EFFECT OF MINERAL AND BIO-FERTILIZATION ON PRODUCTIVITY OF SUGAR BEET

By

SAMAH FARAHAT KURANY DESOKY
B. Sc. Agric. Sci. (Agronomy), Fac. Agric., Cairo Univ., 2000

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ABSTRACT

Two field experiments were conducted during 2008/2009 and 2009/2010 seasons at Sakha Agricultural Research Station, Kafer El-Sheikh, Governorate, Egypt, to study the effect of phosphorus treatments: 30 kg P_2O_5 and 300 and 600g/fed of phosphorin, *Bucillus megatherium* (phosphate dissolving bacteria) and nitrogen treatments: 100 kg N/fed, *Azotobacter chroococcum* +60 or 80 kg N/fed, *Azospirillum brasilense* + 60 or 80 kg N/fed, *Azoto.* + *Azosp.* + 60 or 80 kg N/fed on yield and quality traits of sugar beet. *Azotobacter chroococcum* and *Azospirillum brasilense* were used at the rate of 300g/fed. A split plot design with four replications was used with P treatments in the main plots and N treatments in the sub plots. Results revealed that application of 30 kg P_2O_5/fed produced the highest LAI, root diameter, root length, root, top and, plant fresh weight and plant dry weight, as well as yields of roots, sugar and tops and juice quality traits in terms of TSS%, sucrose%, purity%, and recoverable sugar %, followed by phosphorin at the rate of 600 and 300 g/fed in a descending order. On the other hand biophosphatic fertilizer decreased sucrose loss to molasses. Application of 100 kg mineral N/fed produced the highest growth traits followed by *Azoto.* + *Azosp*. with 80 kg N/fed. The highest values of TSS%, sucrose%, and recoverable sugar resulted from either *Azoto*. or *Azosp*.+ 60kgN/fed. Increasing N rates from 60 to 80 kg/fed in combination with N fixing bacteria depressed beet quality and increased impurities in beet roots. The highest root and top yields resulted from 100 kg N/fed. The highest sugar yield/fed (6.54 tons) in the first season resulted from the mixture of N fixing bacteria + 80 kg N/fed, with 600 g phosphorin/fed.

It could be concluded that application of 600 g Phosphorin and *Azoto.* + *Azosp.* with 80 kg N/fed could optimize sugar yield/fed and decrease mineral fertilizer costs and environmental pollution.

Key words: Sugar beet, Biofertilizer, Nitrogen, Phosphorus, Sugar yield, Juice quality.

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CONTENTS

INTRODUCTION

In Egypt, sugar beet has become an important crop of sugar production, since it has a good opportunity in the wide newly reclaimed soils at the northern regions of the country. It could be cultivated without competition the other winter crops, due to its tolerance to salinity and ability to grow under saline soil and water conditions as compared with most of the other traditional winter crops. The total sugar beet cultivated area reached 433.3 thousand feddan (one feddan= 0.42 ha) with an average tonnage of 17.6 tons/fed, i.e., the total sugar beet production is 1.06 million tons in Egypt that contributed to about 53.1% of total sugar production (Annual Report of Sugar Crops Council, 2014).

Nitrogen fertilizer has a pronounced effect on the growth, physiological and chemical characteristics of the yield and quality of sugar beet. So that, nitrogen fertilization should be managed to produce high root tonnage with high sucrose concentration and purity levels.

Recently, under Egyptian conditions a greet attention is being devoted to reduce the high rates of mineral fertilizers, the cost of production and environmental pollution *via* reducing doses of nitrogenous fertilizers by using biofertilized farming system.

The biofertilizers (microbial inoculants) are microbial preparation of rhizospheric microorganisms that possess definite roles, i.e., contribute to the transformation of one or more of the plant nutrient elements and stimulate to a great extent, plant growth by producing growth regulators (**Gomaa, 1995**). In general, the use of biofertilizers improved soil fertility and enriched its biological activity under biofertilized farming.

Therefore, the present work was conducted to study the effect of inoculation of sugar beet seeds with nitrogen fixers, namely, *Azotobacter sp.* and *Azospirillum sp.* and phosphate dissolving bacteria, namely *Bacillus sp.* at different rates with mineral fertilizers on growth, yield and juice quality of sugar beet plants.

