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INFLUENCE OF ORGANIC, N-MINERAL AND BIOFERTILIZATION ON GROWTH, YIELD AND CHEMICAL COMPOSITION OF WHEAT PLANTS

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ABSTRACT: ***Two field experiments were carried out at Abou-El-Ghr village, Kafre El-Ziat district, El-Gharbia Governorate, during the two growing successive seasons of 2007/2008 and 2008/2009 to investigate the influence of three organic manure rate (0, 10 and 20m^3 FYM/fed.), three inorganic N-fertilizer levels (45, 60, and 75 kg N/fed) and two biofertilization treatments (with inoculation and with N-fixing bacteria) and accordingly their interaction on wheat growth, yield and its attributes as well as N, P and K uptakes in wheat grain and straw, grain protein content and total carbohydrate. A split-split plot deign with three replicates was used. The obtained results could be summarized as follow:-***

1- ***Raising mineral nitrogen fertilizer level from 45 to 60 and 75 kg N/fed resulted in significant increases in plant height, spike length, 1000-grain weight, grain and straw yields/fed and protein content of grain and straw as well as N, P and K uptakes in grain and straw.***
2- ***Grain and straw as well yields/fed as their N, P and K contents, as well as protein and total carbohydrate contents in grains were significantly augmented by increasing the rate of FYM.***
3- ***Grain inoculation with the mixture of (Azospirillum + Azotobacter) resulted in significant increases in plant height, spike length, 1000-grain weight, grain and straw yield., protein content of grain, as well as N, P and K uptakes of both grain and straw as compared with the uninoculated treatment.***
4- ***Although grain weight/spike, 1000-grain weight and wheat yield/fed. were significantly increased by increasing N rate under FYM treatments, application of 60 kg N/fed. combined with 20 m^3/fed. FYM showed no significant differences in most cases when compared with 75 kg N/fed. only (without FYM) showing that 15 kg N/fed could be saved avoiding environmental pollution due to excessive N fertilization. The same trend could be noticed with nutrient uptake in wheat grain and straw.***

Moreover, grain yield only was significantly affected by the interaction effects between FYM and inoculation or N rate and inoculation. The interaction effects among the three tested factors were significant for N % and uptake as well as protein in grains.

Key words: ***N, P and K contents, FYM, Nitrogen fertilization, Biofertilization, Wheat.***

INTRODUCTION

Wheat is one of the main cereal crops in Egypt. The policy of the country aims to improve wheat production and in the same time reduce the pollution caused by using excessive amounts of nitrogen fertilizers.

Nitrogen is an essential element for plant growth and maintenance, since it is considered as key nutrients in crops production. Many researchers studied the effect of different levels of N fertilizers on growth, nutrients uptake and yield of wheat to find out the economic N fertilizers level to produce the highest wheat productivity which gives the highest grain yield (Morsy, 1993, Sultan *et al*., 1994 and Hamed, 1998).

Recently, intensive efforts is being spent to minimize the amount of N fertilizers applied to wheat to decrease production cost and environmental pollution without grain yield reduction.

Organic matter application to soil is known that it improves soil properties and consequently the plant growth. Among the types of organic matter, farmyard manure could be one of the most economical ways to increase organic matter content in soil. Several investigators indicated that the application of FYM increased plant growth and dry matter production (Khalil *et al*., 2000). Organic fertilizers considered as an important source of humus, macro and microelements carrier and at the same time increase the activity of the usefull microorganisms (El-Gizy, 1994). Dahdouh *et al*., (1999) found that organic manures play an important role in nutrients solubility which activate physiological and biochemical processes in plant leading to increase the plant growth and nutrients uptake. The best means of maintaining soil fertility and productivity level could be achieved through periodic addition of proper organic materials in combination with inorganic fertilizer (Sakr *et al*., 1992).

Modern agricultural practices largely rely on high inputs of mineral fertilizers to achieve high yields. It is widely recognized that application of mineral fertilizers, (especially nitrogen), can result in ground water contamination with nitrates by leaching through the soil profile. Knowing the deleterious effects of using only the chemical fertilizers, use of soil microorganisms, which can fix atmospheric nitrogen to reduce the environmental pollution. Several free-living bacteria species can fix atmospheric nitrogen, such as Azotobacter and Azospirillum. In this concern, Ahmed (1995) reported that wheat grain inoculated with Azotobacter and /or Azospirillum resulted in increases in plant height, percentage of fruitful tillers, number of spikes, weight of spikes and grain yield/plant. El-Sebasy and abd El-Maaboud (2003) reported that inoculation of wheat grains with Azotobacter and Azospirillum significantly increased grain yield and nitrogen uptake. They added that such inoculation of wheat plant with Azotobacter significantly increased root length and plant dry matter compared to the control. Safwat *et al*., (2001) and Massoud *et al.* (2004) mentioned that inoculation of wheat by Azospirillum increased total yield and yield

components. Palm *et al*., (2001) and Ibrahim *et al*.,(2005) suggested that the importance or the superiority of the applied N-biofixation was not only taken as a criterion for increasing the income for crop or rationalize of costly mineral N-fertilizers, but also for minimizing the possibly adverse effects on both human health and environmental risks resulted from mineral N-fertilizers.

The objective of the present work is to study the impact of applying different sources of N-fertilization on growth, nutrients uptake and yield of wheat.

MATERIALS AND METHODS

Two field experiments were carried out at Abou-El-Ghr Village, Kafre El-Zaiat district, El-Gharbia Governorate, during the two growing successive seasons of 2007/2008 and 2008/2009, to study the effects of nitrogen application levels, FYM and mixed biofertilizers (Azotobacter and Azospirillum) on growth, yield and its components as well as chemical constituents of wheat plants (Sakha93 variety).

