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EFFECT OF SOME BIOFERTILIZERS ON YIELD AND THE INCIDENCE OF SUGAR BEET WITH CEROCOSPORA LEAF SPOT DISEASE

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ABSTRACT

Two field experiments were conducted to study the effect of some biofertilizers with and without normal fertilization on sugar beet yield and the incidence of cercospora leaf spots disease.

The experiments carried out at The Experimental Farm of Tag Al-Ezz Research Station in clay loamy soil during 2003/2004 and 2004/2005 using two of biofertilizers containing N-fixing bacteria (i.e., Rhizobacterin and Nitrobien), one containing P-dissolving bacteria (Phosphorine) and the fourth is Microbien contains both of the two types of bacteria.

The obtained results revealed that the lasted biofertilizers could compensate the plant with more than half the recommended doses of the mineral nitrogenous and phosphorus fertilizers.

INTRODUCTION

Many countries are going now on the way of clean agriculture with minimum pollution effects. Using natural materials such as biofertilizers. The concept of biofertilization is not new to Egyptian agriculture.

Recently, investigation aimed to study the effect of biofertilizers application and different levels of nitrogen on yield and sucrose percentage (Mitkees *et al.*, 1996). Most agronomists are now in favour of the use of biofertilizers to conserve environment and reduce agricultural costs (Saber, 1993 and Eglal *et al.*, 1996). Sugar beet (*Beta vulgaris* L.) is considered as one of the most important winter crops. Its cultivated area reached at Dakahlia governorate about 25.395 feddan produced 485203 tons (19.1 ton/feddan), while the cultivated area all over the country reached 125.823 feddan produced about 2431007 ton (19.3 ton/feddan) according to FAO (2003/2004).

Sugar demands in Egypt have increased at a very rapid rate during the past. This increasing due to the growth of population as well as, the change of sugar consumption patterns. There are several advantages favouring sugar beet to be an economic additional source.

In Egypt, the crop is an annual growing during the winter season and is highly adapted to grow in moderate saline soils especially in newly reclaimed land.

Sugar beet (*Beta vulgaris*, L.) in Egypt is the second producing sugar crop after sugar cane. Sugar beet can not only be grown in fertile soil, but also in newly reclaimed. Therefore, efforts are focused on increasing the productivity of this crop by growing high yielding varieties under the most favourable cultural treatments such as fertilization.

Difference among sugar beet cultivars in growing root yield and sugar yield have demonstrated by Ibrahim *et al.* (1988) and Hanna *et al.* (1988).

Nitrogen is an essential element for plant nutrient because it is essential for the synthesis of many important biological molecules including amino acids (proteins) and nucleic acids (DNA and RNA). It was added either with mineral or bio-fertilizers because nitrogen usually in short supply in different types of Egyptian soils also nitrogen has affect on the growth and physiological processes of sugar beet. Increasing in the levels of nitrcgen decreased sugar content (Fayed and Kowalski, 1987).

The present investigation studied the effect of some biofertilizers on the incidence of cercospora leaf spot disease and the yield of roots and sucrose percentage in sugar beet.

MATERIALS AND METHODS

Two field experiments were conducted on sugar beet (*Beta vulgaris*, L.) at the experimental farm of Tag El-Ezz Agriculture Research Station at Dakahlia Governorate, Egypt during two seasons of 2003/2004 and 2004/2005.

Four bio-fertilizers produced and distributed commercially by the General Organization for Agriculture Equalization Fund (GOAEF), Ministry of Agriculture, Egypt, were used in this study with the following treatments:-

1. **Bio-fertilizer only:**
   a. Rhizobacterien containing symbiotic N-fixing bacteria.
   b. Nitrobien containing non symbiotic N-fixing bacteria.
   c. Phosphorien containing non-symbiotic P-dissolving bacteria.
   d. Microbien containing non symbiotic both N-fixing and P-dissolving bacteria.
2. Bio-fertilizers + 50% of NPK dose.
3. Bio-fertilizers + full dose of NPK.

Where, the full doses were; 120 kg N/feddan as $(NH_2)_2$, 50 kg (K) potassium sulphate 48% K_2SO_4 / feddan, and 50 kg P (15.5% P_2O_5) / feddan.

