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Original article

Effects of vermicompost, humic acid and Flabacterium on yield, chlorophyll fluorescence indices and some physiological traits of triticale under soil salinity conditions

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Extended abstract

Introduction

Soil salinity is one of the most serious limiting factors for crop growth and production in the arid and semi-arid regions. Several strategies have been developed in order to decrease the toxic effects caused by high salinity on plant growth. Among them, use of bio-fertilizers such as plant growth promoting rhizobacteria (PGPR), vermicompost and humic acid play a very important role in yield improvement. Inoculation of plants with native suitable microorganisms may decrease the deleterious effects of environmental stresses and increase stress tolerance of plants by a variety of mechanisms, including synthesis of phytohormones such as auxins, cytokinin and gibberellins, solubilization of minerals like phosphorus, production of siderophores and increase in nutrient uptake, N_2 fixation. Vermicompost plays a very important role in plant nutrition and soil health. So, it seems that application of bio fertilizers such as PGPR, vermicompost and humic acid can improve crop yield under soil salinity stress. Therefore, the aim of this study was evaluation of yield, chlorophyll fluorescence indices and some physiological traits of triticale in response to humic acid and bio fertilizers application under soil salinity conditions

Material and methods

In order to study the effects of vermicompost, humic acid and seed inoculation with flavobacterium on yield, chlorophyll fluorescence indices and some physiological traits of triticale under soil salinity conditions, an experiment was conducted as factorial based on randomized complete block design with three replications in greenhouse research of the Faculty of Agriculture and Natural Resources, the University of Mohaghegh Ardabili during 2020. Experimental factors were included salinity levels (non-application of salinity as control, application of 50 and 100 mM salinity by NaCl), and bio-fertilizers application (no application of bio-fertilizers as control, application of vermicompost, seed inoculation with Flavobacterim, both application vermicompost and Flavobacterim) and foliar application humic acid (foliar application with water as control and foliar application of 2 $g.l^{-1}$ humic acid). vermicompost was purchased from the Gilda corporation. Flavobacterim was isolated from the rhizospheres of wheat by Research Institute of Soil and Water, Tehran, Iran. The triticale cultivar "SANABAD" was used in the

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experiment with plant density of 400 seeds m^{-2}. For inoculation, seeds were coated with gum Arabic as an adhesive and rolled into the suspension of bacteria until uniformly coated. The strains and cell densities of microorganisms used as PGPR in this experiment were 1×108 colony forming units (CFU).

Relative water content: Weight of fresh leaf was measured just after detached from the plants then taken turgid weight after leaf was incubated in distilled water for 24 h to obtain a full turgidity. Dry weight of leaf was measured after it was dried at 60°C for 24 h in an oven. Relative water content was measured according to the following formula (Chelah et al. 2011).

$RWC\ (\%) = [(FW-DW) / (TW-DW)] \times 100$

Where, RWC, FW, DW and TW are relative water content, fresh weight, dry weight and turgid weight respectively.

Chlorophyll content: A portable chlorophyll meter (SPAD-502; Konica Minolta Sensing, Inc., Japan) was used to measure the leaf greenness of the wheat plants.

Quantum yield: The quantum yield was measured by the uppermost fool expanded leaf using a fluorometer (chlorophyll fluorometer; Optic Science-OS-30 USA).

Electrical conductivity: Electrical conductivity was calculated by following the standard method of Jodeh et al. (2015). Electrical conductivity (EC) values were measured at room temperature of 23±1 °C using an electrical-conductivity meter. At plant maturity, grain yield in each pot were harvested five plants per pot.

Statistical analysis: Analysis of variance and mean comparisons were performed using SAS ver 9.1 computer software packages. The main effects and interactions were tested using the least significant difference (LSD) test at the 0.05 probability level.

Results and discussion

Means comparison showed that the both application of vermicompost, Flavobacterim and foliar application of 2 $g.l^{-1}$ humic acid under no salinity condition increased maximum fluorescence (22.53%), variable fluorescence (94.69%), quantum yield (58.88%), chlorophyll index (28.91%), nitrogen index (3.88%), relative water content (50.48%)of flag leaf and grain yield (69.56%) in comparison with no application of bio-fertilizers and humic acid under 100 mM soil salinity. No application of biofertilizers and foliar application of humic acid at salinity of 100 mM increased the electrical conductivity and minimum fluorescence (F0) the flag leaf.

Conclusion

It seems that application of bio-fertilizers and humic acid can increase grain yield of triticale under soil salinity conditions due to improving chlorophyll fluorescence and some physiological traits.

***Keywords*:** Bio-Fertilizers, Chlorophyll Fluorescence, PGPR, Relative Water Content

Table 1. Result for Gilda vermicompost analysis in water and soil laboratory under Agticulture Ministry's observation

Cd	Pb	Zn	Cu	Mn	Fe	Mg	Ca	K	P	N	C/N	EC	pH
---------- mg.kg^{-1} ----------						---------- % ----------						dS m^{-1}	
1	19	110	20	275	5000	0.95	2.73	0.4	0.4	1.55	21.25	1.12	7.64

Table 2. Analysis of variance of the effect of bio fertilizers, foliar application of humic acid and salinity stress on chlorophyll index of triticale in different days after planting (DAP)

S.O.V	df	M.S (DAP)						
		57	61	65	69	73	77	81
Replicatin	2	2432.1**	2461.1**	2022.5**	1749.6**	1590.5**	1504.8**	1285**
Salinity (S)	2	95.8**	57.9**	64.4**	22.4**	61.9**	22.8**	92**
Biofertilizers (B)	3	118.1**	134.2**	83.29**	54.9**	87.86**	54.7**	125.5**
Humic acid (H)	1	10.5**	72**	15.68**	23.8**	7.8**	28.8**	13.2**
S×B	6	3.59**	1.89**	1.84**	0.87**	4.32**	0.87**	7.49**
S×H	2	0.24^{ns}	0.19^{ns}	1.18**	0.52*	0.15^{ns}	0.02^{ns}	1.35*
B×H	3	1.35**	1.50**	1.25**	0.46*	0.23*	0.97**	1.25*
S×B×H	6	1.64**	1.19**	1.31**	1.7**	0.68*	1.55**	1.24**
Error	46	0.34	0.35	0.24	0.14	0.24	0.14	0.36
C.V%	-	*7.6*	*9.2*	*7.8*	*6.52*	*8.06*	*9.8*	*7.9*

ns, * and ** are non-significant, significant at P≤0.05 and P≤0.01, respectively.