The experiments included 18 treatments resulting from the combinations of three organic fertilizer rates (0, 10 and 20 m^3 FYM/fed.), three nitrogen fertilizers levels; (45, 60, and 75 kg N/fed.) and two biofertilizers treatments; (uninoculation and grain inoculation with biofertilizer mixture of Azotobacter + Azospirillum).

The experimental design was a split-split plot with three replications. FYM treatments were arranged as the main plots, the three levels of nitrogen treatments were assigned to the sub plots, while the two biofertilizers treatments were assigned to sub-sub plots. Plot size was 10.5 m^2 in both growing seasons.

Randomized samples were taken from the experimental soils and FYM to determine the physical and chemical contents according to Jackson, 1973 as shown in Tables (1 & 2). Wheat cultivar (Sakha 93) was kindly obtained from Wheat Dept. Field Crop Res. Institute, Agric. Res. Center, Giza, Egypt. The organic manure was thoroughly mixed with 0-20 cm soil surface layer two weeks before sowing. Super phosphate was added as a single dose at the rate of 15 kg P_2O_5 /fed and mixed in the same times with such surface layer. The nitrogen fertilizer(as ammonium sulphate 20.6%N) was added according to the treatment in two equal portions, i.e. after 30 and 60 days after sowing. Also, potassium fertilizer (as Potassium sulphate, 48% K_2O)was added at a rate of 50kg K $_2$O/fed., which was divided into two equal portions applied with N fertilizer cultivation.

Prior to sowing, wheat grains were inoculated with the liquid culture of Azospirillum and Azotobacter. Arabic gum was added to the liquid culture as an adhesive agent. The inoculated grains were air dried before planting. The control treatment was done using uninoculated grains.

Table (1): some physical and chemical properties of the experimental soil.

Soil properties	Value
Particle size distribution %	
Coarse sand	6.95
Fine sand	22.80
Silt	37.90
Clay	32.35
Textural class	Clay loam
Chemical analysis	
EC (dSm^{-1})(1:5,soil extracted)	3.65
pH(1:2.5, soil suspension)	8.62
Organic matter (%)	1.62
Total $CaCO_3$ (%)	1.84
Soluble anions (meq/L)	
$CO_3^{=}$	0.00
HCO_3^{-}	1.95
Cl^{-1}	32.0
$SO_4^{=}$	1.80
Soluble cations (meq/L)	
Ca^{++}	1.20
Mg^{++}	4.75
Na^{+}	2.89
K^{+}	26.71
Available macronutrients (μ g^{-1} soil) (DTPA extraction)	
N	8.20
P	6.30
K	185.4
Available micronutrients(μ g^{-1} soil)	
Fe	61.70
Mn	28.90
Zn	32.40
Cu	9.80

Table (2): Some chemical properties of the used farmyard manure

Properties	Value
pH (1:2.5 manure suspension)	7.60
EC dSm^{-1}	3.88
Organic matter (%)	23.80
Organic carbon (%)	14.85
Total N (%)	0.92
C/N ratio	16.1:1
Total P (%)	0.09
Total K (%)	2.15
Total micronutrients (μ g^{-1} soil)	
Fe	86.90
Mn	39.65
Zn	32.72
Cu	8.96

At harvesting time, the following characteristics were estimated:

1-Yield and its components:

Plant height (cm), number of spikes/plant, spike length (cm), spike weight (g), grain weight/spike (g), 1000-grain weight (g), grain yield (ard./fed.), [Ardab=150kg]., straw yield (Ton/fed.).

II- Chemical analysis

- **Grain and straw samples were taken for chemical analysis to determine N, P and K percentages in grains and straw and then N, P and K uptakes in them were calculated.**
- **Nitrogen content in grains and straw was determined by Keldahl method as described by A.O.A.C (1985). Protein content in the grins was calculated by multiplying N% by 5.75 factor. Phosphorus was determined calorimetrically according to Chapman and Pratt, 1978. Potassium was determined by flamphotometer according to Jackson (1973)**
- **Total carbohydrate was determined according to Smith *et al.,* (1956)**

Statistical analysis:

- **The data was subjected to statistical analysis and the difference between the miens of treatments were tested using least significant difference test (L.S.D) at 5%. The combined analysis was carried out for the two growing seasons and their average data were presented in the tables (L.S.D) at 5% according to Snedecor and Cochran,1967.**

RESULTS AND DISCUSSION

I- Yield and its components

A-Effect of farmyard manure:-

Data in Table (3) showed the effect of farmyard manure on growth and yield and yield components (Plant height. no. of spike/plant, spike length, no. of grains/spike, grain weight/spike, 1000-grain weight, grain and straw yields). All the studied characters were significantly affected by the application of farmyard manure. Raising FYM rate gradually increased the quantity of wheat yield. The highest rate of FYM (20m^3/fed.) was the superior treatment for increasing yield components and wheat yield. The positive impacts of FYM on yield and its components are mainly due to improving the soil physical and chemical properties, preparing the suitable bed for germination and development of plant growth that reflect on resultant yield. Moreover, FYM is considered as an important source of humus; macro and microelements carrier, and in the same time increase the activity of the useful microorganisms. Similar results were gained by Abd El-Rasoul *et al*., (2003), Ali *et al*., (2005) and El-Shouny (2006).

