EFFECT OF GRAIN BIOINOCULATION ON WHEAT YIELD AND ITS COMPONENTS UNDER APPLYING DIFFERENT LEVELS OF NITROGEN FERTILIZATION

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ABSTRACT

A field experiment was conducted at El-Wanysa village, Itsa district, El-Fayoum Governorate, during the two successive winter seasons of 2008/2009 and 2009/2010 to investigate the influence of applied different mineral nitrogen levels and grain bio-inoculation with, Azotobacter and /or Azospirillum and their interactions on wheat growth, yield and its attributes as well as N-uptake of either wheat grain or straw and grain protein content. A split plot design with three replicates was used. The obtained results could be summarized as follows:

The results showed significant increases in plant dry weight, plant height, spike length, 1000-grain weight, grain or straw yield/fed. N-uptake by straw or grain and of grain protein content either by increasing the rate of mineral nitrogen or with grain inoculation by the tested N_2-fixers. In addition, the dual grain inoculation with Azotobacter and Azospirillum performed significantly greater followed by single inoculation with either Azospirillum or Azotobacter. At any level of N-fertilizer, the inoculated treatments gave much higher straw and grain yields than the uninoculated one.

From the economical point of view, it could be concluded that, the amount of mineral N-fertilizer could be reduced by using grain bio-inoculation, which in turn increases soil fertility as well as, minimizes the production cost and environmental pollution, which can occur by the excess use of chemical fertilizers.

Key words; Grain wheat-inoculation- Azotobacter- Azospirillum –growth-yield- chemical constituents

INTRODUCTION

Wheat (*Triticum aestivum L.*) is the major and most important crop in many countries, and it is the main winter cereal crop in Egypt. There are many attempts to increase wheat productivity in order to face the gap between consumption and production. Supplying crop plants with nitrogen fertilizer plays an essential role in improving its productivity, because nitrogen is considered as one of the limiting factors to achieve the high yield of wheat crop. Application of mineral nitrogen may be results in environmental pollution, in addition to its high cost. So, many efforts were done to decrease the utilization of chemical fertilizers by using biofertilizers which might reduce financial costs. Recently, biofertilization is used in order to compensate a part of the mineral fertilizer doses, taking in consideration the complementary or synergetic 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 fertilizers and consequently reduce agricultural costs as well as soil pollution. The use of nitrogen fixing bacteria such as Azotobacter, Azospirillum and others is considered as an index to soil fertility and saving more than half recommended dose of mineral nitrogen fertilizer (**Tantawey *et al*., 2004).** The beneficial effect of Azotobacter and Azospirillum are related not only to their N_2-fixing proficiency but also with their ability to reduce anti-fungal compounds and production of phytohormones (gibberllins and cytokinins like substances as well as auxins) that promote root development and proliferation, resulting in efficient uptake of water and nutrients (**Pandey and Kumar, 1989**). Single or dual inoculation of wheat grains with Azotobacter and Azospirillum in sterilized soil have been extremely variable from significantly negative to significantly positive stimulation of their population in wheat rhizosphers soil, and also, stimulated plant growth and significantly increased the concentration of indole acetic acid, P, Mg, N and total soluble sugars in wheat shoots (**Ali *et al*., 2002**).

Therefore, this study was under taken to evaluate the impact of bio-inoculation of wheat grains with Azotobacter and /or Azospirillum on the growth, chemical constituents and productivity of wheat plant grown in the field under applied different mineral nitrogen levels.

MATERIALS AND METHODS

A field experiment was conducted at El-Wanysa village, Itsa distric, El-Fayoum Governorate, during the two successive winter seasons of 2008/2009 and 2009/2010. This work aimed to study the effect of grain inoculation with two strains of non-symbiotic N_2-fixing bacteria, Azospirillum and /or Azotobacter on the growth, chemical constituents and productivity of wheat plants (c.v.Sakha93) under different nitrogen levels.

Soil samples were taken from the surface layer (0-30 cm depth) and analyzed for physical and chemical properties (Table 1) as described by **Page *et al*., (1982).** The experimental design was split plot with three replicates, the plot area was $10.5m^2$.