Table 3. Analysis of variance of the effect of bio fertilizers, foliar application of humic acid and salinity stress on nitrogen index of triticale in different days after planting (DAP)

S.O.V	df	M.S (DAP)						
		57	61	65	69	73	77	81
Replicatin	2	0.009**	0.009**	0.008**	0.0072**	0.006**	0.006**	0.005**
Salinity (S)	2	0.0002**	0.0001**	0.0001**	0.00005**	0.0001**	0.00006**	0.0002**
Biofertilizers (B)	3	0.0003**	0.0003**	0.0002**	0.0001**	0.0002**	0.0001**	0.0003**
Humic acid (H)	1	0.00002**	0.0001**	0.00004**	0.00006**	0.00002**	0.000007**	0.00003**
S×B	6	0.000009**	0.000005**	0.000004**	0.000002**	0.00001**	0.000002**	0.00001**
S×H	2	0.0000006^{ns}	0.0000005^{ns}	0.000003**	0.000001*	0.0000004^{ns}	0.0000000^{ns}	0.000003*
B×H	3	0.000003**	0.000004**	0.000003**	0.000001*	0.0000006^{ns}	0.000002**	0.000003*
S×B×H	6	0.000004**	0.000003**	0.000003**	0.000004**	0.000001*	0.000004**	0.000003**
Error	46	0.0000009	0.0000009	0.0000006	0.0000003	0.0000006	0.0000004	0.0000009
C.V%	-	*8.5*	*7.4*	*8.2*	*6.7*	*9.7*	*8.3*	*8.7*

ns, * and ** are non-significant, significant at P≤0.05 and P≤0.01, respectively

Table 4. Means comparison of effects of bio fertilizers, foliar application of humic acid and salinity stress on chlorophyll and nitrogen index of triticale.

Treatments	Chlorophyll Index						
	Day after planting						
	57	61	65	69	73	77	81
$S_1 \times B_1 \times H_1$	48.4^{g}	48.5^{h}	43.8^{j}	40.9^{h}	38.5^{ijk}	38.3^{ijh}	34.1^{ghij}
$S_1 \times B_2 \times H_1$	50.9^{e}	49.7^{g}	46.3^{fg}	41.7^{g}	41.8^{efj}	38.6^{ijh}	36.6^{f}
$S_1 \times B_3 \times H_1$	53.7^{b}	52.8^{de}	48.8^{bc}	44^{d}	43.1^{cd}	$40d^{e}$	39.8^{c}
$S_1 \times B_4 \times H_1$	55.6^{a}	54.8^{ab}	49.9^{a}	45.6^{a}	45^{a}	43.1^{a}	41.9^{ab}
$S_1 \times B_1 \times H_2$	50^{fe}	51.2^{f}	45.8^{gh}	42.9^{e}	39.8^{h}	$39f^{g}$	34.9^{g}
$S_1 \times B_2 \times H_2$	53^{cd}	52.9^{d}	48.1^{cd}	$44.6d^{c}$	43^{cd}	40.7^{c}	39^{cd}
$S_1 \times B_3 \times H_2$	53.7^{b}	$54b^{a}$	49^{b}	$45b^{a}$	43.8^{bc}	42^{b}	41^{b}
$S_1 \times B_4 \times H_2$	55.7^{a}	54.9^{a}	50^{a}	45.6^{a}	44.7^{a}	43.5^{a}	42.8^{a}
$S_2 \times B_1 \times H_1$	41.1^{h}	45.9^{i}	43^{jk}	40.3^{ih}	38^{kl}	37.9^{jk}	34.2^{gh}
$S_2 \times B_2 \times H_1$	47.2^{h}	47.7^{h}	43.1^{jk}	40.6^{ih}	38.2^{jkl}	38^{ij}	33.9^{hji}
$S_2 \times B_3 \times H_1$	50.2^{ef}	50^{g}	46^{hg}	42.5^{fe}	41^{g}	38^{ij}	39^{f}
$S_2 \times B_4 \times H_1$	53.8^{cd}	53^{ab}	47.1^{ef}	44.1^{d}	42.6^{de}	41.1^{c}	41^{de}
$S_2 \times B_1 \times H_2$	46.3^{g}	47.8^{f}	43.7^{jk}	40.7^{h}	38.4^{ijk}	38.1^{ij}	42.8^{ghij}
$S_2 \times B_2 \times H_2$	46.4^{h}	49^{g}	44.9^{i}	40.9^{h}	39^{hij}	38.6^{igh}	34.2^{gh}
$S_2 \times B_3 \times H_2$	50.2^{ef}	52.9^{ab}	46^{gh}	44^{d}	41.2^{fg}	40.5^{dc}	33.9^{f}
$S_2 \times B_4 \times H_2$	53.8^{b}	54.8^{ab}	49.9^{a}	45.5^{ba}	44.3^{ab}	43^{c}	36^{b}
$S_3 \times B_1 \times H_1$	46.3^{h}	45.7^{i}	42.41^{l}	40.5^{ih}	37.4^{l}	37^{jk}	38.3^{j}
$S_3 \times B_2 \times H_1$	46.4^{h}	45.8^{i}	42.9^{kl}	40^{i}	37.9^{kl}	37.3^{kl}	34.1^{hij}
$S_3 \times B_3 \times H_1$	49.5^{f}	49.8^{g}	$44.9i$	42.1^{fg}	39^{hjl}	$38.8f^{g}$	36.1^{ghi}
$S_3 \times B_4 \times H_1$	52^{d}	51.9^{ef}	47^{ef}	43.1^{e}	42^{ef}	39.4^{ef}	41.2^{e}
$S_3 \times B_1 \times H_2$	47.2^{h}	47.7^{h}	43.1^{jk}	40.6^{ih}	38.2^{kl}	37.9^{jk}	33.2^{ij}
$S_3 \times B_2 \times H_2$	48.4^{g}	48.6^{h}	43.4^{jk}	41.6^{g}	38.3^{ijk}	38.5^{ghij}	33.8^{ghij}
$S_3 \times B_3 \times H_2$	49.6^{f}	51.2^{f}	45.2^{hi}	42.9^{d}	39.1^{hi}	39.1^{fg}	34.2^{gh}
$S_3 \times B_4 \times H_2$	52.2^{cd}	53.9^{bc}	47.3^{de}	40.9^{bc}	42.6^{de}	41.8^{b}	37.9^{de}
LSD	*0.9633*	*0.9804*	*0.8104*	*0.6273*	*0.8171*	*0.6335*	*0.9957*
	Nitrogen Index						
	Day after planting						
	57	61	65	69	73	77	81
$S_1 \times B_1 \times H_1$	0.096^{g}	0.096^{h}	0.088^{j}	0.08^{h}	0.08^{ijk}	0.079^{hij}	0.072^{ghij}
$S_1 \times B_2 \times H_1$	0.1^{e}	0.098^{g}	0.092^{fg}	0.085^{g}	0.085^{ef}	0.08^{ghi}	0.077^{f}
$S_1 \times B_3 \times H_1$	0.104^{b}	0.103^{de}	0.096^{bc}	0.089^{d}	0.087^{cd}	0.082^{de}	0.082^{c}
$S_1 \times B_4 \times H_1$	0.108^{a}	0.106^{ab}	0.098^{a}	0.091^{a}	0.09^{a}	0.087^{a}	0.085^{ab}
$S_1 \times B_1 \times H_2$	0.098^{g}	0.1^{h}	0.092^{gh}	0.087^{e}	0.082^{h}	0.08^{fg}	0.074^{g}
$S_1 \times B_2 \times H_2$	0.103^{bc}	0.103^{d}	0.095^{cd}	0.09^{cd}	0.087^{cd}	0.083^{c}	0.08^{cd}
$S_1 \times B_3 \times H_2$	0.104^{b}	0.105^{ab}	0.097^{b}	0.09^{abc}	0.088^{bc}	0.085^{b}	0.084^{b}
$S_1 \times B_4 \times H_2$	0.108^{a}	0.106^{a}	0.098^{a}	0.091^{a}	0.09^{a}	0.088^{a}	0.087^{a}
$S_2 \times B_1 \times H_1$	0.094^{h}	0.092^{i}	0.087^{jkl}	0.083^{hi}	0.079^{kl}	0.079^{jk}	0.073^{ghi}
$S_2 \times B_2 \times H_1$	0.094^{h}	0.095^{h}	0.087^{jkl}	0.083^{hi}	0.079^{kl}	0.079^{ij}	0.072^{hij}
$S_2 \times B_3 \times H_1$	0.099^{ef}	$0.098g$	0.092^{gh}	0.086^{ef}	0.084^{g}	0.079^{ij}	0.076^{f}
$S_2 \times B_4 \times H_1$	0.102^{cd}	0.103^{cd}	0.094^{ef}	0.089^{d}	0.086^{de}	0.084^{c}	0.079^{de}
$S_2 \times B_1 \times H_2$	0.096^{g}	0.095^{h}	0.088^{ik}	0.083^{h}	0.08^{ijk}	0.079^{ij}	0.072^{ghij}
$S_2 \times B_2 \times H_2$	0.093^{h}	0.098^{g}	0.09^{i}	0.084^{g}	0.08^{hij}	0.08^{ghi}	0.073^{gh}
$S_2 \times B_3 \times H_2$	0.099^{ef}	0.103^{d}	0.092^{gh}	0.089^{d}	0.084^{fg}	0.083^{cd}	0.076^{f}
$S_2 \times B_4 \times H_2$	0.105^{b}	0.106^{ab}	0.098^{a}	0.091^{ab}	0.089^{ab}	0.087^{a}	0.084^{b}
$S_3 \times B_1 \times H_1$	0.092^{h}	0.091^{i}	0.086^{l}	0.083^{hi}	0.078^{l}	0.077^{l}	0.07^{lj}
$S_3 \times B_2 \times H_1$	0.093^{h}	0.092^{i}	0.087^{kl}	0.082^{i}	0.079^{kl}	0.078^{kl}	0.072^{hij}
$S_3 \times B_3 \times H_1$	0.098^{f}	0.098^{g}	0.09^{i}	$0.086f^{g}$	0.08^{hij}	0.08^{fgh}	0.073^{ghi}
$S_3 \times B_4 \times H_1$	0.102^{d}	0.102^{ef}	0.094^{ef}	0.087^{e}	0.085^{ef}	0.081^{ef}	0.079^{e}
$S_3 \times B_1 \times H_2$	0.094^{h}	0.095^{h}	0.087^{jkl}	0.083^{hi}	0.079^{jkl}	0.079^{jk}	0.072^{ij}
$S_3 \times B_2 \times H_2$	0.096^{g}	$0.096h$	0.088^{ikl}	0.085^{g}	0.079^{ijk}	0.080^{ghij}	0.072^{ghij}
$S_3 \times B_3 \times H_2$	0.098^{f}	0.1^{f}	0.091^{hi}	0.087^{e}	0.081^{hi}	0.081^{fg}	0.073^{gh}
$S_3 \times B_4 \times H_2$	0.102^{cd}	0.105^{bc}	0.094^{de}	0.09^{bc}	$0.086d^{e}$	0.085^{b}	0.08^{de}
LSD	*0.0016*	*0.0016*	*0.0013*	*0.001*	*0.0013*	*0.001*	*0.0016*