Table 3

Table 3

B-Effect of nitrogen fertilization

Plant height, no. of spikes/plant, spike length, no. of grains/spike, grain weight/spike, 1000-grain weight, grain and straw yield/fed were significantly increased with increasing nitrogen fertilizer up to the lightest level (75 kg N/fed). This increase might be attributed to the fact that nitrogen fertilization promote tillering in cereals and encourage the formation of more spikes/plant (El-Sebasy and Abd El-Maaboud 2003). As nitrogen is one of the most important components of cytoplasm, nucleic acid and chlorophyll, so nitrogen has an important role in encouraging cell elongation, cell division and consequently increasing vegetative growth and activation of photosynthesis process which enhance the amount of metabolites necessary for building plant organs which reflect increases in grain and straw yields. These results are in accordance with those obtained by El-Moursy (1998); El-Naggar (1999), Abbas *et al.,* (2007) who and Zaki *et all*, (2007).concluded that nitrogen level had positive significant effect on grain and biological yield as well as yield components.

C-Effect of biofertilizers

The data in Table (3) show that all studied characters except grain yield/fed and spike length were significantly affected by biofertilizers. Inoculation of wheat grains with the mixture of Azotobacter and Azospirillum significantly increased plant height, no. of spikes/plant, no. of grains/spike, grains weight/spike, 1000-grains weight and straw yield/fed comparing with those of the uninoculated plants. Such results may be due to the beneficial effects of biofrtilizer on yield and its components of plant which caused N-fixation or production of plant growth promoting substances such as indol actic acids, gibberellins, pyridoxine and others which stimulate plant growth and subsequently affect yield attributes. These results are in agreement with those obtained by Ahmed (1995), Omar *et al.,* (1996), Kotb (1998), Sharief *et al*., (1998) and Metwaly (2000).

D-Effect of interactions:-

1-Effect of the interaction between FYM and N levels (AxB)

Data in Table (3) showed the interaction effect between FYM and nitrogen fertilization treatments were found to be significant for grain weight/spike, 1000-grain weight, grain and straw yields/fed. The highest values were obtained when nitrogen was applied at rate of 75Kg N/fed., with 20m^3 FYM/fed. On the other hand, the lowest values were obtained by application of nitrogen at rate of 45 kg N/fed without FYM application. Similar results were obtained by Soliman (2007) who found that the application of N and organic manure increased plant growth and consequently the yield. These stimulatory effects of organic manure may be due to the effect of micronutrients and growth regulators present in organic manure which may have activated the cell division as well as meristematic activity in the kernel

2-The interaction effect between FYM and biofertilization (AxC)

The data show that grain yield/fed was significantly affected by the interaction between FYM and inoculation. The highest grain yield (19.41 ard/fed.) was realized by the application of FYM at the rate of 20 m^3/fed. and grain inoculation with biofertilizers. However, the lowest value of grain yield was recorded when the plants were untreated with FYM and/or biofertilizer. Moreover, the rest characters were significantly affected by such interaction.

3-Effect of interaction between N-levels and biofertilization (BxC)

Data in Table (3) show the interaction effect between mineral N-levels and biofertilization on yield and its components. It is clear from the data, that in general, plants received 75 kg N/fed and inoculated with Azotobacter + Azospirillum gave the highest significant values of plant height and grain yield/fed. The obtained results are in harmony with those of Khalil and El-Aref, 2001, who found positive interaction effect between biofertilizer and N-fertlilizer on no. of grains /spike and grains and straw yields.

4-Effect of interaction between FYM, N-levels, and biofertilization (AxBxC)

Data in Table (3) clearly showed that all aforementioned traits were not significantly affected by the interaction among the three tested factors.

II- Nitrogen, phosphorus and potassium concentrations and uptake

A- Effect of farmyard manure:

Data in Tables (4,5 and 6) cleared that the application of 10 or 20 m^3 FYM/fed significantly increased N, P and K concentration and uptakes in the grains and straw of wheat plant against no FYM in favor of the high rate. This may be due to the decomposition of organic manure supplying more available nutrients as well as formation of organic and inorganic acids during decomposition which slightly reduce the soil pH which in turn enhanced the solubility and availability of N, P and K. These beneficial effects are in agreement with those reported by El-Kouny *et al*., (2004). Moreover, Hassan and Mohey El-Din (2002) reported that the increasing of NPK concentration and uptake in wheat plants with FYM application, may be attributed to the mineralization of organic matter and slow releasing of minerals in an available form from organic manure, or may be due to the effect of several organic acids, produced during manure decomposition, which solublize the native P of the soil and partly due to the formation of a coating on $CaCO_3$ which did not allow to react with soil P, and thus P availability increased and consequently the content in plant increased. The bicarbonate ions released from O.M decomposition might also increase P availability through ion exchange phenomenon, as well as displacement of phosphate by organic anion formed from break down of O.M.

Table 4

Table 5

Table 6

B- Effect of nitrogen fertilization :

The results illustrated in Tables (4,5 and 6) showed that increasing the applied rate of nitrogen fertilizer gradually increased the concentration and uptake of N, P and K in both grains and straw of wheat plant at maturity stage. The highest values of concentration and uptake amounts for NPK uptake were recorded by the application of 75 kg N/fed. This might be attributed to the role of nitrogen nutrient in building metabolites which increases the dry matter content and subsequently increase nutrients uptake in wheat plant. These findings are in harmony with those obtained by El-Desouky (2004) and Abd El-Hady *et al*.(2006).

C- Effect of biofertilization :

Concerning the tested biofertilizers influence on nutrients concentration and their uptake in the grains and straw, the data in the same table indicated clearly that grain inoculation with biofertilizers significantly increased nitrogen, phosphorus and potassium concentration and uptake in wheat grains and straw. The positive effect of biofertilizer inoculation upon nutrient uptake could be described to the high efficiency of bacteria presence in this biofertilizers to fix atmospheric nitrogen and /or to produce some biologically active substances, e.g. IAA, gibberellin and cytokinins. Such substances would help in increasing the root biomass and thus indirectly help in greater absorption of nutrients from surrounding environment (Awad,1998). Moreover, Kotb, (2005) reported that Azotobacter and Azospirillum strains produced adequate amounts of IAA and cytokinins, which increase the surface area per unit root length and are responsible for root hair branching and eventually increase the uptake of nutrients.

