EFFECT OF BIOFERTILIZER ON BARLEY PRODUCTIVITY IN NEW RECLAIMED SANDY AND SILTY CLAY LOAM SOILS.

Abdel-Hamid, M. * and G.A. Mohmed **
* Field Crops Res. Ins., A.R.C., Egypt.
** Soils Water Res. Inst. and Environment, A.R.C., Egypt.

ABSTRACT

Four field experiments were conducted at EL-Minia Governorate in new reclaimed sandy (Salamout District, west bank of the Nile) and Mallawi Agricultural Research Station, during the two successive seasons in 1999/2000 and 2000/2001 to study the effect of biofertilizer on barley productivity under new reclaimed sandy and silty clay loam soils. The studied characters were number of spikes/m², plant height in cm, spike length in cm, number of kernels/spike, weight of kernels/spike in gm, 1000-kernel weight in gm, grain yield in aradab/fed and straw yield in ton/fed.

Results showed that the application of biofertilizer with the recommended doses of nitrogen and phosphate fertilizers under new reclaimed sandy and silty clay loam soils in middle Egypt increased significantly the most characters of barley crop compared with the control without the application of biofertilizer. Also application of biofertilizer significantly increased plant height, number of spikes/m², grain yield (aradab/fed) and straw yield (ton/fed) in both seasons compared with the treatment of control without application of biofertilizer, while spike length and number of kernels/spike were significantly increased in the second season and the first season, respectively. The increases of spikes/m² with application of biofertilizer compared with control in new reclaimed sandy soil were 40.90% in the first season and 25.58% in the second one, while in silty clay soils the percentage of increases reached 15.32% in the first season and 15.30% in the second one. However, the average increase percentages in new reclaimed sandy and silty clay loam soils were 25.52% in the first season and 20.02% in the second one.

The increases in grain yield due to using biofertilizer compared with control in sandy soil were 47.36% in the first season and 26.49% in the second one, but in silty clay loam the increase percentages were 19.50% in the first season and 20.18% in the second one while the mean percentages in sandy and silty clay were 33.45% and 23.39% in the first and the second seasons respectively. The increases of straw yield as a result of using biofertilizer in sandy soil were 61.79% in the first season and 33.33% in the second one while in silty clay loam increase the percentages were 8.58% in the first season and 16.79% in the second one. However, the average increase percentages in sandy and silty clay loam were 28.25% in the first season and 23.69% in the second one. The percentages of increases due to using biofertilizer with nitrogen and phosphate recommended on number of spikes/m², grain and straw yields obtained more amount in new reclaimed sandy than the silty clay.

Thus, it can be concluded that application of biofertilizer with the recommended doses of nitrogen and phosphate fertilizers gave the maximum productivity of barley crop in new sandy more amount than silty clay loam under EL-Minia governorate conditions.
INTRODUCTION

Barley (Hordeum vulgare L.) is considered one of the most important cereal crops in Egypt to be used for many purposes such as bread making or by mixing with wheat flour in some places, human food and beverages, animal feeding and many other uses. In Egypt, most of barley production areas are located in marginal areas where adverse conditions exist such as in rainfed areas, poor soils and saline soils and new reclaimed sandy soil. These new reclaimed areas have characteristics of containing small proportion of clay and organic matter as well as deficiency in macro and micro elements. In addition, due to the structureless of sandy soil, drought and loss of both irrigation water and nutrients are expected problems.

Inoculating seeds with biofertilizers are easier and less costs than the use of fertilizers, and in the same time increased yield crop and decreased pollutant environment, especially under rainfed condition. Intensive research on a symbiotic nitrogen fixation has concentrated on the positive role of the plant-microbe relationship in an effort to increase plant growth and grain yield. Several reports have been published by many researchers (Hassan et al., 1985; Nur et al., 1980; Baltesperger et al., 1978; Hassouna, 1973; Madkour, 1972) and indicated that the inoculation of seeds or seedling of various C3 and C4 plants with associative N2-fixing bacteria such as Azotobacter spp and Azospirillum brasilens led to changes in plant growth and sometimes to yield increases. Investigations to the effect of biofertilizer has been heavily investigated by many researchers (Said, 1998; Mitkees et al., 1996; Belimov et al., 1995; Abou El Naga, 1993; Zaid, 1992; Eid, 1982; Pohlman and Mccoll, 1982; Oken, 1982). They reported that the biofertilization is very important for increasing grain yield of barley in reclaimed sandy soils. However, Hassanein, and Hassouna; 1997; El-Kawas; 1990; Fayez, 1990, indicated that biofertilizers increase the yield by increasing number of spikes/m² and number of grains per spike. The objective of this study is the study of the effect of biofertilizer on productivity of barley under in new reclaimed sandy and silty clay loam.

