IJABBR- 2014- eISSN: 2322-4827

International Journal of Advanced Biological and Biomedical Research

Journal homepage: www.ijabbr.com

Original Article

Changes in Carbohydrates and Sugar Yield in Sugar Beet (*Beta Vulgaris* L.) Under Different Biofertilizers and Irrigation Closed Time

Gholamreza Hashemi*[1], Amin Farnia[1], Mehrdad Rahnamaeian[2], Morad Shaban[3]

[1]*Department of Agronomy and Plant Breeding, Islamic Azad University, Boroujerd Branch, Boroujerd, Iran*
[2] *Lorestan natural resources and agriculture reaserch center, Boroujerd agricultural reaserch station, Boroujerd, Iran*
[3] *Young Researchers and Elite club, Boroujed branch, Islamic Azad University, Boroujerd, Iran*

ARTICLE INFO

Article history:
Received: 05 June, 2014
Revised: 30 June, 2014
Accepted: 15 July, 2014
ePublished: 30 August 2014

Key words:
Nitrogen biofertilizer
Carbohydrate
Sugar Beet
Sugar yield

ABSTRACT

Objective: Many agronomic practices may need to be adjusted to maximize yield and quality of sugar beet. Thus agronomic package must be always modified. This sutdy was laid out for evaluation of changes in carbohydrates and sugar yield in sugar beet (*Beta vulgaris* L.) under different biofertilizers and irrigation closed time at Dorud region of Iran, during 2013. **Methods:** The experimental design was factorial based on RCBD with three replications. Treatments were three irrigation closed time [Oct-6 (A1), Oct-13 (A2) and Oct -21 (A3)] and three nitrogen biofrtilizers [Nitroksin (B_1), Nitrokara (B_2), Biozar (B_3) and control (B_4)]. After treatments 3m2 in each plot harvested for sugar measurement. Sugar was determined by Betalizer machine in Isfahan sugar beet factory. **Results:** The effect of any treatment on root and Molasses sugar was not significant but all treatments were significant on sugar yield and white sugar yield. Among the all treatment highest sugar yield and white sugar yield was belonged at application of Biozar in Oct-13 irrigation closed time and minimum sugar yield and white sugar yield was belonged at application of Nitrokara in Oct-21 irrigation closed time.

1.INTRODUCTION

Nowadays, sugar beet (*Beta vulgaris* L.) has been introduced as a sugar crop in Iran to take descending order after sugar cane. The aim of all investigators was to decrease the gap between production and consumption of sugar. Water and Fertilization are limiting factors for sugar beet production. Thus, they are favorable to choose the optimum rate and times of water and application from macro and micro nutrients to gave the maximum yield and quality for sugar beet crop. 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). Intermittent or alternate irrigation has been widely used in U.S.A. since 1962 and in the cultivation of potatoes, corn, sorghum, sugarbeet and cotton have had good results. 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). Serious environmental degradation due to the misuse of chemical fertilizers caused a critical attention and interest in a healthy crop production in sustainable farming systems. Nowadays development of sustainable agricultural systems is a key to combat with the disaster (Ardakani, 2009). Alimadadi et al. (2010) reported that one of the strategies for improving crop production and protecting

***Corresponding Author:** Gholamreza Hashemi, *Department of Agronomy and Plant Breeding, Islamic Azad University, Boroujerd Branch, Boroujerd, Iran.*(moslem.hashemi_2012@yahoo.com)