Inoculation with bio-fertilizers was performed through mixing the seeds of both cultivars, Oscar and Top from El-Dakahlia Company for Sugar in Belqas with appropriate amount of each one. All the biofertilizers were seed coated with Arabic gum, as an adhesive material, just to sowing on 3 August in the two seasons (2003/2004 and 2004/2005).

The seeds were planted and irrigation took place. Super phosphate (P_2O_5 15.5%) and potassium sulphate (K_2SO_4 48%) were applied and mixed with soil before planting.

Nitrogen fertilizers as $(NH_2)_2$ SO_4 was added at two equal doses 50% at 1st irrigation and 50% after thinning and before the second irrigation. A split split plot design with three replicates was used. Plot size was 12 m^2 and each plot consisted of 6 rows 4 m long and spaced 50 cm. The plants were thinned to one plant per hill after 40 days from sowing in both seasons. Ten (10) roots

were uprooted randomly from each sub sub plot to determine the following parameters:-

1. Plant height (cm) was measured from the soil surface up to the highest top.
2. Root length.
3. Root diameter.
4. Sucrose percentage in fresh sugar beet roots was determined according Le-Doctor (1927).
5. Root yield / feddan.

The percentage of disease infection and disease severity index (SDI) of (cercospora leaf spot disease) were recorded after 120 days from sowing.

Chemical and mechanical analysis were done to pinpoint the saturated extract and the soil texture in the Farm of Agriculture Research Station of Tag Al-Ezz according to Black (1965) and Jackson (1968).

RESULTS AND DISCUSSION

Chemical and mechanical analysis of soil:

Data presented in Table 1 show the percentage of some contents in the soil sample from the experimental farm. Clay was 60.5% and silt 8.3%, so the texture named clay loamy. Also, in the chemical analysis, Na^+ was the highest (0.75) and pH 8.0 (Black, 1965 and Jackson, 1968).

Table 1. Chemical and mechanical analysis of the soil in the experimental farm.

Characters	Value
Coarse sand (%)	5.5
Fine sand (%)	6.0
Silt (%)	8.3
Clay (%)	60.5
$CaCO_3$ (%)	1.7
OM (%)	0.36
pH	8.0
Na^+	0.75
K^+	0.10
Ca^{++}	1.6
Mg^{++}	0.80
Available K (ppm)	300
Available P (ppm)	2.80
Available N (ppm)	15.0
Soil texture	Clay loamy

Data in Table 2 appeared that there are differences between the two cultivars (Oscar and TOP) in the yield of roots and percentage of sucrose at different fertilizer treatments (Anderson and Garya, 1988; Darweish *et al.*, 1982 and El-Kased *et al.*, 1993).

Sugar (Oscar variety) gave 8.90 ton/feddan at the treatment (Rhizobacterien + 50% of NPK dose), while the yield was 3.35 ton/feddan at the treatment of phosphorien without any of mineral fertilizers (Osman, 1986; Mahmoud *et al.*, 1990; Neamat Alla, 1991and Omar *et al.*, 1991).

Sucrose percentage was 23.30% in the first season with Microbien only without any mineral fertilizers. Percentage decreased to 21.0% at treatment of Rhizobacterien + recommended dose of NPK. In the same table with Top variety of roots (8.22 ton/feddan) treated with Phosphorien + 50% of NPK dose produced 8.22 ton of roots / feddan. When the treatment was Microbien only without any mineral fertilizers, it was produced 5.30 ton of roots / feddan.

Table 2. Effect of the level of bio- and mineral fertilizers applications on gross sugar yield and sucrose percentage of two sugar beet cultivars under field conditions during two agricultural seasons (2003/2004 and 2004/2005).