D- Effect of interactions:

1-Effect of interaction between FYM and N-levels (AxB)

Concerning the impact of interaction between organic manure and nitrogen fertilizers on N, P and K concentrations and there uptakes in grains and straw (Table, 4), it was noticed that the maximum significant values of N, P and K concentration and uptake were obtained by the addition of 20m^3/fed FYM and 60. No significant differences between 60 and 75 kg N/fed when they were applied with 20 m^3 FYM. The previous result means that using organic manure had beneficial influence on reducing the amount of mineral nitrogen. This may be due that addition of organic manure encouraged the microorganisms living in the soil to convert the organic N to mineral form available for plants and hence can reduce inorganic N application.

2-The interaction effect between FYM and biofertilization (AxC)

Regarding the effect of interaction between organic manure and biofertilizer inoculation on N, P and K concentration and uptakes in grains and straw, the highest values were obtained by the addition of 20 m^3/fed FYM

and grain inoculation with Azotobacter and Azospirillum while the lowest one was attained when the plants were not fertilized with either organic manure or biofertilizer.

3-Effect of interaction between N-levels and biofertilization (BxC)

Data in Tables (4,5 and 6) show that the highest effect of the interaction between nitrogen levels and biofertilizers inoculation on N, P and K concentration and uptakes in grains and straw were obtained by addition of 75 kg N/fed and grain inoculation with Azotobacter and Azospirillum. This effect could be due to that biofertilizers inoculation help converting an organic form of nutrients such as N to mineral N. This led to increase in the uptake of nutrients from the soil by root of plant and hence promotes plant growth, leading to an increase in plant yield.

4-Effect of interaction among FYM, N-levels and biofertilization (AxBxC)

In regard to the effect of interaction among organic manure, nitrogen fertilizer and biofertilizers inoculation on NPK concentration and uptake in grains and straw of wheat plants, the data revealed that the interaction among the three factors show significant effect on N concentration and uptake in grains, only. Application of 20m^3 FYM under 75 kg N/fed with grain inoculated with biofertilizers recorded the highest values of N concentration (2.45%) and uptake (82.5 kg N/fed.). However, the other tested nutrients concentration and uptake were not significantly. Affected by such interaction.

III -Protein and carbohydrate contents in grains:

A- Effect of farmyard manure:-

The results in Table (7) showed significant increases for protein % and protein yield/fed in wheat grains by increasing FYM rate. The highest FYM rate (20 m^3/fed.) recorded highest protein (13.46%) and highest protein yield in (382.64kg/fed.). With regarding to carbohydrates the data in Table (7) show that the highest rate of organic manure 20m^3/fed. gave the highest increase in total carbohydrates (70.17 kg/fed). The favorable effect of organic manure on enhancement of grain quality could be interpreted as the organic manure contains considerable amounts of macro and micronutrients which contribute to improve chemical constituents of grains.

B- Effect of nitrogen fertilization :

The data reported in Table (7) show that the protein concentration and protein yield/fed. were significantly increased by increasing N fertilization levels up to 70 kg N/fed. The beneficial effect of nitrogen fertilization on protein yield may be due to, its favorable effect on grain yield (table 3) and /or

to enhance the absorbing efficiency of the roots. Besides, the stimulating effect of nitrogen may be due to its function in plant metabolism as it considered a major constituent of amino acid, protein, nucleic acids and phospholipids. In this concern, Ali *et al.,* (2002) showed that N-fertilization of wheat plants increased the protein content and that subsequently improve the grain quality. This is due to the influence of N availability at critical stages of spike initiation and the development on plant metabolism in way leading to increase synthesis of amino acids and their incorporation into grain protein.

With regarding to carbohydrates, data in Table (7) demonstrate that significant increase took place in total carbohydrates yield with increasing chemical N levels up to the highest level. This increase in total carbohydrates may be due to the increase in vegetative growth, since nitrogen is an important constituent of chlorophyll which increases photosynthesis, resulting in assimilation of more carbohydrates. These results came in agreements with those of Morvan-Bertrand *et al*., (1999) who reported that water soluble carbohydrates were markedly increased at higher concentrations of the N treatments suggesting that carbohydrates were reserved in leaf sheaths. Also, Weber *et al*. (1998) stated that there is a good correlation between N-treatments and accumulation of reducing sugars and sucrose. In addition Manh *et al*., (1993) suggested that a possible mechanism in the levels of amino nitrogen can regulate the carbon flux in wheat leaves from amino acids to carbohydrates through activation of phosphoenol pyruvate carboxylase pathway.

C- Effect of biofertilization :

Regarding to the biofertilization, the data indicate that the mean values for the protein concentration and protein yield/fed. were significantly increased by inoculation with Azotobacter and Azospirillum compared with the uninoculation treatment. With this respect, Ali *et al*., (2002) showed that the increase in the protein content in grains can be attributed to the ability of Azotobacter and Azospirillum to fix atmospheric nitrogen together with high production of growth promoting substances that enhance root development and function and stimulate seed germination, shoot and root length, and subsequently increased nutrients uptake in wheat plants.

With regarding to carbohydrates, data in Table (7) revealed that the biofertilizers inoculation had no significant effect on total carbohydrate in wheat grain over the non-inoculated treatment.

