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Correlation between yield and other treats in sugar beet (*Beta vulgaris* L.) under application of different biofertilizers and irrigation

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Abstract

This study was conducted at Dorud region, Iran, during 2013. The aim of this research was study on correlation between yield and some agronomic characteristics of sugar beet (*Beta vulgaris* L.) under of different biofertilizers and irrigation closed time. The experimental design was factorial based on RCBD with three replications. Treatments were three irrigation closed time [Oct-6 (A_1), Oct-13 (A_2) and Oct -21 (A_3)] and three nitrogen biofrtilizers [Nitroxin (B_1), Nitrokara (B_2), Biozar (B_3) and control (B_4)]. After treatments 3m^2 in each plot harvested for leaf and root yield measurement. Sugars, K%, Na% and N% were determined by Betalizer machine in Isfahan sugar beet factory. Results showed that, the effect of irrigation on root yield, sugar yield and white sugar yield were significant. The effect of different biofertilizers were significant on root yield, K%, N%, alkalinity coefficient and sugar yield and white sugar yield. Interaction effect of irrigation and biofertilizers were significant on root yield, sugar yield and white sugar yield only. Application of different biofertilizers and different irrigation closed time reviled that among the all treatment highest root yield was belonged at application of Biozar in Oct-13 irrigation closed time and minimum root yield was belonged at application of Nitrokara in Oct-21 irrigation closed time. The correlation matrix indicated strong and significant ($p<0.01$) correlation of root yield with sugar yield and white sugar yield ($r=0.97$ and 0.95) respectively. Also results showed had significant ($p<0.05$) positive and negative correlation between root yield and N % and alkalinity coefficient respectively. In final our results showed that with increase in root yield, sugar yield and white sugar yield increased and N % and alkalinity coefficient decreased.

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Introduction

Bio-fertilizers have a positive effect on growth, yield and yield component of many crops. Fertilizer management is one of the most important factors in successful cultivation of crops affecting yield quality and quantity (Tahmasbi *et al*, 2011). Overuse of different chemical fertilizers is one of the causes for the degradation of environment and soil. Bio fertilizers are the newest and most technically advanced way of supplying mineral nutrients to crops. Compared to chemical fertilizers, their supply nutrient for plant needs, minimizes leaching, and therefore improves fertilizer use efficiency (Subbarao *et al*, 2013). Beyranvand *et al* (2013) reviled that application nitrogen and phosphate biofertilizers increased yield and yield components of maize under Boroujerd environmental condition. They suggested that effect of nitrogen and phosphate biofertilizers were evaluated positively, there were an increase in plant height, ear weight, number of grain per cob, grain yield and biomass yield. Also Azimi *et al* (2013) found that that application nitrogen and phosphate biofertilizers increased yield and yield components of barley under Boroujerd environmental condition. They suggested that Grain yield and biomass yield increasing was reported with the biofertilizer application which account important benefit, causing decreasing in the inputs of production because of economizing much money to chemical fertilizers and increasing in yield and biological yield. Increasing yield was attributed to the plant growth promoting substances by root colonizing bacteria more than the biological nitrogen fixation, (Lin *et al*, 1983) stated that yield increased due to promoting root growth which in turn enhancing nutrients and water uptake from the soil. A small dose of biofertilizer is sufficient to produce desirable results because each gram of carrier of biofertilizers contains at least 10 million viable cells of a specific strain (Anandaraj and Delapierre, 2010). In recent years, utilizing biological fertilizer and nitrogen through bacteria had considerable attention. Application of biological fertilizers (growth stimulator bacteria) in sugar beets could be a recommended alternative too (Jafarian *et al*, 2013).

Due to the shortage of water over the world, providing strategies such as proper irrigation methods, irrigation management, while offering ways to reduce and control the negative effects of water stress in plants and varieties more resistant to water etc., to save water in agriculture is critical and should be a priority research (Sadeghi-Shoae *et al*, 2013).

Sugar beet (*Beta vulgaris* L.) is an industrial crop is cultivated in many countries in the world. Improving sugar beet yield and quality are the main goals of the governmental policy to increase sugar production in order to gradually cover gap between sugar consumption and production. The aim of all investigators was to decrease the gap between production and consumption of sugar (Nemeat-Alla *et al*, 2009). Fertilization is limiting factor for sugar beet production (Nemeat-Alla *et al*, 2009). Thus, its favorable to choose the optimum rate and times of application from macro and micro nutrients to gave the maximum yield and quality for sugar beet crop (Nemeat-Alla *et al*, 2009). Ismail and Ghait (2005) and Nemeat Alla *et al.* (2007) reported that root dimensions significantly affected by nitrogen levels and gave maximum root dimensions with high dose of N. Positive effect of biofertilizer may resulted from its ability to increase the availability of phosphorus and other nutrients especially under the specialty of the calcareous nature of the soil which cause decreasing on the nutrients availability, results agree with (Tiwari *et al*, 1989).

