaweed extracts (g/fed):										
Water	13.2	12.9	277.3	283.7	18.0	18.6	45.7	46.3	43.4	44.2
50	13.8	13.6	312.6	319.8	21.0	21.4	45.8	46.7	45.0	45.5
100	14.3	14.2	322.4	329.3	22.4	23.3	50.5	51.3	47.9	48.4
LSD at 0.05	0.6	0.7	11.2	10.9	0.4	0.7	1.4	2.5	1.6	2.4
C) Soil application of fulvic acid (kg/fed):										
Control	13.5	13.1	294.2	300.3	20.0	20.6	46.6	47.2	43.7	44.4
1	13.6	13.4	303.2	310.2	20.1	20.7	46.6	47.4	45.0	44.5
2	14.2	14.1	315.0	322.4	21.3	22.1	48.8	49.7	47.6	49.2
LSD at 0.05	0.4	0.4	11.2	11.3	0.9	0.8	1.3	2.2	1.8	1.8
Interaction:										
A x B	*	*	*	*	*	*	*	*	*	*
A x C	*	*	*	*	*	*	*	*	*	*
B x C	*	*	*	*	*	*	*	*	*	*
A x B x C	*	*	ns	ns	ns	ns	*	ns	*	*

* and ns: significant difference and not significant difference, respectively.

The results in the same Tables showed the effect of fulvic acid on yield, its components, and protein content of wheat, where increasing the rate of fulvic acid from 1 to 2 kg/fed increased spike length (14.2 and 14.1 cm), number of spikes/m^2 (315.0 and 322.4), number of spikelets/spike (21.3 and 22.1), number of grains/spike (48.8 and 49.7), 1000-grain weight (47.6 and 49.2 g), straw yield (4.1 and 4.1 t/fed.), grain yield (2.7 and 2.8 t/fed.), biological yield (6.8 and 6.9 t/fed.), harvest index (39.7 and 40.6 %) and grain protein content (9.3 and 9.5 %) as compared with control which gave the lowest ones in both seasons. These findings results are in harmony with those recorded by Xudan (1986), Pettit (2004) and Yang *et al*. (2013) who revealed that using fulvic acid increased plant attributes and yield by enhancing the soil properties and root ignition and root growth.

Table 4. Yield attributes of wheat as affected by water quality, seaweed extracts, fulvic acid and their interaction during 2017/2018 and 2018/2019 seasons.

Treatments	Straw yield (t/fed)		Grain yield (t/fed)		Biological yield (t/fed)		Harvest index (HI%)		Grain protein content (%)	
	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019
A) Water quality:										
Nile water	4.1	4.2	2.8	2.9	6.9	7.1	40.6	40.8	9.3	9.6
Drainage water	3.5	3.5	2.3	2.3	5.8	5.8	39.7	39.7	8.7	8.9
LSD at 0.05	0.4	0.4	0.2	0.2	0.7	0.6	ns	1.4	0.3	0.6
B) Foliar application of Seaweed extracts (g/fed):										
Water	3.3	3.3	2.1	2.1	5.4	5.4	38.9	38.9	8.4	8.7
50	3.8	3.8	2.5	2.6	6.3	6.4	39.7	40.6	9.2	9.4
100	4.4	4.3	3.0	3.0	7.4	7.3	40.5	41.1	9.4	9.6
LSD at 0.05	0.2	0.2	0.2	0.2	0.3	0.2	ns	1.8	0.5	0.4
C) Soil application of fulvic acid (kg/fed):										
Control	3.7	3.7	2.3	2.3	6.0	6.0	38.3	38.3	8.8	9.1
1	3.7	3.7	2.4	2.4	6.1	6.1	39.3	39.3	8.9	9.1
2	4.1	4.1	2.7	2.8	6.8	6.9	39.7	40.6	9.3	9.5
LSD at 0.05	0.2	0.2	0.1	0.2	0.3	0.3	ns	0.9	0.3	0.3
Interaction:										
A x B	*	*	*	*	*	*	*	*	*	*
A x C	*	*	*	*	*	*	*	*	*	*
B x C	*	*	*	*	*	*	ns	ns	*	*
A x B x C	ns	ns	*	*	ns	ns	ns	ns	*	*

* and ns: significant difference and not significant difference.

Regarding the effect of interaction of water quality X seaweed extracts on yield and its components of wheat, there was a significant effect on these traits in both seasons. The results in Table (5) showed that the highest mean values of straw yield (4.6 and 4.5 t/fed), grain yield (3.1 and 3.1 t/fed), and biological yield (7.7 and 7.6 t/fed) were obtained by Nile water + foliar application of seaweed extracts at the rate of 100 g/fed followed by Nile water + foliar application of seaweeds at the rate 5 g/fed then Agricultural drainage water + foliar application of seaweed extracts at the rate of 100 g/fed in both seasons.

The results in the same revealed that the effect of interaction of water quality X fulvic acid on yield and its components of wheat, was significant on these traits in both seasons, where the highest mean values of straw yield (4.4 and 4.5 t/fed), grain yield (3.1 and 3.2 t/fed), and biological yield (7.5 and 7.7 t/fed) were obtained by Nile water + foliar application of fulvic acid at the rate of 100 g/fed followed by Nile water + foliar application of fulvic acid at the rate 1 kg/fed in both seasons.