D- Effect of interactions:

Concerning the impact of interaction between organic manure and nitrogen fertilizers (AxB) on protein concentration and its yield/fed. of wheat grains, it was noticed that the maximum value of protein concentration (14.09%) and protein yield/fed (450.89 kg/fed) were attained by the (AxC) addition of 20m^3/fed. FYM and 75 kg N/fed.

Table 7

There are significant effects on protein percentage in grains due to the interaction between FYM and biofertilizer inoculation (AxC) which amounted to (13.63%) by application of 20 m^3/fed along with biofertilizers application.

With respect to the interaction between nitrogen fertilizer levels and biofertilization (BxC), the data in Table (7) revealed that, the highest protein yield values were obtained by the combination between the full nitrogen dose (75 kg N/fed.) along with biofertilizers inoculation.

In regard to the effect of interaction among organic manure, nitrogen fertilizer and biofertilizers (AxBxC) on protein concentration and protein yield in wheat grain, it was found that highest significant values of protein concentration in grain (14.09%) was obtained by applying 20 m^3/fed FYM, 75 kg N/fed and inoculated with Azotobacter and Azospirillum, while, the lowest one (9.72%) was obtained by applying, 45kg N/fed without FYM and biofertilizer.

With regarding to the interaction effects among the three tested factors, on total carbohydrate content in grain the data show that total carbohydrate content of was not significantly affected by all interactions among the three tested factors as shown in Table (7).

V- Conclusion

- From the obtained data it could be concluded that grain inoculation with the mixture of Azotobacter + Azospirillum combined with the application of organic manure at a rate of 20 m3 FYM/fed and mineral N at a rate of 75 kg N/fed. was sufficient to produce the good quantity and quality of wheat crop.

From the aforementioned results, it can be concluded that application of FYM at 20 m^3/fed is important for increasing wheat productivity and improving its quality.

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تأثير التسميد العضوى والنيتروجينى المعدنى والحيوى على النمو والمحصول والمكونات الكيميائية لنباتات القمح

ماجدة على عويس ، عواطف عبد المجيد محمود ، سامى عبد الحكيم الشيخة

معهد بحوث الاراضى والمياه والبيئة – مركز البحوث الزراعية

الملخص العربى

اقيمت تجربتان حقليتان فى قرية أبو الغر – مركز كفر الزيات– محافظة الغربية خلال الموسمين الزراعيين ٢٠٠٧/٢٠٠٨، ٢٠٠٨/٢٠٠٩ بهدف دراسة تأثير مستويات التسميد العضوى (صفر، ١٠، ٢٠م^{٢} /فدان) ، والنتروجين المعدنى (٤٥، ٦٠، ٧٥ كجم نيتروجين للفدان) وكذلك التسميد الحيوى (بدون تلقيح، التلقيح بالازوتوباكتر والازوسبيرلليم) والتفاعل بينهما على نمو وانتاج محصول القمح ومكوناته والنسبة المئوية والكمية الممتصة من النيتروجين والفوسفور والبوتاسيوم بواسطة الحبوب والقش وكذلك محتوى الحبوب من البروتين والكربوهيدرات الكلية.

ويمكن إيجاز النتائج المتحصل فيما يلى:

١- أدت زيادة التسميد الازوتى من ٤٥ الى ٦٠و ٧٥كجم ن/فدان الى زيادة معنوية فى طول النبات– طول السنبلة– وزن الالف حبة– محصول الحبوب والقش/فدان – نسبة البروتين فى الحبوب وكذلك الكمية الممتصة من كل من النيتروجين والفوسفور والبوتاسيوم بواسطة الحبوب والقش.

٢- كان هناك زيادة معنوية متدرجة فى محصول الفدان لكل من الحبوب والقش ومحتوى كل منهما من العناصر الغذائية الثلاث (النيتروجين والفوسفور والبوتاسيوم) وكذلك محتوى الحبوب من البروتين والكربوهيدرات الكلية وذلك بإضافة السماد العضوى .

٣- أدى تلقيح حبوب القمح بالمخصب الحيوى الى زيادة معنوية فى طول النبات وطول السنبلة ووزن ال١٠٠٠حبه ومحصولى الحبوب والقش ومحتوى الحبوب من البروتين والعناصر الغذائية فى الحبوب والقش وذلك مقارنة بالحبوب غير الملقحة حيويا .

٤- كان التفاعل بين معدلات التسميد العضوى والمعدنى ومعاملات التسميد الحيوى معنويا على المحصول فى الحبوب وكذلك على الكمية الممتصة من النيتروجين ونسبة البروتين فى الحبوب

٥- بالرغم من ان وزن الحبوب /سنبله ووزن ال١٠٠٠حبه ومحصول القمح قد ازدادا معنويا بزيادة معدل السماد الازوتى حتى ٧٥ كجم ن/فدان تحت معاملات السماد العضوى، إلا أنه لم يكن هناك فروق معنوية بين معدلى التسميد الآزوتى ٦٠ و ٧٥ كجم ن/فدان ، مع إضافة ٢٠م^{٣} سماد عضوى/ف لمعظم الصفات المدروسة مما يشير إلى إمكانية توفير ١٥ كجم من النيتروجين المضاف للفدان . وبذلك يمكن تجنب التلوث البيئى الذى قد تحدثه الإضافة الزائدة من السماد الآزوتى . هذا وقد تأثر محصول الحبوب تأثيرا معنويا بالتفاعل بين السماد العضوى والتلقيح الحيوى وكذلك بين التسميد الآزوتى والتلقيح الحيوى فى حين لم يكن هناك تأثيراً معنوياً بين العوامل الثلاثة تحت الدراسة على محصول القمح ونموه.