S_1, S_2 and S_3 are no salinity, salinity 50 and 100 mM respectively. B_1, B_2, B_3 and B_4 are no application of bio fertilizers, application of vermicompost, Flabacterium and both application vermicompost, Flabacterium. H_1 and H_2 are no foliar application and foliar application 2 $g.L^{-1}$ humic acid respectively.

Means with similar letters in each column are not significantly different based on LSD test.

Table 5. Analysis of variance of the effect of bio fertilizers, foliar application of humic acid and salinity stress on variable fluorescence of triticale in different days after planting (DAP)

S.O.V	df	M.S (DAP)						
		57	61	65	69	73	77	81
Replicatin	2	361326.9**	253093.8**	18984.8**	139537.5**	88768**	42076**	25741.5**
Salinity (S)	2	12231.3**	45305.3**	11478.2**	16695.3**	31853.3**	1548.2**	11803.3**
Biofertilizers (B)	3	16883.6**	63687.1**	19923.2**	20046.8**	56320.8**	2662.4**	15181.5**
Humic acid (H)	1	4802**	19701.1**	4851.1**	5618**	11704.5**	790**	4802**
S×B	6	333**	1250.3**	173.1**	464.2**	653.7**	84.3**	150**
S×H	2	4.62^{ns}	12.8^{ns}	140*	43.6^{ns}	34.1^{ns}	5.34^{ns}	60.5^{ns}
B×H	3	78.3^{ns}	558.4*	142.3*	151*	227.5^{ns}	36.1**	149^{ns}
S×B×H	6	1.64**	78.3*	687.2**	304.5**	336.1**	732.1**	42.1**
Error	46	48	182.4	52.84	60.57	146.9	7.39	44.09
C.V%	-	*6.8*	*8.02*	*8.9*	*6.03*	*7.11*	*10.2*	*8.55*

ns, * and ** are non-significant, significant at P≤0.05 and P≤0.01, respectively.

Table 6. Analysis of variance of the effect of bio fertilizers, foliar application of humic acid and salinity stress on minimum fluorescence triticale in different days after planting (DAP)

S.O.V	df	M.S (DAP)						
		57	61	65	69	73	77	81
Replicatin	2	29744**	34367.8**	44266.8**	41633.3**	43808.5**	50600.1**	51894**
Salinity (S)	2	1805.8**	1135.1**	12.1^{ns}	2438.5**	4.76^{ns}	581.4**	371.6**
Biofertilizers (B)	3	2731.3**	1781.7**	3124.2**	2250.9**	7015.8**	1314.7**	909.6**
Humic acid (H)	1	87.7**	1596.1**	53.3**	1035.1**	12.2^{ns}	338**	288**
S×B	6	136.3**	1277**	105.5**	110.3**	835.4**	48.3**	107.2**
S×H	2	326.1**	596.2**	557.5**	122.4**	981.3**	7.05^{ns}	7.12*
B×H	3	82.6**	2203.7**	316.6**	391.3**	337.5**	48.2**	54.3**
S×B×H	6	128.6**	1891.4**	137.9**	337.3**	126.9**	44.6**	49.4**
Error	46	8.39	20.8	7.54	9.72	17.2	3.57	2.82
C.V%	-	*8.2*	*5.6*	*8.9*	*6.5*	*9.11*	*8.3*	*7.18*

ns, * and ** are non-significant, significant at P≤0.05 and P≤0.01, respectively

Table 7. Means comparison of effects of bio fertilizers, foliar application of humic acid and salinity stress on variable fluorescence and minimum fluorescence of triticale