Treatments	Oscar variety cultivar				Top variety cultivar			
	Gross sugar beet yield (ton/fed.)		Sucrose percentage		Gross sugar beet yield (ton/fed.)		Sucrose percentage	
	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005
Control	6.20	6.40	21.00	20.30	6.30	6.20	21.00	21.30
Microbien + 0 a	4.33	4.00	23.30	19.60	5.60	5.30	22.80	24.70
Microbien + 1 b	7.66	7.00	22.60	23.00	8.00	8.22	23.19	23.00
Microbien + 2 c	6.10	7.00	22.10	23.10	7.66	7.00	22.22	22.11
LSD at 5%	**1.56**	**1.31**	**NS**	**1.41**	**1.14**	**1.32**	**1.41**	**0.83**
Control	5.00	5.75	20.20	20.70	6.25	6.20	22.15	22.20
Phosphorien + 0 a	3.35	4.45	21.66	20.80	5.00	6.00	24.33	24.22
Phosphorien + 1 b	6.00	6.66	22.33	21.30	6.80	8.22	22.16	22.88
Phosphorien + 2 c	5.75	6.00	23.20	22.35	7.00	7.30	23.16	20.35
LSD at 5%	**0.63**	**NS**	**0.42**	**0.33**	**0.31**	**NS**	**1.00**	**1.03**
Control	6.10	7.00	21.13	20.66	6.20	6.50	22.33	22.22
Nitrobien + 0 a	4.50	3.00	19.20	21.62	6.20	6.20	22.16	22.22
Nitrobien + 1 b	8.60	8.00	23.00	22.00	6.80	7.30	22.33	23.61
Nitrobien + 2 c	7.20	7.30	23.18	23.28	6.00	7.00	23.66	23.33
LSD at 5%	**1.36**	**2.10**	**1.62**	**NS**	**NS**	**NS**	**NS**	**NS**
Control	6.70	6.90	22.00	21.00	6.80		22.30	21.00
Rhizobacterin + 0 a	4.30	3.80	21.33	21.30	6.00		25.80	24.00
Rhizobacterin + 1 b	8.90	7.66	22.25	22.47	7.75		24.16	24.00
Rhizobacterin + 2 c	7.00	7.50	21.00	21.16	6.60		23.90	23.30
LSD at 5%	**1.83**	**1.42**	**NS**	**0.51**	**0.41**		**0.93**	**0.53**

0 a = Biofertilizer without any mineral fertilization. 1 b = Biofertilizer + 50% of NPK dose.
2 c = Biofertilizer + recommended dose of NPK. Control = Mineral fertilization only.

Sucrose percentage (%) was reached to 24.70 with the biofertilizer of Microbien only decreased to 20.33% at the treatment Phosphorien + full doses of NPK though that we found the percentage of sucrose increased, while we use biofertilizer only was used, but the yield of roots increased when we used mineral fertilizer of NPK was used.

Cercospora leaf spot disease incidence:

It is observed from Table 3 that the treatment of Microbien + 1 gave significant lower percentage (5.75%) of disease infection than the control, also the disease severity decreased too from 2 to 1. In the same way, phosphorien + 1 induced the same trend of Microbine + 1 on the two cultivars (Oscar and Top) among the two seasons.

Table 3. Effect of the level of bio- and mineral fertilizers on the percentage of infection and disease severity index of sugar beet cercospora leaf spots in two cultivars under field conditions.