Therefore the aim of this experiment is study on effect of different biofertilizers and different irrigation correlation between some agronomic characteristics of Sugar Beet (*Beta vulgaris* L.).

Material and methods

Field material and Experimental design

A field experiment was laid out to study effect of different biofertilizers and irrigation closed time on some agronomic characteristics of Sugar Beet (*Beta vulgaris* L.) an experiments was conducted under temperate condition in station of agricultural farm in Deh-Haji village, Dorud city, Lorestan provience, Iran during 20013. The soil type was a silty loam, pH of 7.6 and EC = 0.65 d s m–1. In the soil of this farm available P= 8.6 ppm, organic carbon= 84%, available K= 235 ppm. The Dorud region has a continental semi-arid climate with annual precipitation of 224 mm.

Treatments

The experimental design was factorial based on RCBD with three replications. Treatments were three irrigation closed time [Oct-6 (A_1), Oct-13 (A_2) and Oct -21 (A_3)] and three nitrogen biofrtilizers [Nitroxin (B_1), Nitrokara (B_2), Biozar (B_3) and control (B_4)].

After treatments 3m² in each plot harvested for leaf and root yield measurement. K%, Na% and N% were determined by Betalizer machine in Isfahan sugar beet factory.

Sugar percent and yield were determined by Betalizer machine in Isfahan sugar beet factory. Sugar percent (POL) was determined by Betalizer machine directly. After that, root sugar percent and Molasses sugar percent were determined by follow formulas:

[Root sugar yield =POL-[0/343(K+Na)+/094 a-amino-N+0/29]

Molasses sugar percent =-POL-Sugar.

Statistical analysis

After ANOVA analysis correlation between treats was determined with Proc GLM procedure, SAS (SAS Inst., 1994) statistical software.

Results and discussions

Analysis of variance

The effect of irrigation on root yield, sugar yield and white sugar yield were significant. The effect of different biofertilizers were significant on root yield, K%, N%, alkalinity coefficient and sugar yield and white sugar yield. Interaction effect of irrigation and biofertilizers were significant on root yield, sugar yield and white sugar yield only (Table 1).

Table 1. Analysis of variance (mean squares) for yield and other characteristics of sugar beet under application of different biofertilizers and different irrigation closed time.

S.O.V	df	leaf fresh yield	root yield	K	Na	N	extract coefficient	extractable sugar	Alkalinity coefficient	Root sugar	Molasses sugar	Sugar yield	White sugar yield
R	2	1.3	117	0.36	1.5	1.6	10.7	7.3	21.1	5	0.16	8.4	8.4
irrigation (A)	2	13.1	105**	0.13	0.15	0.009	3.7	1.3	1.9	0.6	0.05	4.7**	4.5**
Biofertilizer (B)	3	2.7	236**	0.41*	0.38	0.41*	0.13	0.04	4.6*	0.39	0.01	10.4**	6.5**
A*B	6	4.8	270**	0.25	0.24	0.14	0.79	0.53	2.1	0.47	0.006	10.16**	7.6**
Error	22	10	15.6	0.17	0.38	0.15	2.2	1.1	1.62	1.12	0.04	0.7	0.5
CV%		30	8.9	13.1	27	29	1.7	6.6	27	5.6	8.8	10.3	10.2

* and **: Significant at 5% and 1% probability levels, respectively.

