EFFECT OF USING BIOFERTILIZERS ON PRODUCTIVITY OF BREAD WHEAT *(Triticum aestivum, L.)*

By

YOUSSERI AHMED MAHMOUD

B. Sc. Agriculture (Agronomy), Zagazig University, 1994

Diploma in Environmental Science, 2004

A Thesis Submitted in Partial Fulfillment

of

The Requirement for the Master Degree

In

Environmental Science

Department of Agriculture Science

Institute of Environmental Studies and Research,

Ain Shams University

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APPROVAL SHEET

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This Thesis Towards a Master Degree in Environmental Science

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تأثير استخدام التسميد الحيوي
على إنتاجية قمح الخبز

رسالة مقدمة من الطالب

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صفحة الموافقة على الرسالة

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1. INTRODUCTION

Bread wheat *(Triticum aestivum, L.)* is one of great importance as grain crop in Egypt and all over the world. Egypt produces about 8 million tons in winter season 2005/2006 of bread wheat and its need about 12 million tons. So, there is a shortage in our need of bread wheat. Therefore, increasing wheat productivity and the cultivated area are highly recommended. Recently, biofertilizers are used in order to compensate a part of the mineral fertilizer doses taking into considerations, the complementary or synergistic effects of such combination between bio and mineral fertilization. This could be of economic value from the applied point of view for minimizing the used doses of the mineral fertilization and consequently reduce agricultural costs as well as soil and water pollution.

In the last two decades, the biofertilizers are frequently used in modern agriculture through the promotive effect of special groups of microorganisms such as *Azospirillum*, *Azotobacter* and *Bacillus*.

Growth characters at various stages, physiological characters, yield and yield attributes and grain yield and its component are of great interest in increasing grain yield of wheat through various groups of characters that contribute to grain yield under various mineral fertilizers (nitrogen, phosphorus and potassium) in various levels of each fertilizer as combined with biofertilizers, Azotin, phosphatin and potassiomag. So, it is great attention to study the response and the effect of mineral and biofertilizers on such characters and their contribution to grain yield/plant (productivity) and grain yield ardb/fed.

Watson (1952), concluded that Nat Assimilation rate (NAR) varies among and within species of crop plant on one hand, and on the other hand, it was influenced by nutrients supply, water availability and

seasonal climatic conditions**. Watson *et al.*, (1966),** found that in periods of 50 days from sowing for wheat and 90 days for sugarbeet, net assimilation rate decreased by about 50%. Photosynthesis (P) was always at least (5) times as greatest as (R) (Respiration). Most of the decrease in net assimilation rate, with age was caused by decreased P, while the change in R with age was relatively small 30 days after sowing. The net assimilation rate of sugarbeet was about twice than that of wheat, because of the difference in (P) between species. **Alkaddoussi (1977)** stated that relative growth rate RGR values decreased as plant age increased from 50-60-80 days after sowing in wheat genotypes. Values of net assimilation rate (NAR) were decreased in 2nd period 65-80 days as compared with the 1st one 50-65 days.

Many investigators studied various characters that contributed under various level of mineral fertilization combined with different biofertilizers i. e., Azotin, Phostphatin and Potassiomag and also, studied correlation and path coefficient using various fertilizers; **(Yassen *et al.*, 1986, Selim, 1987,Yu *et al.*, 1992, Ahmed 1995, Sabry *et al.*, 1998, Mohiuddin *et al.*, 2000, El-Habbasha 2001, Noureldin Nemat *et al.*, 2003, Al-Moshileh 2004** and **Abd El-Malk *et al.*, 2005).** Grain yield, also, was affected by two types of fertilizer as reported by **(Abd El-Hady *et al.*, 2006** and **Girgis, 2006)**.

The main targets of this research work are :

1. Studying the effect of the combination of mineral fertilizers for three levels of each fertilizers i.e., 90, 75 and 50% of the recommended dose, with three biofertilizers on growth characters, physiological characters, yield attributes and grain yield and yield components for three wheat cultivar, Sakha 93, Gemmeiza 9 and Giza 168 during two

seasons, 2004/2005 and 2005/2006 winters growing season at Sharkia governorate.

2. Estimation the contribution of yield components in grain yield for each cultivar under various bio and mineral fertilizers
3. Determining the effectiveness of Co_2 evolution as measurement for the activity of soil microorganisms.

2. REVIEW OF LITERATURE

2.1. Effect of biofertilizers and various levels of NPK on growth of wheat plants .

Reynder and Vlassak (1982) used ten CV. of winter wheat and 4 of spring wheat in field experiments during 1979 and 1980. N was applied at 10, 80 or 160 kg/ha and *A. brasilense* was applied by over head spraying. The results showed that tillering was increased in both winter and spring wheat.