With respect to the effect of interaction seaweed extracts (SWE) x fulvic acid (FA) on yield and its components of wheat, was significant on these traits in both seasons. The results in Table (5) showed that the highest mean values of straw yield (4.8 and 4.8 t/fed), grain yield (3.4 and 3.5 t/fed), and biological yield (8.2 and 8.3 t/fed) were obtained by foliar application of seaweed extracts at the rate of 100 g/fed + soil application of fulvic acid at the rate of 2 kg/fed in the two seasons.

On the other hand, foliar application of seaweed extracts at the rate of 100 g/fed + soil application of fulvic acid at the rate of 2 kg/fed increased yield and its components under drainage water as compared with untreated plots (without SWE or FA) in both seasons.

Table 5. Interaction between water quality X seaweed extracts, water quality X fulvic acid and seaweed extracts x fulvic acid of yield attributes of wheat in both seasons.

Treatments		Straw yield (t/fed)		Grain yield (t/fed)		Biological yield (t/fed)	
		2017/2018	2018/2019	2017/2018	2018/2019	2017/2018	2018/2019
Water quality	Seaweeds (g/fed):	Interaction					
Nile water	Water	3.8	3.8	2.5	2.6	6.3	6.4
	50	4.2	4.2	2.8	2.9	7.0	7.1
	100	4.6	4.5	3.1	3.1	7.7	7.6
Drainage water	Water	2.8	2.9	1.8	1.7	4.6	4.6
	50	3.5	3.4	2.2	2.2	5.7	5.6
	100	4.2	4.2	2.8	2.9	7.0	7.1
LSD at 0.05		0.3	0.2	0.3	0.2	0.4	0.3
Water quality	Fulvic acid (kg/fed):	Interaction					
Nile water	Control (0)	4.1	4.0	2.7	2.8	6.8	6.8
	1	4.1	4.1	2.6	2.6	6.7	6.7
	2	4.4	4.5	3.1	3.2	7.5	7.7
Drainage water	Control (0)	3.3	3.3	2.1	2.1	5.4	5.4
	1	3.4	3.4	2.3	2.3	5.7	5.7
	2	3.8	3.7	2.4	2.4	6.2	6.1
LSD at 0.05		0.3	0.3	0.2	0.2	0.4	0.5
Seaweed extracts (g/fed)	Fulvic acid (kg/fed)	Interaction					
Water	Control (0)	3.0	3.2	1.9	1.9	4.9	5.1
	1	3.2	3.3	2.1	2.1	5.3	5.4
	2	3.6	3.6	2.3	2.4	5.9	6.0
50	Control (0)	3.8	3.8	2.5	2.6	6.3	6.4
	1	3.7	3.7	2.4	2.5	6.1	6.2
	2	3.9	3.9	2.5	2.6	6.4	6.5
100	Control (0)	4.2	4.0	2.7	2.7	6.9	6.7
	1	4.2	4.2	2.8	2.8	7.0	7.0
	2	4.8	4.8	3.4	3.5	8.2	8.3
LSD at 0.05		0.4	0.3	0.2	0.3	0.5	0.6

With respect to the effect of interaction water quality X seaweed extracts (SWE) X fulvic acid (FA) on yield and its components of wheat, it was significant on grain yield in both seasons. The results in Table (6) showed that the highest mean values of grain yield were obtained by Nile water + foliar application of seaweed extracts at the rate of 100 g/fed + soil application of fulvic acid at the rate of 2 kg/fed in the two seasons. On the other hand, Drainage water with foliar application of seaweed extracts at the rate of 100 g/fed + soil application of fulvic acid at the rate of 2 kg/fed increased yield and its components under drainage water as compared with untreated plots (without SWE or FA) in both seasons.

Table 6. Interaction between water quality X seaweed extracts X fulvic acid of grain yield (t/fed) of wheat in both seasons.

Treatments			Seasons	
Water quality	Seaweeds (g/fed):	Fulvic acid (kg/fed):	2017/2018	2018/2019
Nile water	Water	Control (0)	2.4	2.4
		1	2.5	2.5
		2	2.7	2.8
	50	Control (0)	2.6	3.1
		1	2.7	2.7
		2	2.9	2.9
	100	Control (0)	2.7	2.9
		1	2.7	2.6
		2	3.8	3.9
Drainage water	Water	Control (0)	1.6	1.5
		1	1.8	1.7
		2	1.9	1.9
	50	Control (0)	2.1	2.2
		1	2.3	2.2
		2	2.3	2.3
	100	Control (0)	2.6	2.6
		1	2.9	2.9
		2	3.1	3.1
LSD at 0.05			0.3	0.4

CONCLUSION:

As a result of these two growing seasons field's study, it was concluded that yield and its components of wheat crop increased with using Nile or drainage water with foliar application of seaweed extracts (SWE) at the rate of 100 g/fed and soil application of fulvic acid at the rate of 2 kg/fed which increased grain yield and yield components characters of wheat under study conditions at Rosseta, El-Behira Governorate, Egypt.