تیمار Treatments	Variable Fluorescence						
	Day after planting						
	57	61	65	69	73	77	81
$S_1 \times B_1 \times H_1$	593^{klm}	471^{klm}	422.5^{jkl}	360^{ij}	264^{kl}	199.5^{jkl}	146^{hi}
$S_1 \times B_2 \times H_1$	614^{hi}	513^{hi}	444.5^{hi}	381^{fg}	302^{hi}	206.5^{gh}	164^{ef}
$S_1 \times B_3 \times H_1$	638^{ef}	561^{ef}	463^{fg}	417^{d}	346^{ef}	216.5^{e}	185^{d}
$S_1 \times B_4 \times H_1$	670^{ab}	625^{ab}	512^{a}	441^{ab}	406^{ab}	234.5^{ab}	216^{a}
$S_1 \times B_1 \times H_2$	614^{hi}	513^{hi}	444.5^{hi}	376^{fgh}	302^{hi}	206.5^{gh}	161^{efg}
$S_1 \times B_2 \times H_2$	631^{fg}	537^{g}	457.5^{g}	415^{d}	333^{fg}	211.5^{f}	184^{d}
$S_1 \times B_3 \times H_2$	655^{cd}	611^{bc}	479^{de}	425^{cd}	361^{de}	231^{b}	204^{bc}
$S_1 \times B_4 \times H_2$	677^{a}	639^{a}	504.5^{ab}	446^{a}	419^{a}	238^{a}	220^{a}
$S_2 \times B_1 \times H_1$	570^{op}	441^{nop}	406.5^{mno}	339^{lm}	240^{mno}	197^{klmn}	128^{jk}
$S_2 \times B_2 \times H_1$	589^{lm}	463^{lmn}	418^{klm}	355^{jk}	257^{kl}	199^{klm}	145^{hi}
$S_2 \times B_3 \times H_1$	604^{ijk}	493^{ijk}	433.5^{ij}	368^{hj}	284^{ij}	203.5^{hi}	155^{fgh}
$S_2 \times B_4 \times H_1$	655^{cd}	577^{de}	488.5^{cd}	430^{bc}	378^{cd}	221^{d}	205^{bc}
$S_2 \times B_1 \times H_2$	585^{mn}	457^{mn}	414.5^{lm}	352^{jk}	$245l^{mno}$	198.5^{klm}	141^{i}
$S_2 \times B_2 \times H_2$	609^{ij}	503^{ij}	439^{i}	372^{ghi}	293^{i}	205^{hi}	158^{efg}
$S_2 \times B_3 \times H_2$	626^{g}	547^{fg}	470.5^{ef}	402^{hij}	324^{g}	213^{ef}	181^{d}
$S_2 \times B_4 \times H_2$	663^{bc}	595^{dc}	497^{bc}	432^{bc}	393^{bc}	226.5^{c}	211^{ab}
$S_3 \times B_1 \times H_1$	569^{p}	427^{op}	394^{p}	328^{m}	229^{o}	195^{mn}	113^{l}
$S_3 \times B_2 \times H_1$	571^{op}	424^{p}	397^{op}	330^{m}	235^{no}	193^{n}	118^{kl}
$S_3 \times B_3 \times H_1$	570^{p}	441^{nop}	406.5^{mno}	335^{lm}	240^{mno}	$197k^{lmn}$	125^{k}
$S_3 \times B_4 \times H_1$	621^{gh}	527^{gh}	452^{gh}	385^{f}	315^{gh}	210^{fg}	167^{e}
$S_3 \times B_1 \times H_2$	574^{nop}	433^{op}	402^{nop}	333^{lm}	231^{no}	196^{lnm}	118^{kl}
$S_3 \times B_2 \times H_2$	582^{mno}	449^{mno}	411^{lmn}	343^{kl}	250^{lmn}	198.5^{klm}	137^{ij}
$S_3 \times B_3 \times H_2$	598^{jkl}	481^{jkl}	427^{jk}	364^{hij}	273^{jk}	201^{ijk}	152^{gh}
$S_3 \times B_4 \times H_2$	646^{de}	595^{cd}	488.5^{cd}	421^{cd}	378^{cd}	226.5^{c}	196^{c}
LSD	*11.387*	*22.199*	*11.947*	*12.792*	*19.921*	*4.4686*	*10.914*

Treatments	Minimum Fluorescence						
	Day after planting						
	57	61	65	69	73	77	81
$S_1 \times B_1 \times H_1$	175^{fg}	193^{fg}	212.5^{j}	210^{ef}	208^{j}	236.1^{bcde}	236^{cde}
$S_1 \times B_2 \times H_1$	163^{i}	190^{gh}	213.5^{ij}	215^{de}	213^{ij}	232^{fgh}	241^{a}
$S_1 \times B_3 \times H_1$	162^{ij}	207^{cd}	$221ef^{gh}$	204^{g}	208.5^{j}	228.8^{i}	234^{ef}
$S_1 \times B_4 \times H_1$	148.5^{l}	200edf	186m	190^{j}	198^{k}	212^{mn}	215^{j}
$S_1 \times B_1 \times H_2$	172^{gh}	175^{j}	218.5^{gh}	210^{ef}	213^{ij}	231^{ghi}	240^{cde}
$S_1 \times B_2 \times H_2$	193^{ab}	216^{ab}	239.05^{a}	201.5^{g}	243.4^{a}	233.2^{efg}	233^{f}
$S_1 \times B_3 \times H_2$	173^{fgh}	157^{fk}	224^{def}	196^{h}	227^{cdef}	214.4^{lm}	220^{i}
$S_1 \times B_4 \times H_2$	155^{k}	174^{j}	203.5^{kl}	189^{j}	201^{k}	209^{n}	215^{j}
$S_2 \times B_1 \times H_1$	188^{cd}	197^{efg}	210.5^{j}	219^{cd}	224^{ef}	237.2^{bcd}	238^{bc}
$S_2 \times B_2 \times H_1$	186^{d}	184^{hi}	223^{defg}	205^{fg}	220.5^{fgh}	235.6^{ced}	236^{cde}
$S_2 \times B_3 \times H_1$	177.5^{ef}	202^{ed}	229.5^{b}	223^{bc}	223^{fg}	234.5^{def}	236^{cde}
$S_2 \times B_4 \times H_1$	158^{ijk}	143^{l}	202.5^{kl}	173.5^{k}	188.5^{l}	218.2^{k}	22^{1i}
$S_2 \times B_1 \times H_2$	186^{d}	203^{de}	212.5^{j}	215^{de}	223.5^{efg}	236.8^{bcd}	236^{cde}
$S_2 \times B_2 \times H_2$	181^{e}	176.5^{ij}	229^{bc}	204^{g}	230^{cde}	231.5^{fghi}	235^{def}
$S_2 \times B_3 \times H_2$	171^{gh}	148^{l}	205.5^{k}	189^{j}	217^{ghi}	225j	230^{g}
$S_2 \times B_4 \times H_2$	155.5^{k}	206^{d}	199.6^{l}	195^{hi}	183.5^{lm}	219.5^{k}	219^{i}
$S_3 \times B_1 \times H_1$	18^{6d}	197^{degf}	218^{hi}	226^{b}	233^{bc}	238^{abc}	242^{a}
$S_3 \times B_2 \times H_1$	191^{bc}	205.5^{efg}	225^{bcde}	226^{b}	231^{bcd}	240.8^{a}	238^{bc}
$S_3 \times B_3 \times H_1$	195^{ab}	223.5^{d}	224.5^{cdef}	238^{a}	230^{cde}	238.9^{ab}	237^{cd}
$S_3 \times B_4 \times H_1$	169^{h}	185^{h}	200.5^{l}	215^{de}	181^{m}	228.9^{hi}	240^{ab}
$S_3 \times B_1 \times H_2$	191^{bc}	214^{bc}	225^{bcde}	227^{b}	237.5^{ab}	238.6^{abc}	241^{a}
$S_3 \times B_2 \times H_2$	191^{bc}	202^{bc}	227^{bcd}	220^{cd}	224.5^{def}	236.5^{bcd}	237^{cd}
$S_3 \times B_3 \times H_2$	196^{a}	200.5^{def}	220^{fgh}	217^{d}	214^{hij}	236^{bcde}	233^{f}
$S_3 \times B_4 \times H_2$	161^{ij}	142^{l}	183.5^{m}	190^{ij}	154^{n}	217.5^{kl}	227^{h}
LSD	*4.7623*	*7.5109*	*4.5147*	*5.1245*	*6.8333*	*3.1063*	*2.7638*