Table (3): Effect of FYM, nitrogen and bio-fertilization and their interactions on yield components of wheat plants (combined analysis 2007/2008 and 2008/2009 seasons)

Treatments		Plant height (cm)			No. of spike/plant			Spike length (cm)			No. of grains/spike		
FYM (m^3/fed)	N-levels (kg/fed)	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean
0	45	92.2	94.6	93.4	8.67	10.33	9.50	10.2	10.8	10.5	44.00	46.33	45.17
	60	96.9	100.2	98.55	11.33	12.33	11.83	11.8	12.4	12.1	47.67	50.33	49.00
	75	106.2	111.5	108.85	12.67	13.67	13.17	14.3	14.7	14.5	51.67	54.33	53.00
	Mean	98.43	102.10	100.27	10.89	12.11	11.50	12.10	12.63	12.37	47.78	50.33	49.06
10	45	96.4	99.90	98.15	9.67	11.67	10.67	10.8	11.4	11.10	47.00	49.67	48.34
	60	105.2	108.7	106.95	12.67	13.67	13.17	12.8	13.5	13.15	52.67	57.00	54.84
	75	112.4	116.5	114.45	14.00	14.67	14.34	14.9	15.3	15.10	58.00	64.33	61.17
	Mean	104.67	108.37	106.52	12.11	13.34	12.73	12.83	13.40	13.12	52.56	57.00	54.78
20	45	102.8	106.2	104.50	10.67	12.33	11.50	11.5	11.8	11.65	51.00	54.33	52.67
	60	110.2	115.2	112.70	13.33	14.67	14.00	13.5	13.7	13.60	59.33	62.67	61.00
	75	117.2	119.5	118.35	14.67	15.33	15.00	15.2	15.6	15.40	63.33	66.67	65.00
	Mean	110.07	113.63	111.85	12.89	14.11	13.50	13.4	13.7	13.55	57.89	61.22	59.56
Average	45	97.13	100.23	98.68	9.67	11.44	10.56	10.83	11.33	11.08	47.33	50.11	48.72
N levels	60	104.10	108.03	106.07	12.44	13.56	13.00	12.70	13.20	12.95	53.22	56.67	54.95
	75	111.93	115.83	113.88	13.78	14.56	14.17	14.80	15.20	15.00	57.67	61.78	59.73
	Mean	104.39	108.03	106.21	11.96	13.19	12.58	12.78	13.24	13.01	52.74	56.19	54.47
L.S.D at 5%		OM (A) 1.17			0.39			0.27			1.42		
		N (B) 1.86			0.47			0.37			1.50		
		Inoc. (C) 2.22			0.48			n.s			2.00		
		A x B n.s			n.s			n.s			n.s		
		A x C n.s			n.s			n.s			n.s		
		B x C 3.00			n.s			n.s			n.s		
		A x B x C n.s			n.s			n.s			n.s		

Table (3): Continued

Treatment		Grain weight /spike (g)			1000-grain weight (g)			Grain yield (ard./fed,)			Straw yield (Ton/fed)		
FYM (m^3/fed)	N-levels (kg/fed)	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean
0	45	2.27	2.35	2.31	43.2	45.6	44.40	14.46	14.74	14.6	3.34	3.52	3.43
	60	2.39	2.45	2.42	46.9	48.4	47.65	16.58	16.82	16.7	3.70	3.87	3.79
	75	2.58	2.64	2.61	51.6	53.5	52.55	18.85	19.66	19.26	3.99	4.17	4.08
	Mean	2.41	2.48	2.45	47.23	49.17	48.20	16.63	17.07	16.85	3.68	3.85	3.77
10	45	2.44	2.59	2.52	47.7	49.2	48.45	14.98	15.34	15.16	3.63	3.88	3.76
	60	2.61	2.66	2.64	50.7	53.1	51.9	17.53	17.89	17.71	4.15	4.34	4.25
	75	2.69	2.77	2.73	54.3	56.5	55.4	19.93	20.49	20.21	4.56	4.63	4.60
	Mean	2.58	2.67	2.63	50.9	52.93	51.92	17.48	17.91	17.69	4.11	4.28	4.20
20	45	2.57	2.63	2.60	49.8	52.4	51.10	15.67	16.29	15.98	4.09	4.23	4.16
	60	2.68	2.75	2.72	54.1	55.8	54.95	18.63	19.49	19.06	4.52	4.70	4.61
	75	2.76	2.82	2.79	56.8	59.2	58.00	20.82	22.45	21.64	4.78	4.89	4.84
	Mean	2.67	2.73	2.70	53.57	55.8	54.68	18.37	19.41	18.89	4.46	4.61	4.54
Average N levels	45	2.43	2.52	2.48	46.90	49.07	47.99	15.04	15.46	15.25	3.69	3.88	3.79
	60	2.56	2.62	2.59	50.57	52.43	51.50	17.58	18.07	17.83	4.12	4.30	4.21
	75	2.68	2.74	2.71	54.23	56.40	55.32	19.87	20.87	20.37	4.44	4.56	4.50
	Mean	2.56	2.63	2.59	50.57	52.63	51.60	17.49	18.13	17.82	4.08	4.25	4.17
L.S.D at 5%		OM(A) 0.02			1.42			0.24			0.02		
		N(B) 0.02			1.50			0.20			0.02		
		Inoc.(C) 0.04			2.00			n.s			0.04		
		A x B 0.03			2..15			0.30			0.03		
		A x C n.s			n.s			0.25			n.s		
		B x C n.s			n.s			0.03			n.s		
		A x B x C n.s			n.s			n.s			n.s		

Table (4): Effect of different levels of FYM, nitrogen and biofertilization and their interaction on N(%) and uptake (kg/fed)in grains and straw wheat plant (combined analysis of 2007/2008 and 2008/2009 seasons).