the environment is providing plant growth via using more soil microorganisms and bio-fertilizers instead of chemicals. Biofertilizer is a natural product carrying living microorganisms derived from the root or cultivated soil (Ramakrishnan, and Selvakumar, 2012). So they don't have any ill effect on soil health and environment. Besides their role in atmospheric nitrogen fixation and phosphorous solubilisation, these also help in stimulating the plant growth hormones providing better nutrient uptake and increased tolerance towards drought and moisture stress (Ramakrishnan, and Selvakumar, 2012). The impact of injection had a profound improvement in growth in the above process. This growth might be due to nitrogen settlement which was caused by bacteria. Nitro bacteria presence caused an improvement in the efficiency of sugar beet product and it raised gross sugar percentage between7 to 24 and pure sugar percentage between 2.5 to 5.39. Ibiene et al (2012) showed that the ability to solubilize phosphate was exhibited by Nitrobacter species and Nitrosomonas species while Azotobacter species produce indole acetic acid (IAA) and siderphore. Abo-El-Goud (2000) reported that using biological fertilizer had a positive impact on the weight of the fresh and dry root and the weight of the fresh and dry stem, as well as leaf surface indicator in wheat. Nitrobacteria presented in the soil environment of inoculated sugar beet seeds showed a significant effect on the secretion of additive growth substances such as Gibberellins (Mrkovacki et al., 2001). Favilli et al (1993) inoculated sugar beet seed with a fertilizer containing a biological agent of Azosperillium accelerated the germination, seedling growth and optimum plant growth and increased root and sugar yield and reduce nitrogen fertilizer requirement during the growth season. Therefore the aim of this experiment is study on changes in carbohydrates and sugar yield in sugar beet under different biofertilizers and irrigation closed time in Dorud vregion of Iran.

2. MATERIALS AND METHODS

A filed experiment was laid out in order to study effect of different biofertilizers and irrigation closed time on carbohydrates and sugar changes in sugar beet (*Beta vulgaris* L.) 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. 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 [Nitroksin (B_1), Nitrokara (B_2), Biozar (B_3) and control (B_4)]. After treatments 3m^2 in each plot harvested for root and sugar yield measurement. 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

Data were analyzed with Proc GLM procedure, SAS (SAS Inst., 1994) statistical software.

3. RESULTS AND DISCUSSION

The effect of any treatment on root and Molasses sugar was not significant but all treatments were significant on sugar yield and white sugar yield (Table 1).

The simple comparison of the mean values of root sugar showed that among the irrigation closed time treatments, the highest root sugar (18.9%) was belonged at Oct-13 treatment and the lowest root sugar (18.4%) was belonged at Oct-21 treat and the differences were not significant (Table 2). Among the nitrogen biofertilizers, control treatment has the highest (18.9%) root sugar and Nitrokara treatment has the lowest root sugar (18.4%) but the differences were not significant (Table 2). These result are in agreement with Abdel Gawad et al (1997) and Nemeat-Alla (2005).

Table1.

Analysis of variance (mean squares) for carbohydrates and sugar of sugar beet under application of different biofertilizers and different irrigation closed time

S.O.V	df	Root sugar	Molasses sugar	Sugar yield	White sugar yield
R	2	5	0.16	8.4	8.4
irrigation closed (A)	2	0.6	0.05	4.7**	4.5**
Biofertilizer (B)	3	0.39	0.01	10.4**	6.5**
A*B	6	0.47	0.006	10.16**	7.6**
Error	22	1.12	0.04	0.7	0.5
CV%		5.6	8.8	10.3	10.2

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

Table 2.

Mean comparisons for carbohydrates and sugar of sugar beet under application of different biofertilizers and different irrigation closed time

treatments	Root sugar(%)	Molasses sugar(%)	Sugar yield (ton/ha)	White sugar yield(ton/ha)
irrigation closed (A)				
Oct-6 (A_1)	18.7	2.3	8.6a	7.4a
Oct-13 (A_2)	18.9	2.2	9.1a	8a
Oct -21 (A3)	18.4	2.3	7.8b	6.8b
LSD	0.9	0.17	0.7	0.6
Biofertilizers				
Nitroksin (B_1)	18.6	2.3	7.7b	6.8b
Nitrokara (B_2)	18.4	2.2	7.5b	6.6b
Biozar (B3)	18.7	2.3	9.5a	8.3a
Control (B4)	18.9	2.2	9.4a	7.9a
LSD	1	0.19	0.86	0.74

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

For Molasses sugar the results showed that among the irrigation closed time treatments, the highest Molasses sugar (2.3%) was belonged at Oct-6 and Oct-21 treatments and the lowest root yield (2.2%) was belonged at Oct-13 treat and the differences was not significant (Table 2). Among the nitrogen biofertilizers, Nitroksin and Biozar treatments has the highest (2.3%) Molasses sugar and Nitrokara treatment has the lowest Molasses sugar 2.2%) and the differences were not 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).