S_1, S_2 and S_3 ara no salinity, salinity 50 and 100 mM respectively. B_1, B_2, B_3 and B_4 are no application of bio fertilizers, application of vermicompost, Flabacterium and both application vermicompost, Flabacterium. H_1 and H_2 are no foliar application and foliar application 2 $g.L^{-1}$ humic acid respectively.

Means with similar letters in each column are not significantly different based on LSD test.

Table 8. Analysis of variance of the effect of bio fertilizers, foliar application of humic acid and salinity stress on maximum fluorescence of triticale in different days after planting (DAP)

S.O.V	df	M.S (DAP)						
		57	61	65	69	73	77	81
Replicatin	2	598409.4**	473990.8**	417471.4**	3333609**	257296.9**	184959.4**	150733.5**
Salinity (S)	2	4682.8**	39933.9**	11101.8**	7779.4**	32600.2**	245.1**	8055.3**
Biofertilizers (B)	3	6704.6**	44539**	10042.7**	9290.9**	26032.6**	246.3**	8703.1**
Humic acid (H)	1	6188.2**	10082**	5921.4**	1830.1**	12474.1**	94.5**	2738**
S×B	6	140.6**	1175.2**	358.2**	283.7**	1685.2**	12.8**	306.5**
S×H	2	324.4**	525.2*	159.9**	25.5^{ns}	727.6**	0.12^{ns}	42.8*
B×H	3	197.6**	756.3**	192.08**	123.2**	378.2**	12.2**	54*
S×B×H	6	140.3**	1073**	83.1*	87.7**	500.1**	9.20**	90.3**
Error	46	22.3	139.3	35.8	27.7	99.4	0.86	27.5
C.V%	-	*9.12*	*9.8*	*10.1*	*8.42*	*9.02*	*7.65*	*8.55*

ns, * and ** are non-significant, significant at P≤0.05 and P≤0.01, respectively.

Table 9. Analysis of variance of the effect of bio fertilizers, foliar application of humic acid and salinity stress on quantum yield of triticale in different days after planting (DAP)

S.O.V	df	M.S (DAP)						
		57	61	65	69	73	77	81
Replicatin	2	0.57**	0.5**	0.43**	0.39**	0.32**	0.21**	0.16**
Salinity (S)	2	0.005**	0.01**	0.003**	0.01**	0.01**	0.005**	0.03**
Biofertilizers (B)	3	0.007**	0.01**	0.01**	0.01**	0.07**	0.01**	0,04**
Humic acid (H)	1	0.0001*	0.009**	0.0007**	0.006**	0.007**	0.002**	0.01**
S×B	6	0.0002**	0.002**	0.0001**	0.0005**	0.002**	0.0003**	0.0002*
S×H	2	0.0003**	0.0005**	0.0008**	0.0002**	0.001**	0.00003^{ns}	0.0002^{ns}
B×H	3	0.00006*	0.003**	0.0004**	0.0008**	0.0004*	0.0001**	0.0006**
S×B×H	6	0.0001**	0.002**	0.0003**	0.0008**	0.0009**	0.0002**	0.0003*
Error	46	0.000021	0.000074	0.000032	0.000060	0.00016	0.000027	0.00012
C.V%	-	*8.65*	*7.3*	*7.85*	*8.31*	*9.8*	*10.2*	*6.35*

ns, * and ** are non-significant, significant at P≤0.05 and P≤0.01, respectively

Table 10. Means comparison of interaction of bio fertilizers, foliar application of humic acid and salinity stress on maximum fluorescence and quantum yield of triticale