Selim (1987), reported that dry weight of wheat plants significantly increased in inoculated treatments with *Azotobacter* as compared with uninocalated ones.

Bashan *et al.*, (1989) found that *Azospirillum* and *Pseudomonas* improved wheat growth through the significant increases in dry matter accumulate in both roots and shoots of treated plants.

The effect of inoculation with symobitic (cow pea, *rhizobia* and / or Rh. *Leguminosarum* biovar vicease) and / or asymbiotic N_2 fixers (*Azotobacter chroococcum* and *Azospirillum fipoferum*) on N_2 – ase activity in rhiozosphere was studied on growth of wheat cultivar Sakha 60. The obtained results showed that wheat inoculation with symbiotic (*cowpea rhizobia* and or *Rh. Leguminosarum biovar viceae*) and associative N_2-fixers (*Azotobacter chroococcum* and *Azospirillum lipoterum*) gave better growth of shoot dry weight and tillers/plant than inoculation with associative N_2 fixers only **(El-Demerdash *et al*., 1992).**

Plant inoculation with endomy corrhiza separately or in a combination with N_2 fixing bacteria improved plant growth to

a highly significant extend, especially when supplementary rock phosphate as a P fertilizer **(Yassen, 1993).**

The effects of commercial inoculant of cyanobacteria on wheat CV. Sakha 69 grown in pots using sterilized or non-sterilized clay or sand soils. Treatments were control (water), live cyanobacteria, killed cyanobacteria, live cyanobacteria + K, P and S (at rates equivalent to 100, 50 and 50 kg/ha, respectively), killed cyanobacteria plus K, and S and K, P and S only live inoculant and live inoculant plus K, P an S significantly increased dry weight, total nitrogen and pigment contents (chloroply a and b and carotinoides) of wheat plants compared with control and other treatments. The increase in growth parameter was attributed to the substantial increase of N_2 fixing in soil due to nitrogenase activity of inoculatd cyanobacteria . It was concluded that the primitive effect of cyanobacterial inoculated, especially on growth, holds promise for use of such inoculants to enhance the nitrogen status of irrigated field crops. **(Abd-Alla *et al.*, 1994)** .

Zaghloul *et al.*, (1996a) stated that it is clearly observed from data that inculation of wheat grains with *Azospirillum brasilense* in the presence of a half dose of inorganic N-fertilizer significantly increased all studied characters i.e., plant height, fresh weight of shoot and roots as well as total dry weight of shoot and roots.

Kabli *et al.*, (1997) investigated the efficiency of cyanbaceteria from soil of wester region in the kingdom of Saudi Arabia as biofertilizer for wheat. The results showed that when testing the effeiciency of these atemospheric nitrogen fixers to meet the nitrogen requirements of wheat, in the absence of nitrogen in the growth media, N. commune and A. cylindrica could supply wheat with atomosphenic nitrogen to maintain its vegetative growth.

Adam (1999), investigated the promotive effect of the cyanobacteria *Nostoc muscorum* on the growth of some crop plants including wheat. He found the effect of cyanobacteria as biofertilizer on seed germination and related process of wheat. Germination of seeds of the tested crop plants either in line inculum, algal filitrate (exogenous) or boild algal extract (endogenous) of the nitrogen fixing cyanobacteria *Nostoc moscorum* was significantly increased, as were growth parameters and content of nitrogenous components as compared with control.

Shams *et al.*, (1999) studied the response of some wheat varieties to biofertilizers, mineral nitrogen and copper fertilization. They used three wheat cultivars i. e., Sids1 and two really released hybrids H_1 and H_2 and the bacteria inoculation (without, *Azospririlum* spp and foliar application of copper. The results indicated clearly that there were evident significant differences between (H) 1 and both Sids 1 and H_2. The data revealed that the most earliest heading date was associated with H_1. Sids 1 ranked the second place, whereas (H_2) was the latest.

Wheat varieties showed significant variation in plant height in both season. Hybrid 1 was the tallest with significant differences when compared with Sid 1 and (H_2).

A field experiment was conducted during the winter seasons of 1997/1998 and 1998/1999, in west Bengal, India, to determine the effect of integrated use of biofertilizers (phosphert, Azofert, Bioplin and vitormone) with different NPK fertilizer rates (low, 70 – 33 – 35 kg N – P_2O5 – K_2O/ha, and high, 100 – 50 – 50 kg N – P_2O5 – K_2O / ha) on wheat CV. Sonalika growth. Combination of Azofert, Phosphert or Bioplin with vitromone and protein hydrolysate at low NPK fertilizer levels significantly increased plant height, tiller number and total dry matter production. **(Mohiuddin *et al.*, 2000)**

Mukherjee and Rai (2000) stated that interaction of biofertilizer and phophorus nutrition significantly influnced the dry-matter production of wheat. The highest dry-matter production was noticed in the xase of *Psedomones striata*, followed by *cdomus fasciculatum* at both levels of phosphorus and in both crops. The possible reason for such increase in dry matter in wheat could be correlated with the increase number of tillers. An increase in tiller production could be attributed to the effect of increased root biomass through cell divison and multiplication which was influenced by solubilization of native as well as added phosphorus by *Pseudomonas striata* and mobilization of native soil phosphorus .