The experiment consisted of 12 treatments, the main plots were assigned to nitrogen levels (40, 60 and 80kg N/fed)., in the form of ammonium sulphate (20.6% N) was applied in two equal doses, one dose being applied before the first irrigation, while the remaining dose was applied before the second irrigation. While biofertilizers treatments were randomly distributed in the sub plots. The non-symbiotic nitrogen fixing bacteria; Azospirillum and Azotobacter were kindly obtained from Microbial.Dept., Soil, Water and Environ. Res. Instit. Agric. Res. Center, Giza, Egypt.

Prior to sowing, wheat grains were inoculated by soaking in liquid culture of Azospirillum and/or Azotobacter. Arabic gum was added to liquid culture as adhesive agent. Inoculated grains were air dried by spreading over a plastic sheet for short time before planting. The control treatment was done using uninoculated grains.

Phosphorus fertilizer was applied to all experimental plots in one dose pre-planting wheat in the form of monocalcium superphosphate (15% P_2O_5) at the rate of 15 kg P_2O_5/fed) . Potassium was added as potassium sulphate (48 % K_2O)at a rate of 50 Kg K_2O/fed. to each plot in two equal doses at the same time of nitrogen application.

The other agronomic practices of wheat cultivation were done as recommended.

A sample consisted of 10 plants was collected from all replications for each treatment 90 days after plantation for fresh and dry weight. Also, sample of flag leaf were taken from each experimental plot for N, P and K concentrations. Nitrogen was determined using the micro-kjeldhl method as described by **Chapman and Pratt (1961).** Potassium was determined using a flame photometer. Phosphorus was determined colorimetically according to **Hesse (1971).**At harvesting stage, grain and straw yields/fed. were recorded. Ten plants were taken from each plot to determine: plant height (cm), spike length (cm), number of grain/spike, grain weight/spike (g) and weight of 1000-grain (g). Grain and straw samples were taken and oven dried at 70°C, then milled and kept for chemical analysis. N% and uptake of grain and straw were calculated. Crud protein content of grain and straw were determined by multiplying the corresponding values of N-content by 5.75 according to **A.O.A.C. method (1980).** Finally, the economic advantage of biofertilizers was done.

Results for all studied parameters were statistically analyzed using the combined analysis of the two growing seasons according to **Gomez and Gomez (1984).** The significant difference among means was tested using the least significant differences' (L.S.D.) at 5% level of significance.

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

Soil characteristics	Data
Particle size distribution (%):	
Coarse sand	7.20
Fine sand	22.95
Silt	16.43
Clay	53.42
Soil textural class	Clay
Soil $CaCO_3$%	9.88
Organic Matter %	1.82
EC_e (dSm^{-1}) in soil paste extract	2.65
Soil pH (1:2.5 soil water suspension)	7.45
Soluble ions in soil past extract (meq/l):	
Ca^{+2}	6.63
Mg^{+2}	3.66
Na^{+}	16.02
K^{+}	0.29
$CO_3^{=}$	0.00
HCO_3^{-}	2.55
Cl^{-}	10.78
$SO_4^{=}$	13.27
Available nutrients in soil (mg/kg soil)	
Available N	42.00
Available P	5.00
Available K	450

RESULTS AND DISCUSSION

I-Fresh and dry weight (g/plant) after 90 days from plantation

Data in Table (2) showed the effect of bio and mineral N- fertilizer and their interactions on fresh and dry weights of wheat plants after 90 days from plantation. Application of 80 kg N/fed gave significant higher values as compared with the other treatments. The positive effect of N fertilizers could be arranged according to the following order: 80>60>40 kg N/fed. The increases in fresh and dry weights of wheat plants by N application may be attributed to the beneficial effects of N on stimulating the meristmatic activity for producing more tissues and organs, since N plays a major roles in the synthesis of structural proteins and other several macro molecules, in addition to its vital contribution in several biochemical processes in the plant related to growth (**Marschner, 1986**, **Mengel and Kirkby, 1987 and Fathi 2006).** Furthermore, it was clear that the use of any of the studied biofertilizers significantly increased the fresh and dry weights of wheat plants as compared to the control treatment. However, the use of Azospirillum gave a higher value either a fresh or dry weight (g/plant) as compared to Azotobacter. Higher values of fresh and dry weights were observed when inorganic nitrogen was used with dual grain inoculation by Azospirillum followed Azotobacter treatments. This may be due to that these inoculants produced growth promotings and other substances as well as fixing much more amount of atmospheric nitrogen, thus these materials enhance and stimulate the plant growth.