Treatments	Maximum Fluorescence						
	Day after planting						
	57	61	65	69	73	77	81
S_1×B_1×H_1	768^{mno}	664^{jk}	635^{lmn}	570^{klm}	472^{m}	435.6^{ijkl}	382^{jk}
S_1×B_2×H_1	777^{kl}	703^{fgh}	658^{hi}	596^{fg}	515^{i}	438.5^{efg}	405^{fg}
S_1×B_3×H_1	800^{fg}	768^{c}	684de	621^{bc}	554.5^{ef}	445.3^{bcd}	419^{cde}
S_1×B_4×H_1	818.5^{cd}	825^{a}	698^{bc}	631^{a}	604^{ab}	446.5^{ab}	431^{ab}
S_1×B_1×H_2	786^{ij}	688^{hi}	663^{gh}	586^{hi}	515^{i}	437.5^{fgh}	401^{fg}
S_1×B_2×H_2	824^{bc}	753^{cd}	696.55^{bc}	616.5^{cd}	576.4^{cd}	444.7^{cd}	417de
S_1×B_3×H_2	828^{ab}	768^{c}	703^{ab}	621^{bc}	588^{bc}	445.4^{bcd}	424^{bcd}
S_1×B_4×H_2	832^{a}	813^{ab}	708^{a}	635^{a}	620^{a}	447^{a}	435^{a}
S_2×B_1×H_1	758^{pq}	638^{lmn}	617^{pq}	558^{op}	464^{m}	434.2^{lmn}	366^{lm}
S_2×B_2×H_1	775^{klm}	647^{klm}	641^{kl}	560^{nop}	477.5^{lm}	434.6^{klm}	381^{jk}
S_2×B_3×H_1	781.5^{kj}	695^{ghi}	663^{gh}	591^{gh}	507^{ij}	438^{efhg}	391^{i}
S_2×B_4×H_1	813^{ed}	720^{ef}	691^{cd}	603.5^{ef}	566.5^{de}	439.2^{e}	426^{bc}
S_2×B_1×H_2	771^{lmn}	660^{k}	627no	567^{lmn}	468.5^{m}	435.3^{jklm}	377^{jk}
S_2×B_2×H_2	790^{hi}	679.5^{ij}	668^{fg}	576^{jk}	523^{hi}	436.5^{hij}	393^{hi}
S_2×B_3×H_2	797^{gh}	695^{ghi}	676^{ef}	591^{gh}	541^{fg}	438^{efgh}	411^{ef}
S_2×B_4×H_2	818.5^{cd}	801^{b}	696.6^{bc}	627^{ab}	576.5^{cd}	446^{abc}	430^{ab}
S_3×B_1×H_1	755^{q}	624^{n}	612^{q}	554^{p}	462^{m}	433^{n}	355^{n}
S_3×B_2×H_1	762^{opq}	629.5^{mn}	622^{op}	556^{op}	466^{m}	433.8^{mn}	356^{n}
S_3×B_3×H_1	765^{nop}	664.5^{jk}	631^{mno}	573^{jkl}	470^{m}	435.9^{ijk}	362^{mn}
S_3×B_4×H_1	790^{hi}	712^{fg}	652.5^{ij}	600^{f}	496^{jk}	438.9^{ef}	407^{fg}
S_3×B_1×H_2	765^{nop}	647^{klm}	627no	560^{nop}	468.5^{m}	434.6^{klm}	359^{mn}
S_3×B_2×H_2	773^{lm}	651^{kl}	638^{klm}	563^{mno}	474.5^{lm}	435^{jklm}	374^{kl}
S_3×B_3×H_2	794^{gh}	681.5^{ij}	647^{jk}	581^{ij}	487^{kl}	437^{ghi}	385^{ij}
S_3×B_4×H_2	807^{ef}	737de	672^{fg}	611de	532^{gh}	444^{d}	423^{bcd}
LSD	*7.7741*	*19.401*	*9.8371*	*8.6617*	*16.386*	*1.5291*	*8.6323*

Treatments	Quantum Yield						
	Day after planting						
	57	61	65	69	73	77	81
S_1×B_1×H_1	0.772^{i}	0.709^{g}	0.665^{fg}	0.631^{hijk}	0.559^{gf}	0.486defg	0.457^{ijk}
S_1×B_2×H_1	0.79^{fg}	0.729^{ef}	0.675^{de}	0.639^{ghi}	0.586^{e}	0.513d	0.47^{fgh}
S_1×B_3×H_1	0.797^{ef}	0.73^{e}	0.676^{de}	0.671^{f}	0.623^{c}	0.556c	0.486^{e}
S_1×B_4×H_1	0.818^{a}	0.757^{c}	0.733^{a}	0.698^{bc}	0.672^{b}	0.63a	0.525^{ab}
S_1×B_1×H_2	0.781^{h}	0.745^{cd}	0.670^{ef}	0.641^{gh}	0.586^{e}	0.51de	0.472^{fgh}
S_1×B_2×H_2	0.765^{ij}	0.713^{g}	0.656^{gh}	0.673^{ef}	0.577^{ef}	0.556c	0.475^{fg}
S_1×B_3×H_2	0.791^{fg}	0.795^{ab}	0.681^{d}	0.684^{de}	0.613^{cd}	0.61ab	0.518^{bc}
S_1×B_4×H_2	0.813^{ab}	0.785^{b}	0.712^{b}	0.702^{ab}	0.675^{b}	0.64a	0.532^{a}
S_2×B_1×H_1	0.751^{lmn}	0.691^{i}	0.658^{gh}	0.607^{m}	0.517^{hik}	0.44hi	0.453^{jk}
S_2×B_2×H_1	0.76^{jk}	0.715^{gf}	0.652^{hi}	0.633^{ghij}	0.538^{gh}	0.48efg	0.457^{ijk}
S_2×B_3×H_1	0.772^{i}	0.709^{g}	0.653^{h}	0.622^{jk}	0.56^{f}	0.5def	0.464^{ih}
S_2×B_4×H_1	0.805^{cd}	0.801^{a}	0.706^{b}	0.712^{a}	0.667^{b}	0.61ab	0.503^{d}
S_2×B_1×H_2	0.758^{jkl}	0.692^{hi}	0.661^{gh}	0.62^{kl}	0.522^{hik}	0.476fg	0.456^{ijk}
S_2×B_2×H_2	0.77^{i}	0.74^{de}	0.657^{gh}	0.645^{g}	0.56^{f}	0.51de	0.469^{gh}
S_2×B_3×H_2	0.785^{gh}	0.787^{b}	0.696^{c}	0.68^{def}	0.598^{de}	0.556c	0.486^{e}
S_2×B_4×H_2	0.81^{bc}	0.742^{de}	0.713^{b}	0.688^{dc}	0.681^{b}	0.62a	0.507^{d}
S_3×B_1×H_1	0.753^{klm}	0.684^{ij}	0.643^{ij}	0.592^{n}	0.495^{j}	0.403j	0.45^{kl}
S_3×B_2×H_1	0.749^{mn}	0.673^{jk}	0.638^{j}	0.593^{n}	0.504^{kj}	0.42ji	0.444^{l}
S_3×B_3×H_1	0.745^{n}	0.663^{k}	0.644^{ij}	0.584^{n}	0.51^{ijk}	0.436hi	0.451^{jkl}
S_3×B_4×H_1	0.786^{gh}	0.74^{ed}	0.692^{c}	0.641^{gh}	0.635^{c}	0.516d	0.478^{ef}
S_3×B_1×H_2	0.75^{mn}	0.669^{k}	0.641^{j}	0.594^{n}	0.493^{j}	0.41ji	0.45^{kl}
S_3×B_2×H_2	0.752^{klm}	0.689^{i}	0.644^{ij}	0.609^{lm}	0.526^{hi}	0.463gh	0.456^{ijk}
S_3×B_3×H_2	0.753^{lkm}	0.705^{gh}	0.659^{gh}	0.626^{hij}	0.56^{f}	0.496def	0.459^{ij}
S_3×B_4×H_2	0.8^{de}	0.807^{a}	0.726^{a}	0.689^{cd}	0.71^{a}	0.583bc	0.51^{cd}
LSD	*0.0076*	*0.0142*	*0.0093*	*0.0128*	*0.0214*	*0.301*	*0.0086*