MATERIALS AND METHODS

Four field experiments were conducted in new reclaimed sandy soil of Minia governorate (samarlout District, west bank of the Nile) and silty clay loam soil at Mallawy Agricultural Research station during the two successive seasons (1999/2000 and 2000/2001) to study the effect of biofertilizer on barley productivity under different lands. Physical and chemical analyses of two locations are given in Table 1. The experimental treatments were:

C1 - The first treatment in the new reclaimed sandy and silty clay loam (without application biofertilizer) application the recommended dosed of nitrogen and phosphate fertilizers.
C2 - The Second treatment in the new reclaimed sandy and silty clay soil is application biofertilizer with nitrogen and phosphate fertilizers recommended in new reclaimed sandy and silty clay.

Nitrogen fertilizer was applied as ammonium nitrate (20.6 %) at the rate of 60 kg N/fed in new reclaimed lands in five equal doses every dose after ten days from irrigation in silty clay loam soil. 45 kg N/fed in two equal doses was done, one before planting irrigation and the other just before the second irrigation. However phosphate fertilizers were added at a rate of 30 kg P<sub>2</sub>O<sub>5</sub>/fed in the form of calcium superphosphate (15.5% P<sub>2</sub>O<sub>5</sub>)

At new reclaimed sandy and 15 kg P<sub>2</sub>O<sub>5</sub>/fed at silty clay before planting. The experimental design was randomized complete blocks with four replicates, plot area was 12.6 m<sup>2</sup>, with 30 cm between rows and 3.5 m long. Seeding rate was 50 kg/fed of barley cultivar (Giza 124) which sown on the 20th of November in both seasons. The biofertilizer were prepared by adding equal amounts of microorganisms. Microbin was commercial multi-strains produced by the general organization for Agricultural Equalization fund, Ministry of agriculture to a carrier material. Arabic gum was melted in suitable amounts of warm water and mixed with each biofertilizer. Barley seeds were mixed carefully to this mixture and spread over a plastic sheet and kept in shade for a short time before seeding. The experiments were harvested on 15 of April in new reclaimed sandy soil and 1 May in silty clay in the two growing seasons. Farmyard manure was applied to this sandy soil year after year. At harvest time, the following characters were studies:

1- Plant height (cm)
2- Number of spikes/m<sup>2</sup>
3- Spike length (cm)
4- Number of kernels/spike (gm)
5- Weight of kernels/spike (gm)
6- 1000-kernels weight (gm)
7- Grain yield (Ardab/fed)
8- Straw yield (ton/fed)

Experimental data were subjected to statistical analysis using analysis of variance and the mean values were compared using L.S.D test according to steel and Torrie (1980).

Table 1: Mechanical and chemical analysis of the experimental site in new reclaimed sandy at Samalout and silty clay loam soil at Mallawi in 1999/2000 and 2000/2001 seasons.

<table>
<thead>
<tr>
<th>Mechanical properties</th>
<th>New reclaimed sandy</th>
<th>Silty clay loam</th>
<th>Chemical properties</th>
<th>New reclaimed sandy</th>
<th>Silty clay loam</th>
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<tr>
<td>Sand %</td>
<td>86.29</td>
<td>7.95</td>
<td>PH</td>
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<td>8.15</td>
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<tr>
<td>Silty %</td>
<td>8.98</td>
<td>57.70</td>
<td>Available nitrogen (ppm)</td>
<td>0.017</td>
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<tr>
<td>Clay %</td>
<td>4.73</td>
<td>34.31</td>
<td>Available phosphorus (ppm)</td>
<td>7.25</td>
<td>9.00</td>
</tr>
<tr>
<td>Texture grade</td>
<td>Loamy sand</td>
<td>Silty clay</td>
<td>Available potassium meg/100 g soil</td>
<td>0.80</td>
<td>0.95</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

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Effect of Biofertilizer in new reclaimed sandy soils

1- Yield attributes:

The data of Table 2 indicate that biofertilizer treatments had positive significant effects on plant height, number of spikes/m² in both seasons, but spike length and number of kernels/spike are significant in the second and the first season respectively. While the weight of kernels/spike and 1000-kernels weight are insignificant in both seasons. The increase in number of spikes/M² with using biofertilizer was 40.90% in the first season and 25.58% in the second one compared without using biofertilizer. Similar results were obtained by Hassanein and Hassouna (1997) who observed that biofertilizers caused an increase in number of spikes/m². Belimov et al. (1995) stated that combination of inoculation with biofertilizers and fertilization treatment were more growth promoting, also, yield components responded positively to biofertilizer; EL-kawas (1990) concluded that bacteria of biofertilizers caused increases in number of spikes/m² and number of grains per spike.