REVIEW OF LITERATURE

In order to present the major points concerning the response of sugar beet plants to mineral and bio-fertilization, the available review of literature will be classified into four separate topics:

1. **Phosphorus fertilization effects**
2. **Nitrogen fertilization effects**
3. **Bio-fertilization effects**
4. **Interaction effects**

1. Phosphorus fertilization effects

Abott and Nelson (1983) reported that no significant differences were recorded by phosphorus fertilizer on root and sugar yields and sucrose percentage. However, the best management would be to apply phosphorus fertilizer at about 40 kg P_2O_5/ha.

El-Leboudi *et al.* (1994) reported that phosphorus fertilization rate of 30 kg P_2O_5 kg/fed usually increased the dry matter content of sugar beet plants and their nutrient uptake as well as carbohydrate status, the effect being depended on both source and rate of applied fertilizer with growth stage being also effective.

El-Moursy *et al.* (1998) reported that raising phosphorus rates from 15 to 45 kg P_2O_5/fed significantly increased root length and diameter, root and sugar yields as well as TSS %.

Basha and Ouda, Sohier (2000) reported that increasing phosphorous fertilizer rates from 15.5 to 31.0 kg P_2O_5 /fed increased root and sugar yields/ fed, but the difference was not significant and decreased significantly sucrose percentage.

Sims and Smith (2001) conducted field experiments in Minnesota USA over 2 years in a low phosphorus testing red river valley sandy loam soil to determine the response of early season sugar beet cultivar Beta 1492 root and shoot growth to P fertilizer. Four rates of P fertilizers; 0, 15, 30 and 45 Kg P_2O_5/ha were broadcasted and incorporated prior to planting. Initial plant and soil samples were taken when seedlings showed purple coloration on the petioles and leaf blade (first true leaves) and continued every 2 weeks for a total of five samplings. Compared to the controls (0 kg P_2O_5/ha), P fertilization increased both shoot and root dry matter weights accumulation significantly. The linear relationship between dry matter accumulation and rate of P fertilizer was significant, but generally 15 Kg P_2O_5 ha produced most of the total observed response. The general relationship of root dry matter accumulation to P rates was apparent within 30 days after planting and was maintained during entire sampling period. Final root yield at the end of growing season were significantly less in the control as compared to treatments where P fertilizer was applied. The data indicated that the reduction in root yield caused by P deficiency is initiated very early and is maintained throughout the growing season. Even though the aboveground sugar beet growth appears to return to near normal as the growing season progresses, root yield potential may have been reduced.

Noureldin *et al.* (2002) studied the effect of mineral Phosphorus at the rates of zero, 15 kg P_2O_5/fed and bio fertilization (*Azotobacter chroococcum* and *Bacillus megatherium*) on yield and quality of sugar beet. Data showed that application of 15 kg P_2O_5/fed recorded the highest percentages of sucrose, purity, recoverable sugar and sugar yield.

Abd El-Magid *et al.* (2004) evaluated the relative efficient effect of some organic compounds and three rates of phosphorous; i.e. 15, 30 and 45 kg P_2O_5 /fed applied to the soil of sugar beet. The results should that using natural compounds with 15 kg P_2O_5 /fed significantly increased the quality of sugar beet juice such as extractable sugar and total sugar % as well as impurities; i.e. sodium, potassium and alpha amino- N.

Ismail and Abo El-Ghait (2004) conducted two field experiments to study the effect of three levels of phosphorous (0, 15 and 30 Kg P_2O_5/fed) on yield and quality of sugar beet. Results showed that sucrose percentage was statistically increased by P levels in the second season.

Azzazy (2006) studied the effect of three levels of phosphorous (zero, 15 and 30) kg P_2O_5/fed on yield and quality of sugar beet plants. He found that increasing P level up to 48 kg P_2O_5/fed increased root length, diameter, sucrose and purity percentages as well as root and sugar yields.

Zahoor *et al.* (2006) studied yield and quality of two cultivars; USH-10 and Maribo Extra- poly of sugar beet as influenced by fertilizer application in Peshawar Pakistan. They applied 56.2, 113.7 or 170 Kg/ha of diamonium phosphate. The two cultivars did not significantly vary in root yield, sugar content and sugar yield. The yield however was significantly affected by P rate. The yield was the lowest for the control (without fertilizer) and highest with the first 2 fertilizer