Interaction effect of treats for sugar yield of sugar beet under application of different biofertilizers and different irrigation closed time showed that, in Oct-6 irrigation

closed time the maximum sugar yield belonged at control treatment and application of any biofertilizer was not significant for sugar yield of sugar beet (figure 1). In this treatment minimum sugar yield was belonged at application of Nitroksin biofertilizer treatment. After control treatment application of Biozar biofartilizer was useful rather than other biofertilizer in Oct-6 irrigation closed time. Nemeat-Alla et al (2009) fond that it could be concluded that fertilized sugar beet plants with 95 kg/fad. and twice sprayed with micronutrients mixture greatest sugar beet productivity under Sakha, Kafr ELSheikh condition.. For Oct-13 irrigation closed time the minimum sugar yield was belonged at control treatment and application of biofertilizer was significant for sugar yield of sugar beet. In this treatment maximum sugar yield was belonged at application of Biozar biofertilizer treatment. After Biozar treatment application of Nitrokara was useful rather than Nitroksin in Oct-13 irrigation closed time (Figure 1). At Oct-21 irrigation closed time the maximum sugar yield belonged at control treatment and application of any biofertilizer was not significant for sugar yield of sugar beet. In this treatment minimum sugar yield was belonged at application of Nitrokara biofertilizer treatment. After control treatment application of Biozar was useful rather than Nitroksin in Oct-21 irrigation closed time (Figure 1). Using nitrogen and biological fertilizer in sugar beet caused rapid germination, higher yield and quality (Balakrishnan and Selvakumar, 2008). Bozena (2000) stated that optimal use of fertilizers in sugar beet caused an increase in root yield and pure and impure sugar yield. In final Interaction effect of treats for sugar yield of sugar beet under application of different biofertilizers and different irrigation closed time reviled that among the all treatment highest sugar yield (12.2 ton/ha) was belonged at application of Biozar in Oct-13 irrigation closed time and minimum sugar yield (6 ton/ha) was belonged at application of Nitrokara in Oct-21 irrigation closed time. In application of Nitrokara in Oct-21 irrigation closed time treatment root yield was equal of 1/2 sugar yield in application of Biozar with Oct-13 irrigation closed time treatment that this differences was significant (figure 1). These results are in agreement with those of Saif-Laila (1991), Abd El-hadi et al (2002), and Nemeat-Alla (2005).

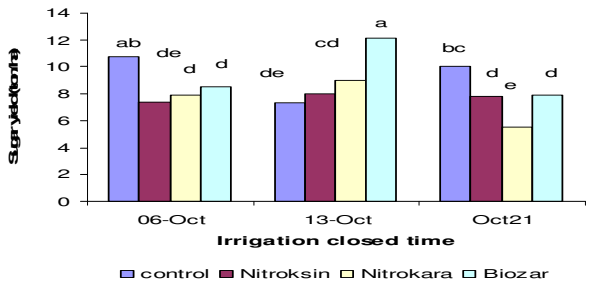

Figure 1. Interaction effect of treats for sugar yield of sugar beet under application of different biofertilizers and different irrigation closed time Means by the uncommon letter in each column are significantly different ($p<0.05$).