The effect of the interaction among biofertilization and mineral nitrogen fertilization on the fresh and dry weights of wheat plants was significantly different. The highest fresh and dry weights were obtained as a result of integrated effect of both the high level of mineral nitrogen fertilization and the bio- inoculation. Similar results were found by **El-Sebsy and Abd El-Maaboud (2003), El- Desouky (2004) and Abd El-Hady *et al.*, (2006)** who found that the application of both biofertilization and the mineral nitrogen significantly increased the plant growth.

II-Nutrients

The effect of different treatments on the mean values of the macronutrient concentrations in the leaves of wheat plants after 90 days from plantation are presented in Table (2).

These results showed that N, P and K concentrations in wheat leaves were increased by mineral N application. The increases of chemical constituents by the increase of N- mineral fertilizers are attributed to that the applied nitrogen increase the capacity of the plants to absorb other nutrients due to the increase of root surface/unit of soil volume as well as the high capacity of plants supplied with nitrogen in building metabolites, which in turn contribute much to the increase of nutrient uptake (**Mohamed, 2000**).

Moreover, more promotive effects were recorded when the different N fertilizer levels were associated with the bio -inoculation. The obtained data strongly confirmed the superiority of the high N level combined with the dual treatment of both Azotobacter and Azospirillum which resulted in the highest promotive effects on the nutrients accumulation that surpassed all other treatments. This strongly emphasizes the superiority of biofertilizers mixture; i.e. Azotobacter and Azospirillum in enhancement the concentration and accumulation of various nutrients in both leaves as well as the produced grains. That means the bio-inoculation of wheat grain resulted a promotive effect on root development, and consequently their function in the uptake of both water and nutrients. Similar results were reported by **Rashad and Ismail (2000a), El Desouky (2004)** and **Abd El- Hady *et al.*, (2006).**

The effect of the interaction among biofertilization and mineral nitrogen fertilization on the NPK concentration by wheat plants was significantly varied. The highest values were obtained as a result of using 80 kg N/fed and the bio-inoculation with dual. In contrary, the lowest values were scored when 40kg N/fed was used in combination with the control treatment. **El-Sersawy *et al*., (1997) and Krol (1999)** indicated that grain bio-inoculation of wheat with Azotobacter and Azospirillum causes improvements in NPK uptake.

Table (2): Effect of N- mineral and grain bio-inoculation on fresh weight, dry weight, N, P and K contents of wheat after 90 days of plantation during 2008/2009 and 2009/2010 seasons (as mean values).

Treatments		Fresh weight (g/plant)	Dry weight (g/plant)	Macronutrients (%)		
N-levels kg/fed	Bio-inoculation			N	P	K
40	Uninoculation	25.72	6.51	2.10	0.235	1.75
	Azotobacter	28.94	6.92	2.40	0.248	1.88
	Azospirillum	34.41	9.32	2.60	0.261	1.95
	Dual inoculation	37.20	10.23	2.80	0.283	2.05
	Mean	31.57	8.25	2.48	0.257	1.91
60	Uninoculation	30.62	8.91	2.40	0.255	2.16
	Azotobacter	33.54	9.63	2.70	0.274	2.25
	Azospirillum	37.75	10.54	2.90	0.283	2.37
	Dual inoculation	40.57	10.80	3.20	0.301	2.49
	Mean	35.62	9.97	2.80	0.278	2.32
80	Uninoculation	36.21	9.83	2.60	0.265	2.26
	Azotobacter	38.43	10.42	2.90	0.293	2.34
	Azospirillum	43.54	11.71	3.20	0.310	2.45
	Dual inoculation	46.35	12.42	3.40	0.334	2.56
	Mean	41.13	11.10	3.03	0.301	2.40
Average overall	Uninoculation	30.85	8.42	2.37	0.252	2.06
	Azotobacter	33.64	8.99	2.67	0.272	2.16
	Azospirillum	38.57	10.52	2.90	0.285	2.26
	Dual inoculation	41.37	11.15	3.13	0.306	2.37
L.S.D at 0.05						
N-rate		0.69	0.17	0.11	0.01	0.02
biofertilizer		0.76	0.29	0.09	0.01	0.03
N x Bio		n.s	0.32	n.s	n.s	n.s