Treatments	Oscar variety cultivar				Top variety cultivar			
	1st season		2nd season		1st season		2nd season	
	Perc (%)	DSI (%)	Perc (%)	DSI (%)	Perc (%)	DSI (%)	Perc (%)	DSI (%)
Control	9.00	2.0	6.00	1.0	7.00	1.0	6.00	1.0
Microbien + 0 a	7.05	2.0	6.90	1.0	5.00	1.0	5.50	1.0
Microbien + 1b	5.75	1.0	6.30	1.0	3.75	1.0	4.80	1.0
Microbien + 2 c	8.00	2.0	7.00	2.0	6.70	1.0	7.00	2.0
LSD at 5%	**1.03**	**NS**	**NS**	**NS**	**1.36**	**NS**	**0.69**	**NS**
Control	6.70	1.0	6.20	1.0	7.75	1.0	6.22	1.0
Phosphorien + 0 a	7.20	2.0	5.70	1.0	6.30	1.0	6.00	1.0
Phosphorien + 1 b	6.10	1.0	5.10	1.0	4.20	1.0	5.75	1.0
Phosphorien + 2 c	6.50	1.0	6.60	1.0	8.00	2.0	7.00	2.0
LSD at 5%	**NS**	**NS**	**0.22**	**NS**	**0.36**	**NS**	**0.24**	**NS**
Control	6.80	1.0	6.00	1.0	6.75	1.0	6.00	2.0
Nitrobien + 0 a	9.00	2.0	8.70	2.0	8.00	2.0	7.00	2.0
Nitrobien + 1 b	6.30	1.0	6.30	1.0	7.00	2.0	6.00	1.0
Nitrobien + 2 c	7.10	2.0	7.00	2.0	7.70	2.0	7.33	2.0
LSD at 5%	**0.85**	**NS**	**0.64**	**NS**	**0.93**	**NS**	**0.43**	**NS**
Control	7.75	2.0	6.00	1.0	6.30	1.0	6.40	1.0
Rhizobacterin + 0 a	7.85	2.0	6.80	1.0	6.00	1.0	5.80	1.0
Rhizobacterin + 1 b	6.00	1.0	6.00	1.0	5.90	1.0	5.30	1.0
Rhizobacterin + 2 c	7.80	2.0	7.30	2.0	7.30	2.0	6.10	1.0
LSD at 5%	**0.44**	**NS**	**NS**	**NS**	**0.12**	**NS**	**0.32**	**NS**

0 a = Biofertilizer without any mineral fertilization.
1 b = Biofertilizer + 50% of NPK dose. 2 c = Biofertilizer + recommended dose of NPK.
Control = Mineral fertilization only. Perc. = Percentage of disease infection (%).
DSI = Disease severity index (%)

Data in Table 4 revealed that fertilization by biofertilizers appeared different variation in plant height and the development of roots among both cultivars of sugar beet under field conditions during the two seasons for example: in the first season, the effect of mineral fertilization on plant height of Oscar variety was clear (40.50) when Rhizobacterien + 2 was used, while the plant height in the same variety was reached to 35.0 cm under the effect of fertilization with Microbien + 0. In addition, plant height of the second variety (Top) was reached to 38.10 cm in the first season. The best root length of Oscar variety was obtained under the effect of Rhizobacterin + 0 among the two seasons (Smith, 1985 and Yashimura and Othsuchi, 1992).

Table 4. Effect of the application level of bio- and mineral fertilizers on some yield attributes of two sugar beet cultivars under field conditions during two seasons.

Fertilizer treatments Bio-fert. Mineral fert.	Oscar variety cultivar						Top variety cultivar					
	1st season			2nd season			1st season			2nd season		
	Plant height (cm)	Root length (cm)	Root diameter (cm)	Plant height (cm)	Root length (cm)	Root diameter (cm)	Plant height (cm)	Root length (cm)	Root diameter (cm)	Plant height (cm)	Root length (cm)	Root diameter (cm)
Control	39.90	22.00	9.70	39.00	22.30	8.60	39.60	24.00	10.00	44.00	23.00	12.60
Microbien + 0 a	35.00	22.00	9.00	35.70	22.00	7.00	38.10	23.00	10.20	40.12	23.70	10.70
Microbien + 1 b	37.00	23.00	8.90	36.80	22.00	8.00	40.20	24.00	10.80	39.70	23.80	12.00
Microbien + 2 c	39.00	23.00	10.00	40.00	24.00	8.50	40.00	25.00	11.60	42.16	24.80	13.00
LSD at 5%	**1.03**	**NS**	**1.40**	**2.01**	**1.07**	**0.31**	**0.12**	**0.46**	**NS**	**1.03**	**NS**	**0.28**
Control	39.40	23.20	10.60	40.50	22.15	8.90	43.00	23.60	10.50	38.15	22.00	12.60
Phosphorien + 0 a	33.00	21.00	9.70	33.16	23.00	9.00	38.60	21.60	9.30	40.70	24.20	11.60
Phosphorien + 1 b	36.00	22.00	9.90	35.00	22.00	9.30	40.60	22.00	10.00	40.00	24.60	12.70
Phosphorien + 2 c	39.00	24.20	10.20	40.00	22.00	9.60	43.80	24.60	10.60	39.00	23.00	13.00
LSD at 5%	**2.42**	**0.25**	**NS**	**2.37**	**NS**	**NS**	**0.98**	**0.47**	**NS**	**NS**	**0.62**	**0.53**
Control	41.20	22.00	13.60	39.60	23.20	9.00	40.00	23.50	13.50	42.00	23.60	13.60
Nitrobien + 0 a	35.00	22.00	10.20	35.70	22.00	8.00	36.00	20.60	11.00	39.00	24.00	10.00
Nitrobien + 1 b	36.00	25.00	11.30	35.70	23.00	9.00	38.70	21.60	12.00	40.00	23.60	12.00
Nitrobien + 2 c	40.00	24.00	12.00	39.80	23.00	9.30	40.30	22.60	13.60	41.00	24.20	12.00
LSD at 5%	**2.39**	**0.15**	**0.22**	**1.41**	**NS**	**0.17**	**1.24**	**0.36**	**0.47**	**0.82**	**0.51**	**0.61**
Control	39.70	23.60	12.60	39.60	23.30	8.70	44.60	24.10	9.90	43.16	24.00	12.70
Rhizobacterin + 0 a	35.00	27.00	10.30	36.00	26.00	9.00	40.00	25.60	10.00	40.30	24.00	10.00
Rhizobacterin + 1 b	37.00	23.00	10.20	36.00	25.20	9.90	40.80	23.60	11.60	40.70	24.00	11.00
Rhizobacterin + 2 c	40.50	24.80	11.30	38.00	22.20	8.60	44.80	25.70	10.70	44.90	24.00	12.30
LSD at 5%	**1.37**	**0.29**	**0.44**	**1.23**	**2.54**	**0.36**	**1.14**	**0.32**	**0.35**	**1.19**	**NS**	**0.71**