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). Interaction effect of treats for white sugar yield of sugar beet under application of different biofertilizers and different irrigation closed time showed that, in Oct-6 irrigation closed time the maximum white sugar yield belonged at control treatment (figure 2). In this treatment minimum white sugar yield was belonged at application of Nitroksin biofertilizer treatment. After control treatment application of Biozar biofartilizer was useful rather than other biofertilizer in Oct-6 irrigation closed time for white sugar yield. For Oct-13 irrigation closed time the minimum white sugar yield was belonged at control treatment and application of biofertilizer was significant for white sugar yield of sugar beet. In this treatment maximum white sugar yield was belonged at application of Biozar biofertilizer treatment. After Biozar treatment application of Nitrokara was useful rather than Nitroksin in Oct-13 irrigation closed time (Figure 2). At Oct-21 irrigation closed time the maximum white sugar yield belonged at control treatment and application of any biofertilizer was not significant for white sugar yield of sugar beet. In this treatment minimum white sugar yield was belonged at application of Nitrokara biofertilizer treatment. After control treatment application of Biozar was useful rather than Nitroksin in Oct-21 irrigation closed time (Figure 2). In final Interaction effect of treats for white sugar yield of sugar beet under application of different biofertilizers and different irrigation closed time reviled that among the all treatment highest white sugar yield (11.7 ton/ha) was belonged at application of Biozar in Oct-13 irrigation closed time and minimum white sugar yield (5.9 ton/ha) was belonged at application of Nitrokara in Oct-21 irrigation closed time. In application of Nitrokara in Oct-21 irrigation closed time treatment white sugar yield was equal of 1/2 white sugar yield in application of Biozar with Oct-13 irrigation closed time treatment that this differences was very significant (figure 2). These result are in agreement with Abdel Gawad et al (1997) they found that increasing total carbohydrate with increasing fertilizer rate. The biological fertilizers were able to increase the percentage of gross sugar between 17.5 to 24.1 percent (in control plants it was 19.8 percent) and the percentage of pure sugar was 16.76 percent (In control plants it was 15.55 percent). Sugar yield efficiency was observed 7.5 percent. Kandil et al (2004) reported that seed treatment with biological fertilizer (Rhizobactrium) significantly

increased root dry weight, leaf area index, crop growth rate and the photosynthesis rate of sugar beet. Favilli et al (1993) inoculated sugar beet seed with a fertilizer containing a biological agent of Azosperillium accelerated the germination, seedling growth and optimum plant growth and increased root and sugar yield and reduce nitrogen fertilizer requirement during the growth season.

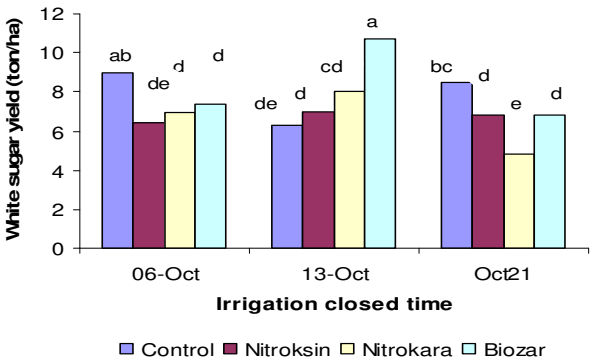

Figure 2. Interaction effect of treats for white sugar yield of sugar beet under application of different biofertilizers and different irrigation closed time Means by the uncommon letter in each column are significantly different ($p<0.05$).

C0NCLUSION

Our results are promising in the field of water and bio-fertilizers. 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 mechanisms which could be involved include the bioavialbility of macro and micronutrients, production of growth hormones, and reduction of the phytopathogens' growth. In addition, they could improve the physical and chemical properties of soil that increase water holding capacity, prevent nutrient leaching and add more mineral nutrients to the soil (Ramadan et al, 2013). In present study interaction effect of treats for sugar yield and white sugar yield of sugar beet under application of different biofertilizers and different irrigation closed time reviled that among the all treatment highest sugar yield and white sugar yield was belonged at application of Biozar in Oct-13 irrigation closed time and minimum sugar yield and white sugar yield were belonged at application of Nitrokara in Oct-21 irrigation closed time.