Treatments		Grain						Straw					
		N(%)			N-uptake(kg/fed)			N(%)			N-uptake(kg/fed)		
FYM (m^3/fed)	N-levels (kg/fed)	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean
0	45	1.69	1.75	1.72	36.66	38.69	37.68	0.44	0.46	0.45	14.70	16.19	15.45
	60	1.89	1.95	1.92	47.00	49.20	48.10	0.48	0.55	0.52	17.76	21.29	19.53
	75	1.97	2.15	2.06	55.70	63.40	59.55	0.59	0.65	0.62	23.54	27.11	25.33
	Mean	1.85	1.95	1.90	46.45	50.43	48.44	0.50	0.55	0.53	18.67	21..53	20.10
10	45	1.79	1.90	1.85	40.22	43.72	41.97	0.47	0.55	0.51	17.06	21.34	19.20
	60	1.95	2.18	2.07	51.28	58.50	54.89	0.56	0.62	0.59	23.24	26.91	25.08
	75	2.22	2.25	2.24	66.37	69.15	67.76	0.67	0.74	0.71	30.55	34.26	32.41
	Mean	1.99	2.11	2.05	52.62	57.12	54.87	0.57	0.64	0.60	23.62	27.50	25.56
20	45	2.21	2.26	2.24	51.95	55.22	53.59	0.58	0.65	0.62	23.72	27.50	25.61
	60	2.34	2.39	2.37	65.39	69.87	67.63	0.65	0.71	0.68	29.38	33.37	31.38
	75	2.38	2.45	2.42	74.33	82.50	78.42	0.75	0.82	0.79	35.85	40.10	37.98
	Mean	2.31	2.37	2.34	63.89	69.20	66.55	0.66	0.73	0.70	29.65	33.66	31.66
Average N levels	45	1.90	1.97	1.94	42.94	45.88	44.41	0.50	0.55	0.53	18.49	21.68	20.09
	60	2.06	2.17	2.12	54.56	59.19	56.88	0.56	0.63	0.60	23.16	27.19	25.33
	75	2.19	2.28	2.24	65.47	71.68	68.58	0.67	0.74	0.71	29.98	33.82	31.90
	Mean	2.05	2.14	2.10	54.32	58.92	56.62	0.58	0.64	0.61	23.98	27.56	25.77
L.S.D at 5%		OM(A) 0.24			0.49			0.02			071		
		N(B) 0.19			0.38			0.01			0.52		
		Inoc.(C) n.s			0.25			0.01			0.58		
		A x B 0.32			0.5.9			n.s			1.33		
		A x C 0.29			0.59			n.s			n.s		
		B x C 0.27			5.00			n.s			n.s		
		A x B x C 0.33			0.64			n.s			n.s		

Table (5): Effect of different levels of FYM, nitrogen and biofertilization and their combinations on P(%) and uptake (kg/fed) in grains and straw wheat plant (combined analysis of 2007/2008 and 2008/2009 seasons).

Treatment		Grain						Straw					
		P(%)			P-uptake(kg/fed)			P(%)			P-uptake(kg/fed)		
FYM (m^3/fed)	N-levels (kg/fed)	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean
0	45	0.34	0.36	0.35	7.37	7.96	7.66	0.21	0.23	0.22	7.01	8.10	7.56
	60	0.38	0.42	0.40	9.45	10.60	10.03	0.24	0.26	0.25	8.88	10.06	9.47
	75	0.45	0.47	0.46	12.72	13.86	13.29	0.25	0.27	0.26	9.98	11.26	10.62
	Mean	0.39	0.42	0.40	9.85	10.81	10.33	0.23	0.25	0.24	8.62	9.81	9.22
10 m^3/fed	45	0.37	0.42	0.40	8.31	9.66	8.99	0.23	0.25	0.24	8.35	9.70	9.03
	60	0.44	0.46	0.45	11.57	12.34	11.96	0.27	0.29	0.28	11.21	12.59	11..90
	75	0.49	0.52	0.51	14.65	15.98	15.32	0.29	0.31	0.30	13.22	14.35	13.79
	Mean	0.43	0.47	0.45	11.51	12.66	12.09	0.26	0.28	0.27	10.93	12.21	11.57
20 m^3/fed	45	0.44	0.48	0.46	10.34	11.73	11.04	0.25	0.27	0.26	10.23	11.42	10.83
	60	0.49	0.54	0.52	13.69	15.79	14.74	0.31	0.33	0.32	14.01	15.51	14.76
	75	0.55	0.57	0.56	17.18	19.19	18.19	0.32	0.35	0.34	15.30	17.12	16.21
	Mean	0.49	0.53	0.51	13.74	15.57	14.66	0.29	0.32	0.31	13.18	14.68	13.93
Average N levels	45	0.38	0.42	0.40	8.67	9.78	9.23	0.23	0.25	0.24	8.53	9.74	9.14
	60	0.44	0.47	0.46	11.57	12.91	12.24	0.27	0.29	0.28	11.37	12.72	12.05
	75	0.50	0.52	0.51	14.85	16.34	15.60	0.29	0.31	0.30	12.83	14.24	13.54
	Mean	0.44	0.47	0.46	11.70	13.01	12.36	0.26	.0.28	0.27	10.91	12.23	11.58
L.S.D at 5%		OM(A) 0.01			0.23			0.10			0.79		
		N(B) 0.01			0.26			0.01			0.91		
		Inoc.(C) 0.01			0.09			0.01			n.s		
		A x B n.s			0.49			0.10			1.32		
		A x C n.s			0.35			n.s			1.70		
		B x C n.s			0.30			n.s			n.s		
		A x B x C n.s			n.s			n.s			n.s		

Table (6): Effect of different levels of FYM, nitrogen and biofertilization and their interaction on K(%) and uptake (kg/fed) in grains and straw wheat plant (combined analysis of 2007/2008 and 2008/2009 seasons).