Simple mean comparison

Leaf and root yield

Among the irrigation closed time treatments, the highest leaf yield was belonged at Oct-6 treatment and the lowest fresh leaf yield was belonged at Oct-13 treat and the differences were not significant (Table 2). Among the nitrogen biofertilizers, Nitrokara treatment has the highest fresh leaf yield and Biozar treatment has the lowest leaf yield but the differences were not significant (Table 2). Also, the results showed that Among the irrigation closed time treatments, the highest root yield (48 ton/ha) was belonged at Oct-13 treatment and the lowest root yield (42 ton/ha) was belonged at Oct-21 treat and the differences were significant (Table 2). Among the nitrogen biofertilizers, Biozar treatment has the highest (50 ton/ha) root yield and Nitrokara treatment has the lowest root yield (40 ton/ha) and the differences were significant (Table 2). The biofertilizers could replace 50% of chemical fertilizers recommended to the plant growth promoting substance produced by biofertilizers in addition to the reasonable quality of atmospheric nitrogen fixed (Gomaa, 1999). For gave to highest yield in agriculture addition of nitrogen fertilizer is very important (Beyranvand *et al*, 2013, Kiani *et al*, 2013 and Shaban, 2013a,b). For Oct-13 irrigation closed time the minimum root yield was belonged at control treatment and application of biofertilizer was significant for root yield of sugar beet. In this treatment maximum root yield was belonged at application of Biozar biofertilizer treatment. Explained the vital roles of water supply at adequate amount for different physiological processes such as photosynthesis respiration, transpiration translocation, enzyme reaction and cells turgidity. Reduction of plant size and growth under water stress my be attributed to a decrease in the activity of meristemic tissues responsible for elongation. As well as the inhibition photosynthetic efficiency under insufficient water condition Siddique *et al* (1999). According to above mentioned results El– Monayeri *et al* (1983), Azzaz (1998) and Mona *et al* (2000).

Table 2. Mean comparisons for yield and other characteristics of sugar beet under application of different biofertilizers and different irrigation closed time.

treatments	leaf fresh yield (ton/ha)	root yield (ton/ha)	K(%)	Na(%)	N(%)	extract coefficient	extractable sugar(%)	Alkalinity coefficient	Root sugar(%)	Molasses sugar(%)	Sugar yield (ton/ha)	White sugar yield(ton/ha)
irrigation closed (A)												
Oct-6 (A_1)	11.5	46.1^{a}	3.1	2.4	1.3	87.3	16.1	4.5	18.7	2.3	8.6a	7.4a
Oct-13 (A_2)	9.5	48^{a}	3	2.2	1.3	88.2	16.7	4.2	18.9	2.2	9.1a	8a
Oct -21 (A3)	9.9	42^{b}	3.2	2.2	1.32	87.2	16	5	18.4	2.3	7.8b	6.8b
LSD	2.6	3.34	0.3	0.52	0.32	1.2	0.91	1.07	0.9	0.17	0.7	0.6
Biofertilizers												
Nitroxin (B_1)	10.4	41^{b}	3.3^{a}	2.2	1.41^{a}	87.4	16	4	18.6	2.3	7.7b	6.8b
Nitrokara (B_2)	10.6	40^{b}	2.8^{b}	2.6	1.03^{b}	87.7	16.2	5.6	18.4	2.2	7.5b	6.6b
Biozar (B3)	9.5	50^{a}	3.3^{a}	2.2	1.3^{b}	87.5	16.4	4.3	18.7	2.3	9.5a	8.3a
Control (B4)	10.6	48^{a}	3^{ab}	2.1	1.4^{a}	87.6	16.3	4.2	18.9	2.2	9.4a	7.9a
LSD	3	3.8	0.4	0.6	0.38	1.4	1	1.2	1	0.19	0.86	0.74

Means by the uncommon letter in each column are significantly different ($p<0.05$).

Potassium

The simple comparison of the mean values of the K% showed that among the nitrogen biofertilizers, Nitroxin and Biozar treatments has the highest (3.3%) K and Nitrokara treatment has the lowest K (2.8%) and the differences were significant (Table 2). High tension exerts a physiological effect on the root, elongation, turgidity and number of root hairs decrease with increasing tension, the decrease nutrients uptake by water stress also has been supported by Nelson 1982. For N% the results showed that among the nitrogen biofertilizers, Nitroxin treatment has the highest (1.41%) N and Nitrokara treatment has the lowest N (1.03%) and the differences were significant (Table 2).

Alkalinity coefficient

The simple comparison of the mean values of the alkalinity coefficient showed that among the nitrogen biofertilizers, Nitrokara had the highest and Nitroxin treatment has the lowest of them and the differences were significant (Table 2). The simple comparison of the mean values of sugar yield showed that among the irrigation closed time treatments, the highest sugar yield (9.1 ton/ha) was belonged at Oct-13 treatment and the lowest sugar yield (7.8 ton/ha) was belonged at Oct-21 treat and the differences were significant (Table 2). Among the nitrogen biofertilizers, Biozar treatment has the highest (9.5 ton/ha) sugar yield and Nitrokara treatment has the lowest sugar yield (7.5 ton/ha) and the differences were significant (Table 2). The simple comparison of the mean values of white sugar yield showed that among the irrigation closed time treatments, the highest white sugar yield (8 ton/ha) was belonged at Oct-13 treatment and the lowest white sugar yield (6.8 ton/ha) was belonged at Oct-21 treat and the differences were significant (Table 2). Among the nitrogen biofertilizers, Biozar treatment has the highest (8.3 ton/ha) white sugar yield and Nitrokara treatment has the lowest white sugar yield (6.6 ton/ha) and the differences were significant (Table 2).