Okon (1982) reported that biofertilizers exhibited about 30-50% greater uptake nitrate, phosphate and potassium compared with control without application of biofertilizers and he reported that Biofertilizers enhancing mineral absorption of the cell which is reflected on the plant growth.

2- Straw and grain yields:

Data of Table 2 show that biofertilizer treatments had significant effects on grain and straw yields, in both seasons. Grain and straw yields of barley significantly increased with using biofertilizer compared without using biofertilizer.

The increases in grain yield with using biofertilizer were 47.36% in the first season and 26.49% in the second one compared without using biofertilizer, while the increases in straw yield with using biofertilizer were 61.79% in the first season and 33.33% in the second one. The results are similar with those obtained by Said (1998) concluded that response of barley to biofertilizer for increasing the yield in reclaimed lands; Hassanein and Hassouna (1997) reported that using biofertilizer for barley caused an increase in grain yield by increasing number of spikes and number of grains/spike; Madkour et al. (1997) observed that inoculation with N₂-fixing bacteria increased yield for barley; Belimov et al. (1995) who found that the biofertilization is very important for increasing grain yield.

Zaid (1992) and Fayez (1989) reported that biofertilizers increased the yield by increasing number of spikes/m²; Okon (1982) found that biofertilizer increased yield of barley.

In can be concluded from these results that biofertilizer caused increases in grain and straw yields by increasing the number of spikes/m² in both seasons because the nitrogen fixing bacteria of biofertilizer may increase the synthesis of endogenous phytohormones i.e. Gibberlic acid (GAA) and cytokinious (cks) which plays an important of abig active root system. Also the temperature during cultural was very suitable to bacteria and irrigation every ten day helps to in actival the bacteria.
Effect of biofertilizer in silty clay loam soil :

1- Yield attributes :
Yield attributes of barley as affected by biofertilizer treatments are shown in the Table 3 Values show that the biofertilizer treatments gave significant increases in most characters. However, plant height and number of spikes / m² were significant in both seasons, while spike length was significant in the second season and number of kernels was significant in the first season. On the other hands weight of kernels / spike and 1000 - kernels weight were insignificant in both seasons. The taller plants, spike length, the highest number of spikes / m² and number of kernels / spike were produced from using biofertilizer with the addition of the recommended doses Nitrogen and phosphate fertilizers.

The increase in number of spikes / m² with (C₂) using biofertilizer with Nitrogen and phosphate fertilizers were 15.32 % in the first season and 15.32 % in the second one compared (C₁) without using biofertilizer. The results were similar with those obtained by Hassanein and Hassouna (1997); Belimov et al (1995); EL-kawas (1990) okon (1982). They concluded that combination of inoculation with biofertilizer and fertilization treatments were more growth promoting.

2- Straw and grain yields :
Data of Table 3 show that (C₂) using biofertilizer with nitrogen and phosphate fertilizers had a significant effect on grain and straw yields in both seasons.

The increases in grain yield as a result of using biofertilizer were 19.50 % and 20.18 % in the first and the second one, respectively. However the increases in straw yield with using biofertilizer were 8.58 % in the first season and 16.79 % in the second one. Similar results were obtained by Said (1998) concluded that barley responded to biofertilizer leading to increasing the yield in reclaimed lands; Hassanein and Hassouna (1997) observed that biofertilizers caused an increased in number of spikes / m²; Madkour etal (1997); Zaid (1992); and fayez (1989) they reported that biofertilizers increase the yield by increasing number of spikes / m².

Effect of biofertilizer under new reclaimed sandy and silty clay loam soils :
1- Yield attributes :
The data of Table 4 show that the combined effects of biofertilizer treatments under new reclaimed sandy and silty clay loam soils were significant on plant height and number of spikes / m² in two growing seasons. While spike length was significant in the second season and number of kernels/spike was significant in the first season - However weight of kernels / spike and 1000- kernels weight were insignificant in both seasons - under new reclaimed sandy and silty clay loam soils.
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The taller plants and length spike and the highest number of spikes / m² and number of kernels / spike were produced from using biofertilizer compared the control treatment which without using biofertilizer. The increases of spikes/m² with using biofertilizer were 25.52 % in the first season and 20.02 % in the second one. The results were similar with those reported by Hassanein and Hassouna (1997); Belimov et al (1995); El - kawas (1990); okon (1982), who observed that biofertilizers caused increases in number of spikes/m² and number of grains/spike.