S_1, S_2 and S_3 ara no salinity, salinity 50 and 100 mM respectively. B_1, B_2, B_3 and B_4 are no application of bio fertilizers, application of vermicompost, Flabacterium and both application vermicompost, Flabacterium. H_1 and H_2 are no foliar application and foliar application 2 g.L^{-1} humic acid respectively.
Means with similar letters in each column are not significantly different based on LSD test

Table 11. Analysis of variance of the effect of bio fertilizers, foliar application of humic acid and salinity stress on electrical conductivity of triticale in different days after planting (DAP)

S.O.V	df	M.S (DAP)						
		57	61	65	69	73	77	81
Replicatin	2	2647.3**	4331.7**	5102.7**	8137.7**	11563.8**	15079.6**	21910.7**
Salinity (S)	2	276.8**	62.6**	89**	2322.4**	2856.3**	2443.6**	10201.2**
Biofertilizers (B)	3	522.2**	95.3**	228**	3070.3**	3715.4**	1682.4**	11472.5**
Humic acid (H)	1	442.9**	18.6**	91.8**	515.6**	3024.4**	1489.2**	4748.2**
S×B	6	22.4**	6.43**	9.96**	124.7**	131.1**	41.9**	545**
S×H	2	1.37^{ns}	1.76**	0.33^{ns}	12.1^{ns}	94.9**	131.5**	231.4**
B×H	3	21.3**	3.38**	8.31**	27*	196.4**	33.7**	475.2**
S×B×H	6	18.9**	1.32**	1.50*	40.8**	77.5**	35.5**	206.2**
Error	46	1.66	0.28	0.60	8.96	12.70	7.10	38.24
C.V%	-	*10.2*	*5.64*	*6.9*	*9.2*	*8.75*	*9.8*	*7.03*

ns, * and ** are non-significant, significant at P≤0.05 and P≤0.01, respectively.

Table 12. Analysis of variance of the effect of bio fertilizers, foliar application of humic acid and salinity stress on relative water content of triticale in different days after planting (DAP)

S.O.V	df	M.S (DAP)						
		57	61	65	69	73	77	81
Replicatin	2	5905.4**	5185.3**	4136.6**	3436.3**	3179.9**	2906.6**	2469.9**
Salinity (S)	2	106.8**	450.4**	503.4**	793.1**	803.7**	704.8**	507.3**
Biofertilizers (B)	3	269.4**	377.4**	666.1**	410.3**	378**	633.2**	326.7**
Humic acid (H)	1	109.7**	285.6**	668.3**	170.8**	234.3**	215.5**	279.7**
S×B	6	2.15**	10.6**	18.1**	31.1**	8.75**	22.5**	6.22**
S×H	2	3.09**	6.81**	39.3**	4.27^{ns}	42.3**	2.43^{ns}	19.7**
B×H	3	1.12^{ns}	10.4**	35.8**	8.42**	6.33*	13.6**	3.78*
S×B×H	6	3.49**	8.75**	17.6**	11.2**	6.76**	9.51**	3.71*
Error	46	0.68	1.43	2.36	1.89	1.84	2.18	1.38
C.V%	-	*7.42*	*8.03*	*10.1*	*9.56*	*6.23*	*7.64*	*7.29*

ns, * and ** are non-significant, significant at P≤0.05 and P≤0.01, respectively.

Table 13. Means comparison of interaction of bio fertilizers, foliar application of humic acid and salinity stress on electrical conductivity and relative water content triticale.