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ARABIC SUMMARY

إستجابة نباتات القمح لمستخلصات الطحالب البحرية وحامض الفولفيك تحت ظروف الري بمياه الصرف الزراعي

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القمـح أكثر المحاصيل الغذائية أهمية في العالم. وتعتمد عليه مئات الملايين من الناس في جميع أنحاء العالم على الأغذية التي تصنع من حبوب القمح. خاصة الدول النامية ومنها مصر. وتندر مياه الري في بعض أوقات السنة. مما يلجأ المزراعيين في استخدام مياه الصرف الزراعي في عملية الري. خاصة ان مصر لديها فجوة غذائية في محصول القمح لذلك يمكن الأستفادة من مياه الصرف في التوسع الأفقي.

لذلك أجريت تجربتان حقليتان بمنطقة رشيد- محافظة البحيرة - مصر- خلال موسمي الزراعة 2018/2017 و 2019/2018 و وذلك لدراسة إستجابة نباتات القمح (صنف جيزة 168) مستخلصات الطحالب البحرية وحامض الفولفيك تحت ظروف الري بمياه الصرف الزراعي .

وإستخدم تصميم القطع المنشقة مرتين فى ثلاث مكرارات حيث وزعت معاملات التجريبية عشوائياً كما يلي:

أ- القطع الرئيسية: (معاملات الري)
- الري بمياه جيدة النوعية (مياه النيل).
- الري بمياه الصرف الزراعي (مصرف رشيد).

ب- القطع الشقية الأولى(3 معدلات من مستخلصات الطحالب البحرية):
-مقارنة (بدون).
-الرش بمستخلصات طحالب بحرية بمعدل 50 جم/200 لتر ماء/فدان.
-الرش بمستخلصات طحالب بحرية بمعدل 100جم/200 لتر ماء/فدان.

يتم الرش الورقي للمستخلصات البحرية مرتين (فى مرحلة النمو الخضري ، و مرحلة طرد السنابل)

ج- القطع الشقية الثانية (3 معدلات من حامض الفولفيك):
-مقارنة (بدون).
-أضافة أرضية لحامض الفولفيك بتركيز 70% بمعدل1 كجم/فدان.
-أضافة أرضية لحامض الفولفيك بتركيز 70% بمعدل2 كجم/فدان.

ولخصت النتائج فيما يلي:

1- أثرت نوعية مياه الري تأثير معنوي على صـفات المحصـول في القمح و حيث وجد أن الري بمياه النيل حقق أعلى متوسطات في صفات المحصول ومكوناته مثل عدد الاشطاء / م2 و عدد السنابل / م2 وعدد السنيبلات / سنبلة و وزن السنبلة (جم) و طول السنبله (سم) و عدد الحبوب / سنبله و وزن1000 حبة ومحصول القش (طن/فدان) والمحصول البيولوجى (طن / فدان) محصول الحبوب (طن/ فدان) ودليل الحصـاد ومحتوى الحبوب من البروتين وذلك مقارنة بالري بمياه الصرف الزراعي الذي حقق أقل القيم خلال موسمي الزراعة.
2- الرش الورقي مستخلصات الأعشاب البحرية أثرت معنوياً على صفات المحصول ومكوناته حيث وجد أن الرش بمعدل 100 جم/فدان من مستخلصات الأعشاب البحرية حقق أعلى متوسطات قيم لصفات المحصول مقارنة بمعاملة المقارنة (الرش بالماء) خلال موسمي الزراعة.
3- الأضافة الأرضية لحامض الفولفيك مع مياة الري سجل تأثير معنوي على صفات المحصول ومكوناته ومحتوى الحبوب من البروتين حيث أن اضافة حامض الفولفيك بمعدل 2 كجم/فدان أعطى أعلى متوسطات قيم لصفات المحصول ومكوناته في القمح وجودته.
4- حقق التداخل بين عوامل الدراسة تأثير معنوي على لمعظم صفات المحصول ومكوناته لنبات القمح و حيث وجد أن الري بمياه النيل + ورش مستخلصات الأعشاب البحرية بمعدل 100 جم والأضافة الأرضية لحمض الفولفيك بمعدل 2 كجم/فدان حقق أعلى متوسطات قيم لصفات المحصول مقارنة بمعاملة المقارنة (بدون اضافة او رش) خلال موسمي الدراسة.

الخلاصة:

نتائج الدراسة أوضحت أن الري بمياه الصرف أو مياه النيل مع الرش مستخلصات الأعشاب البحرية بمعدل 100 جم والأضافة الأرضية لحمض الفولفيك بمعدل 2 كجم/فدان حققت أعلى زيادة في محصول القمح ومكوناته تحت ظروف منطقة رشيد – البحيرة ، كما يوصي بعمل بالتوسع لزراعة مساحات أكثر من القمح على مياه الصرف الزراعي باستخدام الرش الورقي للمستخلصات البحرية والأضافة الأرضية لحامض الفولفيك لتقليل الفجوة الغذائية من القمح.

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