Sushila and Gajendra (2000) carried out an experiment during the winter seasons (rabi) 1994/1995 and 1995/1996 at New Delhi, on integrated nitrogen management in wheat (*Triticum aestivum L. emend Flori Paol*). Application of N up to 90 kg/ha, also, boosted the growth of wheat. An application of biofertlizers significantly increased the plant height in 1995/1996 and tillers/m length in both the years. Among biofertilizers *azospirillum* proved more effective as number of tillers in 1994/1995 were not increased due to *azotobacter*.

Das *et al.*, (2001) searched the effect of different yield attributes on the productivity, of wheat as influenced by growth regulators and biofertilizers. The treatments of fertilizers were, i.e., Azofert, phosphert, bioplin and vitrormne and combined with one of 2 fertilizer treatments, (NPK levels of 70 – 35– 35 or 100 – 50 – 50 kg/ha). During winter seasons of 1997/1998 and 1998/1999 in sriniketan, west Bengal, India. Out of 8 characters was number of tillers/plant. The results showed that the application of biofertilizers with the chemical fertilizer as an integrated nutrient management system increased number of tillers/plant. Also, number of tillers/plant correlated significantly with grain yield.

Ghallab and Salem (2001) investigated the effect of some biofertilizers, Cerealin (*Azospirillum spp.*) and Nemales (serrate spp.), on growth of wheat CV. Giza 167 under different levels of NPK (¼ , ½ and full recommended NPK rate) was determined in a field experiment in Egypt during two winter successive seasons i.e., 1998/1999 and 1999/2000. Data obtained clearly revealed that plants treated with the combination of the recommended dose of NPK fertilizer and both fertilizers recorded a considerable increments regards to growth characters i.e., plant height, number of tillers/plant and dry weight of shoot/plant .

Saleh *et al.*, (2001) found that wheat plants fertilized with the recommended dose of nitrogen (100kg N/fed) and those which received 50% of the recommended nitrogen dose combined with Azospirillum inoculation recorded highly significant increases in dry weight and nitrogen content of shoots over the control plants.

Khalil *et al.*, (2004) conducted a seventy days pot experiments to study the effect of farmyard manure (FYM) and chicken manure (CM) individually and / or together combined with or without a biofertilizer (BF) of *Azospirillum brasilense* or *Bacillus megatherium var. phosphaticum* on wheat growth grown on sandy, calcareous and clay soil. The results revealed that all manure treatments whether combined with or without biofertilizers led to a significant increase in wheat dry weight. Weights of plants grown on a clay soil were higher than that grown on the other soils. Although N, P and K contents of wheat were higher in the clay soil, yet the response to organic manuring was more obvious in sandy and calcareous soils.

2.2. Physiological characters as influenced by biofertilizers and various levels of NPK .

Yassen *et al.*, (1986) studied the responses of grain yield of wheat to dry weight of plants/gm (DW) and net assimilation rate mg/cm^2/ 2weeks (NAR) at different periods of growth (35, 50, 65 and 80 days after sowing) through correlation and path coefficient analysis in 1982/1983 and 1983/1984 seasons. The results showed that path coefficient analysis indicated that the highest average values of both seasons for the direct, indirect and total effect of variation on grain yield were at 65 days for DW, from 50 to 65 for (NAR).

Ahmed (1995) pointed out that specific leaf weight (SLW) showed significant decrease in relation to increase nitrogen rates at 96 and 130 days after sowing. As for biofertilizers the highest specific leaf weight (SLW) was recorded under the application of mixture of *Azotobacter* + *Azospirillum* as well as Azoto at 96 and 130 days after sowing, respectively. Also, the results showed that specific leaf weight of flag leaf was larger under 0.0kg N/fed. *Azospirillum* at 96 and 30 days after sowing.

Physiological response for wheat under various levels of organic and mineral fertilization and their effect on yield and quality characters for grain in south Sinai were studied by **El- Afandey (1995).** The results showed that Sakha8 was superior than Sakha92 in flag leaf area and specific leaf weight. Flag leaf area and specific leaf weight significantly increased by increasing the N-application up to 160 kg/fed. Organic matter application increased flag leaf area and specific leaf weight in both Sakha8 and Sakha92 wheat cultivars at tillering and heading stages.

Sabry *et al.*, (1999) studied the response of six newly released long spike wheat genotypes in comparison with the commercial cultivar Giza