2- Straw and grain yields :

Statistical analysis of the combined effects of the treatments in new reclaimed sandy and silty clay loam soils in Table 4 indicate that the straw and grain yields in both seasons were significantly increased. The increases in grain yield due to using biofertilizer compared with the control were 33.45 % and 23.39 % in the first season and the second one, respectively. However the increases in straw yield were 28.25 % in the first season and 23.69 % in the second one. Similar results were obtained by said (1998); EL -kawas (1990) concluded that bacteria of biofertilizers caused increases in number of spikes / m² and number of grains per spike; okon (1982) reported that biofertilizers exhibited about 30- 50% greater uptake nitrate, phosphate and potassium compared with control. Belimov et al. (1985) stated that combination of inoculation with biofertilizer and fertilization treatment were mor growth promoting also yield components responded positively to biofertilizer. It can be concluded from the data of new reclaimed sandy and silty clay loam soil that using biofertilizer with adding the recommended doses of Nitrogen fertilizers this regions in Middle Egypt comparing control increased the grain and straw yield by increasing the number of spikes / m² and yield components.

REFERENCES


تأثير السماد الحيوى على انتاجية محصول الشعر في الأراضي الرملية حديثة

الاستصلاح والسلبية الطينية.

محفوظ عبد الحميد * - جمال عبد الله **

* معهد بحث المحاصيل الحقلية - مركز الجوهر الزراعي - الجيزة
** معهد بحوث الأراضي والموارد البيئية - مركز الجوهر الزراعي - الجيزة

تم إقتراح تجربة حقلية في الأراضي الرملية بعد استسلام مساحة مساحات الأراضي
السلبية الطينية بمحتوى نباتات مياه خليج مساحات النمو 1999 / 2000 / 2001
لدراسة تأثير السماد الحيوى على انتاجية الشعر في الأراضي الجديد المتصلحة والسلبية الطينية، وتم
دراسة عدد السبايل بالمتجر المرعى - طول النبات بالسما - طول النبات بالسما - عدد حبوب السما - وزن
حبوب السما بالجرام - وزن الألف حبوب بالجرام - محصول الحبوب بالأَرْبَد للفدان - محصول القمح بالطن
للدان.

وأوضح التأثير ما يلي:

1- اضافة السماد الحيوى مع السماد النيتروجيني والفوسفاتي الموصى به في الأراضي الجديدة المستصلحة
والسلبية الطينية في مصر الوسطى أدأ إلى زيادة معنوية في معظم الصفات التي تم دراستها لمحصول
الشعر بالمقارنة بعد إضافة السماد الحيوى مع السماد النيتروجيني والفوسفاتي الموصى به.

2- أثر اضافة السماد الحيوى زيادة معنوية على طول النباتات عند السبايل بالمتجر المرعى ومحصول الحبوب
بالأَرْبَد لكل فدان محصول القمح بالطن لكل فدان خلال مساحات النمو بالمقارنة بعد إضافة السماد
الحيوي في الأراضي الجديدة المستصلحة والسلبية الطينية.

3- أثر اضافة السماد الحيوى تأثير معنوي على طول النباتات في الموسم الثاني وعدد حبوب السما في الموسم
الأول في الأراضي الجديدة المستصلحة والسلبية الطينية.

4- زادت عدد السبايل بالمتجر المرعى مع اضافة السماد الحيوى بالمقارنة بعد إضافة السماد الحيوى في
الأراضي الجديدة المستصلحة بنسبة 40.9% في الموسم الأول و58.5% في الموسم الثاني بينما نسبة
الزيادة في الأراضي المستصلحة العينية 15.32% في الموسم الأول و 15.30% في الموسم الثاني، اما
نسبة الزيادة في الأراضي الجديدة والسلبية الطينية 25.52% في الموسم الأول و 20.02% في
الموسم الثاني.

5- زاد محصول الحبوب إضافة السماد الحيوى بالمقارنة بعد إضافة السماد الحيوى في الأراضي الجديدة
المستصلحة بنسبة 47.36% في الموسم الأول و26.49% في الموسم الثاني، اما نسبة الزيادة في
الأراضي المساحية الطينية 19.5% في الموسم الأول و 20.18% في الموسم الثاني، اما نسبة الزيادة في
الأراضي الجديدة والسلبية الطينية 33.45% في الموسم الأول و 23.39% في الموسم الثاني.