Table 3. Correlation between treats of sugar beet under application of different biofertilizers and different irrigation closed time.

12	11	10	9	8	7	6	5	4	3	2	1	
White sugar yield	Sugar yield	Molasses sugar	extract coefficient	extractable sugar	Alkalinity coefficient	N	Na	K	Root sugar	leaf fresh yield	root yield	treats
											1	1
										1	0.05	2
									1	-0.18	0.32	3
								1	0.3	-0.01	0.1	4
							1	**-0.5	**-0.75	0.2	-0.22	5
						1	-0.32	0.55**	0.38*	0.1	0.36*	6
					1	**-0.83	0.53**	**-0.49	**-0.57	-0.1	*-0.4	7
				1	**-0.53	0.28	**-0.72	0.22	0.92**	0.15	0.21	8
			1	0.84**	-0.21	-0.15	**-0.65	-0.1	0.7**	-0.14	0.12	9
		1	**-0.9	**-0.53	-0.07	0.46**	0.45**	0.34*	*-0.38	0.13	-0.005	10
	1	-0.09	0.27	0.4*	**-0.49	0.41*	*-0.39	0.17	0.51**	0.01	0.97**	11
1	0.98**	-0.14	0.34*	0.49**	**-0.51	0.41*	*-0.41	0.17	0.55**	0.007	0.95**	12

* and **: Significant at 5% and 1% probability levels, respectively.

Simple correlation

The correlation matrix (Table 3), indicated strong and significant ($p<0.01$) correlation of root yield with sugar yield and white sugar yield (r=0.97 and 0.95) respectively. These results were agreement with the previously reported ones (ICARDA, 1993). Also results showed had significant ($p<0.05$) positive and negative correlation between root yield and N % and alkalinity coefficient respectively. Such results indicated that selection for these some of traits such as sugar and white sugar would lead to the increase quality in sugar beet. Also results showed had negative but non-significant correlation coefficient (r= -0.12 and -0.22) of grain yield with extract coefficient and Na% respectively. However root sugar was negatively and significantly ($p<0.05$) correlated with Na% (r=-0.75), alkalinity coefficient (r=-0.57) and Molasses (r=-0.38). The number of pod per plant was negatively and significantly ($p<0.01$) correlated with number of grain per plant (r=0.99) and had a positively correlation with extractable sugar, extract coefficient, Sugar yield and white sugar yield. However the correlation of Molasses with N%, Na% and K% were positively significant and with extractable sugar and extract coefficient were negatively significant. Also sugar yield and white sugar yield had a positively and significant correlation with extractable sugar, extract coefficient and White sugar yield and had a negatively correlation with Na% and alkalinity coefficient. The extract coefficient had a significant and positively correlation with extractable sugar too (r=0.84). Antunovic *et al* (2002) founded that in sugar beet potassium concentration was in significant positive correlation with extractable sugar. Bio-fertilizers include mainly the nitrogen fixing, phosphate solubilizing andproviding a more balanced nutrition for plants (Belimov *et al*, 1995). According Bergman (1992) leaf potassium concentration had a positive correlation with extractable sugar in sugar beet. Louse (1985) found that soil potassium concentration increase result in sugar beet root K increase.

Conclusion

In the present study, significant differences were observed among nitrogen biofertilizers and irrigation closed time treatments regarding the average root yield was more affected. Application of supernitroplas with phosphate barvar2 biofertilizers in the same time on its own increased seed yield of barley significantly. Water supply and Application of biofertilizers increased the sugar content and sugar yield in sugar beet. It significantly enhanced the overall growth of the treated plants. The strong and significant correlation of root yield with sugar yield and white sugar yield respectively. Also results showed had significant positive and negative correlation between root yield and N % and alkalinity coefficient respectively. In final our results showed that with increase in root yield, sugar yield and white sugar yield increased and N % and alkalinity coefficient decreased.

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