0 a = Biofertilizer without any mineral fertilizatin. **1 a = Biofertilizer + 50% of NPK dose.**
2 b = Biofertilizer + recommended dose of NPK. **Control = Mineral fertilization only.**

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تأثير بعض المخصبات الحيوية على الإنتاج والإصابة لمحصول بنجر السكر بمرض تبقع الأوراق السركوسبورى

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أقيمت تجربتان حقليتان فى مزرعة محطة البحوث الزراعية بتاج العز – دقهلية فى موسمين متتالين (٢٠٠٣/٢٠٠٤ ، ٢٠٠٤/٢٠٠٥) لدراسة تأثير أربعة أنواع من المخصبات الحيوية فى حالة إضافتها منفردة أو مع الأسمدة الكيماوية العادية الموصى بإستخدامها على إصابة بنجر السكر بمرض تبقع الأوراق السركوسبورى ومحصول الدرنات ونسبة السكروز فى بنجر السكر.

وتمت الدراسة على المخصبات الحيوية الآمنة: الريزوباكترين والنيتروبين والفوسفورين والميكروبين وتم الحصول عليها من صندوق الموازن الزراعية – وزارة الزراعة المصرية.

وقد دلت النتائج على أن المخصبات الحيوية المختبرة بالإضافة إلى توفيرها مايقرب من نصف معدلات التسميد النيتروجينى والفوسفورى والبوتاسى فى صورة أسمدة معدنية وذلك لتثبيت النيتروجين الجوى وإذابة جزء من الفوسفور الأرضى بأنها تعزز من نشاط النباتات مما يؤدى إلى زيادة المحصول ونسبة السكر فى وحدة المساحة (الفدان).

وقد أسفرت النتائج فى هذه الدراسة على أن نسبة حدوث وشدة الإصابة بمرض التبقع السركوسبورى قد قلت بدرجة معنوية خصوصاً فى المعاملات التى تم فيها إضافة نصف معدل السماد المعدنى مع المخصب الحيوى. وهذا يدعو إلى التوصية بأهمية إستخدام مثل هذه المخصبات الحيوية لتوفير العائد المادى لمزارعى بنجر السكر من خلال زيادة الدرنات والحد من معدل الإصابة بمرض تبقع الأوراق السركوسبورى علاوة على تحسين صفات الجودة للدرنات من خلال زيادة النسبة المئوية للسكر فيها.