REFERENCES

Abd El-Hadi AH, Aly AMA, Attiat AA, Zidan MA, zahran F (2002). Response of sugar beet to various forms and rates of nitrogen fertilizer. Egyptian J. Soil Sci., (4): 643-658.

Abo-El-Goud SMM (2000). Agronomic studies on fodder beet. Ph.D. thesis, Fac. Agric. Mansoura University.

Alimadadi A, Jahansouz MR, Besharati H, Tavakol Afshari R (2010).Evaluating the effects of phosphate solubilizing microorganisms, mycorrhizal fungi and seed priming on nodulation of chickpea. Iranian Journal of Soil Research (Formerly Soil and Water Sciences), 24 (1): 44-53.

Ardakani MR (2009). Ecology. Tehran University press, Iran.

Beyranvand H, Farnia A, Nakhjavan SH, Shaban M (2013). Response of yield and yield components of maize (*Zea maiz* L.) to different bio fertilizers. International journal of Advanced Biological and Biomedical Research. Volume 1, Issue 9: 1068-1077.

Favilli F, Pastorelli R, Gori A (1993). Response of sugar beet toAzospirillumbacterization in field experiments. Agric. Mediterr. 123:281-285.

Ibiene AA, Agogbua JU, Okonko IO, Nwachi GN (2012). Plant growth promoting rhizobacteria (PGPR) as biofertilizer: Effect on growth of Lycopersicum esculentus. Journal of American Science 8(2):318-324.

Kandil AA, Badawi MA, El-Moursy SA, Abdou UA (2004). Effect of planting dates, nitrogen levels and biofertilization treatments on 1: Growth attributes of sugar beet. Scientific journal of king faisal university. Vol.5 1425.

Kiani, M, Farnia, A.,and Shaban, M. (2013). Changes of seed yield, seed protein and seed oil in rapeseed (Brassica napus L.) under application of different bio fertilizers. International journal of Advanced Biological and Biomedical Research. Volume 1, Issue 10: 1170-1178.

Mrkovack N, Milic V.2001.UseofAzotobacterchroococcum as potentially useful in agricultural application. Annals of Microbiology, 51, 145-158.

Nemeat-Alla, E.A.E.; S.S. Zalat and A.I. Badr. 2009. SUGAR BEET YIELD AND QUALITY AS AFFECTED BY NITROGEN LEVELS AND FOLIAR APPLICATION WITH MICRONUTRIENTS. J. Agric. Res. Kafrelsheikh Univ., 35 (4): 995-1012.

Nemeat-Alla, E.A.E; A.I. Badr and M.F.M. Ibrahim (2007). Macro-element requirements of sugar beet. J. Agric. Sci. Mansoura Univ., 32 (1): 8849-8857.

Ramadan AGAMY, Mohamed HASHEM, Saad ALAMRI (2013). Effect of soil amendment with yeasts as bio-fertilizers on the growth and productivity of sugar beet. African Journal of Agricultural Research Vol. 8(1), pp. 46-56.

Ramakrishnan K, Selvakumar G (2012). Effect of biofertilizers on enhancement of growth and yield on

Tomato (*Lycopersicum esculentum* Mill.). International Journal of Research in Botany. 2(4): 20-23.

Sadeghi-Shoae M, Paknejad F, Hassanpour H, Mozafari H, Moharramzadeh M, Tookalloo MR (2013). Effect of intermittent furrow irrigation, humic acid and deficit irrigation on water use efficiency of sugar beet. Annals of Biological Research, 4 (3):187-193.

Saif-Laila MA (1991). Yield and quality of sugar beet as affected by nitrogen sources and rate of some microelements in Kafer EL-Sheikh. Ph. D. thesis, Fac. of Agric. Ain Shams Univ.

Shaban M (2013a). Application of seed equilibrium moisture curves in agro physics. International journal of Advanced Biological and Biomedical Research. 1(9): 885-898.

Shaban M (2013b). Biochemical aspects of protein changes in seed physiology and germination. International journal of Advanced Biological and Biomedical Research. 1(8): 885-898.