Treatments	Electrical Conductivity (µS m^{-1})						
	Day after planting						
	57	61	65	69	73	77	81
S_1×B_1×H_1	58.26^{de}	68.48^{d}	76.1^{ef}	104.75^{bc}	125.35^{ef}	132.5^{fg}	166.45^{de}
S_1×B_2×H_1	53.81^{gh}	65.93^{gh}	73^{gh}	86.25^{h}	112.61^{ij}	121.5^{jk}	134.5^{ij}
S_1×B_3×H_1	47.35^{mno}	64.51^{j}	70.32^{klm}	75.1^{kl}	92.41^{no}	112^{n}	119.4^{klm}
S_1×B_4×H_1	45.84^{op}	64.26^{j}	68.57^{no}	71.35^{l}	90.3^{o}	109^{n}	113.75^{m}
S_1×B_1×H_2	51.57^{ij}	66.78^{efg}	71.29^{ijk}	91.23^{fg}	101.16^{lm}	122^{ijk}	152.75^{fg}
S_1×B_2×H_2	45.35^{op}	64.71^{ij}	69.57^{lmno}	76.6^{jk}	90.91^{o}	110^{n}	117.5^{lm}
S_1×B_3×H_2	45.1^{p}	64.51^{j}	69.07^{mno}	73.6^{kl}	90.3^{o}	109.2^{n}	115^{lm}
S_1×B_4×H_2	44.85^{p}	64.25^{j}	68.45^{o}	70.6^{l}	90.22^{o}	108.7^{n}	112.5^{m}
S_2×B_1×H_1	66.99^{a}	71.33^{a}	78.87^{bc}	111^{a}	136.8^{bc}	144^{bc}	194.1^{a}
S_2×B_2×H_1	54.56^{gh}	70.63^{ab}	77.4^{d}	110.5^{a}	115.81^{hi}	135^{ef}	180.5^{bc}
S_2×B_3×H_1	52.56^{hi}	66.28^{gh}	71.79^{hij}	88.25^{gh}	109.41^{jk}	128.5^{gh}	159.95^{ef}
S_2×B_4×H_1	46.35^{nop}	64.93^{ij}	69.32^{nmo}	81^{ij}	93.66^{no}	120^{jkl}	122^{klm}
S_2×B_1×H_2	57.06^{ef}	69.38^{c}	76.8^{de}	107.99^{ab}	122.15^{fg}	130^{gh}	191^{a}
S_2×B_2×H_2	50.07^{jkl}	66.68^{fg}	74^{g}	98.5^{de}	106.41^{kl}	116.5^{lm}	141.5^{hi}
S_2×B_3×H_2	48.35^{lmn}	66.28^{gh}	69.82^{lmn}	88.25^{gh}	98.16^{mn}	113^{mn}	129.5^{jk}
S_2×B_4×H_2	45.85^{op}	64.26^{j}	68.82^{no}	72.1^{kl}	90.8^{o}	110^{n}	117^{lm}
S_3×B_1×H_1	62.45^{b}	71.42^{a}	80.33^{a}	112.6^{a}	147.8^{a}	150.55^{a}	195.95^{a}
S_3×B_2×H_1	61.71^{bc}	71.4^{a}	79.62^{ab}	111.4^{a}	139^{b}	141.5^{cd}	195^{a}
S_3×B_3×H_1	59.46^{d}	67.58^{e}	72.29^{hi}	100.75^{cd}	128.25^{de}	140^{cd}	186^{ab}
S_3×B_4×H_1	50.58^{ijk}	65.43^{hi}	70.82^{jkl}	84^{hi}	103.41^{lm}	124^{ij}	142.75^{ghi}
S_3×B_1×H_2	60.21^{cd}	71.23^{a}	77.77^{cd}	110.5^{a}	131.55^{cd}	148^{ab}	193^{a}
S_3×B_2×H_2	55.81^{fg}	70.28^{b}	75.5^{f}	108.1^{ab}	119.03^{gh}	137.5^{de}	173.45^{cd}
S_3×B_3×H_2	49.32^{klm}	67.28^{ef}	71.17^{ijk}	94.25^{ef}	103.41^{lm}	126^{hi}	147.75^{gh}
S_3×B_4×H_2	46.85^{nop}	64.33^{j}	69.07^{mno}	81^{ij}	95.16^{no}	118.5^{kl}	124.5^{jkl}
LSD	*2.123*	*0.876*	*1.281*	*4.922*	*5.858*	*4.38*	*10.163*
Treatments	**Relative Water Content (%)**						
	Day after planting						
	57	**61**	**65**	**69**	**73**	**77**	**81**
S_1×B_1×H_1	80.81hi	75.35^{j}	68.2^{hij}	58.65^{ij}	56.5^{g}	56.25^{hi}	49.99^{hi}
S_1×B_2×H_1	84.35fg	76.85^{hi}	71.7^{g}	61.15^{hi}	61.25^{de}	58.75^{fg}	56.14^{de}
S_1×B_3×H_1	85.37ef	79.6^{ef}	79.3^{c}	68.12^{de}	68.3^{ab}	64.5^{cd}	65.22^{ab}
S_1×B_4×H_1	91.1ab	84.95^{a}	82.8^{ab}	75.7^{4b}	69.33^{ab}	67.85^{ab}	66.3^{a}
S_1×B_1×H_2	85.1f	79.35^{ef}	74.2^{ef}	65f^{g}	63de	60.5^{ef}	54.42^{ef}
S_1×B_2×H_2	87.14de	81.25^{d}	81.29^{b}	77.24^{ab}	68.33^{ab}	65.9^{bc}	63.47^{b}
S_1×B_3×H_2	89.49bc	83.45^{bc}	83.3^{a}	79.25^{a}	69.83^{ab}	67.35^{ab}	65.55^{ab}
S_1×B_4×H_2	91.64a	85.45^{a}	83.8^{a}	78.25^{ab}	70.33^{a}	68.35^{a}	67.3^{a}
S_2×B_1×H_1	78.4kj	73.1^{lm}	66.41^{jk}	55.91^{k}	51.86^{hi}	49.25^{m}	45.85^{kl}
S_2×B_2×H_1	79.2jki	73.85^{kl}	69.7^{h}	60.4^{i}	52.6^{hi}	50.5^{lm}	47.1^{jk}
S_2×B_3×H_1	84.03fg	78.35^{fg}	72.45^{fg}	63.25^{gh}	61^{ef}	55^{ij}	55.41^{def}
S_2×B_4×H_1	88.42dc	82.45^{cd}	77.12^{d}	72.73^{c}	65.8^{c}	60^{f}	57.17^{cd}
S_2×B_1×H_2	80jhi	74.6^{jk}	68.95^{hi}	59.9^{ij}	53.45^{hi}	52.5^{kl}	49.6^{hi}
S_2×B_2×H_2	81.34h	75.85^{ij}	73.2^{efg}	66.11^{ef}	58.75^{fg}	58.75^{fg}	51.98^{gh}
S_2×B_3×H_2	85.63ef	79.85^{e}	74.45^{e}	67.63^{e}	62.5^{de}	62.5^{de}	55.42^{def}
S_2×B_4×H_2	90.57ab	84.45^{ab}	81.3^{b}	75.74^{b}	67.8^{bc}	65.9^{bc}	65.22^{ab}
S_3×B_1×H_1	77.8k	72.56^{lm}	64.12^{l}	55.7^{k}	51.46^{i}	48.4^{m}	44.8^{kl}
S_3×B_2×H_1	77.59k	72.35^{m}	65.1^{kl}	56.02^{k}	51.52^{i}	49^{m}	44.63^{l}
S_3×B_3×H_1	83.22g	77.6^{gh}	67.43^{ij}	57.39^{jk}	52.1^{hi}	52^{kl}	50.23^{hi}
S_3×B_4×H_1	85.1f	79.35^{ef}	73.7^{ef}	66.1^{ef}	57.75^{g}	57.5^{gh}	56.67^{de}
S_3×B_1×H_2	79.19kji	73.84^{kl}	67.42^{ij}	57.39^{jk}	52^{hi}	48.8^{m}	47.1^{jk}
S_3×B_2×H_2	81.08h	75.6^{ij}	69.45^{h}	60.1^{i}	53.05^{hi}	49.25^{m}	48.32^{ij}
S_3×B_3×H_2	84.56fg	78.85^{efg}	73.7^{ef}	67.14^{ef}	53.9^{h}	53^{jk}	53.22^{fg}
S_3×B_4×H_2	89.49bc	83.45^{bc}	74.77^{e}	70.53^{cd}	63.5^{d}	59.5^{fg}	59.47^{c}
LSD	*1.796*	*1.356*	*1.97*	*2.525*	*2.265*	*2.229*	*2.427*

S_1, S_2 and S_3 ara no salinity, salinity 50 and 100 mM respectively. B_1, B_2, B_3 and B_4 are no application of bio fertilizers, application of vermicompost, Flabacterium and both application vermicompost, Flabacterium. H_1 and H_2 are no foliar application and foliar application 2 g.L^{-1} humic acid respectively.
Means with similar letters in each column are not significantly different based on LSD test

Table 14. Means comparison of effects of bio fertilizers, foliar application of humic acid and salinity stress on grain yield

Treatments		Grain Yield (g per plant)			
		Biofertilizers Levels			
		B1	**B2**	**B3**	**B4**
S1	**H1**	2.2^{hi}	2.35^{fg}	2.51^{de}	3.1^{a}
	H2	2.42^{efg}	2.6^{cd}	2.9^{b}	3.12^{a}
S2	**H1**	1.9^{jkl}	2^{j}	2.39^{efg}	2.7^{c}
	H2	2.17^{i}	2.31^{gh}	2.47^{ef}	2.97^{b}
S3	**H1**	1.84^{l}	1.99^{jk}	2.3^{gh}	2.45^{ef}
	H2	1.87^{kl}	2^{j}	2.42^{efg}	2.5^{de}
LSD		*0.1224*			

S_1, S_2 and S_3 are no salinity, salinity 50 and 100 mM respectively. B_1, B_2, B_3 and B_4 are no application of bio fertilizers, application of vermicompost, Flabacterium and both application vermicompost, Flabacterium.

H_1 and H_2 are no foliar application and foliar application 2 $g.L^{-1}$ humic acid respectively.

Means with similar letters in each column are not significantly different based on LSD test