6- زاد محصول القمح بضافة السماد الحيوى بالمقارنة بعد إضافة السماد الحيوى في الأراضي الجديدة
المستصلحة بنسبة 61.79% في الموسم الأول و 33.33% في الموسم الثاني، اما نسبة الزيادة في
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الأراضي الجديدة المستصلحة والسلبية الطينية 28.25% في الموسم الأول و 23.69% في
الموسم الثاني.

7- كانت النسب المئوية لزيادة في ( عدد السبايل بالمتجر المرعى - محصول الحبوب - محصول القمح )
التي تم إنتاجها إضافة السماد الحيوى مع السماد النيتروجيني والفوسفاتي الموصى به في الأراضي الرملية أكبر
من النسب المئوية لزيادة في الأراضي السميكة الطينية.

8- يمكن القول بأن اضافة السماد الحيوى مع السماد النيتروجيني والفوسفاتي الموصى به أعطيت انتاجات
محصول الشعر في الأراضي الرملية الجديدة المستصلحة أكثر من الأراضي السميكة الطينية تحت
ظروف محافظة المناخ

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<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant Height (cm)</th>
<th>Number of spikes / m²</th>
<th>Spike Length (cm)</th>
<th>Number of kernels /spike</th>
<th>Weight of kernels /spike (gm)</th>
<th>1000-kernels weight (gm)</th>
<th>Grain yield ardadab /fed</th>
<th>Straw yield Ton / fed</th>
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</thead>
<tbody>
<tr>
<td>C1-control without using biofertilizer with the recommended doses of nitrogen and phosphate fertilizers</td>
<td>89.93</td>
<td>264</td>
<td>7.01</td>
<td>47.06</td>
<td>48.82</td>
<td>2.40</td>
<td>14.80</td>
<td>3.35</td>
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<td>C2-using biofertilizer with recommended doses of nitrogen and phosphate fertilizers</td>
<td>96.24</td>
<td>372</td>
<td>7.43</td>
<td>49.69</td>
<td>50.33</td>
<td>2.60</td>
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<td>L.S.D 5%</td>
<td>4.36</td>
<td>6.11</td>
<td>68.04</td>
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<td>N.S</td>
<td>3.05</td>
<td>47.36</td>
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<td>% increasing by using biofertilizer comparing without using biofertilizer</td>
<td>40.90%</td>
<td>25.58%</td>
<td></td>
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<td>61.79%</td>
<td>33.33%</td>
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<th>Straw yield Ton / fed</th>
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<td>C1-control without using biofertilizer with the recommended doses of nitrogen and phosphate fertilizers</td>
<td>96.4</td>
<td>398</td>
<td>6.43</td>
<td>53.60</td>
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<td>C2-using biofertilizer with recommended doses of nitrogen and phosphate fertilizers</td>
<td>109.4</td>
<td>459</td>
<td>7.03</td>
<td>55.93</td>
<td>57.86</td>
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<td>20.40</td>
<td>6.20</td>
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<td>L.S.D 5%</td>
<td>10.87</td>
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<td>38.64</td>
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<td>0.71</td>
<td>N.S</td>
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<td>% increasing by using biofertilizer comparing without using biofertilizer</td>
<td>19.32%</td>
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<td></td>
<td></td>
<td>19.50%</td>
<td>8.58%</td>
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<th>Plant height (cm)</th>
<th>Number of spikes / m²</th>
<th>Spike length (cm)</th>
<th>Number of kernels /spike</th>
<th>Weight of kernels /spike (gm)</th>
<th>1000-kernels weight(gm)</th>
<th>Grain yield ardab/fed</th>
<th>Straw yield ton / fed</th>
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<tbody>
<tr>
<td>C₁ - control without using biofertilizer with the recommended doses of nitrogen and phosphate fertilizer</td>
<td>93.16</td>
<td>88.55</td>
<td>331</td>
<td>374.5</td>
<td>6.76</td>
<td>6.76</td>
<td>50.33</td>
<td>52.56</td>
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<tr>
<td>C₂ - using biofertilizer with recommended doses of nitrogen and phosphate fertilizers</td>
<td>102.82</td>
<td>104.30</td>
<td>415.5</td>
<td>449.5</td>
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<td>16.54</td>
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<td>% increasing by using biofertilizer comparing without using biofertilizer</td>
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<td>%</td>
<td>%</td>
<td>33.45</td>
<td>23.39</td>
<td>28.25</td>
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