Treatment		Grain						Straw					
		K(%)			K-uptake(kg/fed)			K(%)			K -uptake(kg/fed)		
FYM (m^3/fed)	N-levels (kg/fed)	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean
0	45	0.37	0.38	0.38	8.03	8.40	8.22	1.62	1.65	1.64	54.11	58.08	56.10
	60	0.42	0.43	0.43	10.45	10.98	10.72	1.70	1.74	1.72	62.90	67.34	65.12
	75	0.46	0.49	0.48	13.01	14.45	13.73	1.83	1.89	1.86	73.02	78.81	75.92
	Mean	0.42	0.43	0.43	10.50	11.28	10.89	1.72	1.76	1.74	63.34	68.08	65.71
10	45	0.45	0.47	0.46	10.11	10.81	10.46	1.74	1.77	1.76	63.16	68.68	65.92
	60	0.48	0.52	0.50	12.62	13.95	13.29	1.86	1.95	1.91	77.19	84.63	80.91
	75	0.55	0.58	0.57	16.44	17.83	17.14	2.04	2.10	2.07	93.02	97.23	95.13
	Mean	0.49	0.52	0.51	13.06	14.20	13.63	1.88	1.94	1.91	77.79	83.51	80.65
20	45	0.48	0.50	0.49	11.28	12.22	11.75	1.76	1.80	1.78	71.98	76.14	74.06
	60	0.54	0.57	0.56	15.09	16.66	15.88	1.96	2.05	2.01	88.59	96.35	92.47
	75	0.67	0.69	0.68	20.92	23.24	22.08	2.15	2.19	2.17	102.77	107.09	104.93
	Mean	0.56	0.59	0.58	15.76	17.37	16.57	1.96	2.01	1.99	87.78	93.19	90.49
Average N levels	45	0.43	0.45	0.44	9.81	10.48	10.15	1.71	1.74	1.73	63.08	67.63	65.36
	60	0.48	0.51	0.50	12.72	13.86	13.29	1.84	1.91	1.88	76.23	82.77	79.50
	75	0.56	0.59	0.58	16.79	18.51	17.65	2.01	2.06	2.04	89.60	94.38	91.99
	Mean	0.49	0.52	0.51	13.11	14.28	13.70	1.85	1.90	1.88	76.30	81.59	78.95
L.S.D at 5%		OM(A) 0.01			0.27			n.s			6.02		
		N(B) 0.02			0.49			n.s			3.96		
		Inoc.(C) 0.01			0.08			n.s			n.s		
		A x B 0.02			0.59			n.s			n.s		
		A x C n.s			0.50			n.s			n.s		
		B x C n.s			n.s			n.s			n.s		
		A x B x C n.s			n.s			n.s			n.s		

Table (7): Effect of different levels of FYM, nitrogen and biofertilization and their interaction on protein%, protein yield and total carbohydrate yield of wheat grain (combined analysis 2007/2008 and 2008/2009 seasons)

Treatment		Grain						Total carbohydrates yield in grain (kg/fed)		
		Protein (%)			Protein yield (kg/fed.)					
FYM (m^3/fed)	N-levels (kg/fed)	Unino.	Inoc.	Mean	Unino.	Inoc.	Mean	Unino..	Inoc.	Mean
0	45	9.72	10.06	9.89	210.80	222.47	216.64	65.7	66.2	65.95
	60	10.87	11.21	11.04	270.25	282.90	276.58	68.4	68.7	68.55
	75	11.33	12.36	11.85	320.28	364.46	342.37	70.9	71.3	71.10
	Mean	10.64	11.21	10.91	267.09	289.97	278.53	68.33	68.73	68.53
10	45	10.29	10.91	10.60	231.27	251.39	241.33	66.6	67.3	66.95
	60	11.21	12.54	11.88	294.86	336.38	315.62	69.1	69.6	69.35
	75	12.77	12.94	12.86	381.63	397.61	389.62	71.7	71.9	71.80
	Mean	11.44	12.13	11.79	302.57	328.44	315.51	69.13	69.6	69.37
20	45	12.71	13.00	12.86	298.71	317.52	308.12	67.9	68.2	68.05
	60	13.46	13.74	13.60	375.99	401.75	388.87	70.0	70.4	70.20
	75	13.69	14.09	13.89	427.40	474.38	450.89	72.0	72.5	72.25
	Mean	13.28	13.63	13.46	367.37	397.90	382.64	69.97	70.37	70.17
Average N levels	45	10.91	11.33	11.12	246.91	263.38	255.15	66.73	67.23	67.37
	60	11.85	12.48	12.17	313.72	340.34	327.03	69.17	69.57	69.37
	75	12.59	13.11	12.85	376.45	412.16	394.31	71.53	71.90	71.29
	Mean	11.79	12.31	12.05	312.34	338.79	325.57	69.14	69.57	69.36
L.S.D at 5%		OM(A) 0.12			1 0.98			0.27		
		N(B) 0.08			1 0.18			0.34		
		Inoc.(C) 0.03			15.16			n.s		
		A x B 0.19			n.s			n.s		
		A x C 0.15			n.s			n.s		
		B x C 0.14			n.s			n.s		
		A x B x C 1.97			n.s			n.s		