III-Wheat yield and its components

Results presented in Table (3) clearly showed that wheat yield and its attributes were increased greatly with increasing the applied nitrogen levels and significantly increased with the inoculation by N_2-fixing bacteria. The effective role of N for increasing the wheat yield and its components has been well documented as it is required for the synthesis of proteins, protoplasm formation and it's transferring to cell wall that manifested in enhancing the meristematic activities and increasing the cell size, leaf expansion and intermode elongation. In addition, N supply at the optimum level enhanced the nutrients uptake, capacity of photosynthesis assimilation in building metabolites,its translocation and accumulation in the sink **(Abd El-Rahman, 1999 and El-Masry, 2001).** Similar results were obtained by **Salem *et al.*, (2004**) on wheat, **Abbas *et al.*, (2007) and Zaki *et al.*, (2007).**

All bio-inoculated treatments showed significant increases in both grains and straw yields as compared to uninoculated treatments irrespective of inorganic nitrogen fertilizer levels (Table 3). However, highest values of these parameters were observed with the dual bio-inoculated treatments followed as Azospirillum > Azotobacter inoculation.

These results may be attributed to the high efficiency of bacteria presented in inoculated grains to fix atmospheric nitrogen and to produce some biological active substances e.g., IAA, ALA, gibberellins and cytochinne-like substances.. These results are in line with those reported by **Kotb (1998)** and **Ali *et al.*, (2002).** They showed higher grain and straw yields when they use inoculated grains of wheat than uninoculated.

Table (3): Effect of N-mineral and bio-fertilization on wheat yield and its components (during 2008/2009 and 2009/2010 seasons).

Treatments		Plant height (cm)	Grain weight/ spike(g)	No.of grains/spike (g)	Spike length (cm)	1000-grain weight (g)	Grain yield (ard./fed.)	Straw yield (Ton/fed)
N-levels Kg/fed	Bio-inoculation							
40	Uninoculation	104.20	2.31	45.70	10.50	51.26	13.25	3.65
	Azotobacter	108.50	2.50	48.00	11.20	53.60	14.54	3.79
	Azospirillum	111.40	2.72	49.70	11.70	55.70	14.98	3.85
	Dual inoculation	114.20	2.91	52.30	12.50	58.30	15.78	3.97
	Mean	109.58	2.61	48.93	11.48	54.72	14.64	3.82
60	Uninoculation	110.50	2.59	48.30	11.80	54.35	15.65	4.08
	Azotobacter	113.60	2.82	50.70	12.60	57.65	16.95	4.35
	Azospirillum	116.20	2.98	52.70	13.60	61.64	17.99	4.54
	Dual inoculation	118.50	3.15	55.70	14.50	64.98	18.95	4.60
	Mean	114.70	2.89	51.85	13.13	59.66	17.39	4.39
80	Uninoculation	114.90	2.85	52.70	13.50	56.72	18.82	4.45
	Azotobacter	117.50	3.09	54.30	13.80	60.37	19.98	4.67
	Azospirillum	119.70	3.25	57.30	14.60	64.50	20.59	4.75
	Dual inoculation	122.60	3.37	61.70	15.70	67.95	21.88	4.84
	Mean	118.68	3.14	56.50	14.40	62.39	20.32	4.68
Average overall	Uninoculation	109.87	2.58	48.90	11.93	54.11	15.91	4.06
	Azotobacter	113.20	2.80	51.00	12.53	57.21	17.16	4.27
	Azospirillum	115.77	2.98	53.23	13.30	60.61	17.85	4.38
	Dual inoculation	118.43	3.14	56.57	14.23	63.74	18.87	4.47
L.S.D at 0.05								
N-rate		1.01	0.04	1.92	0.33	0.68	0.11	0.04
biofertilizer		1.13	0.02	3.02	0.12	0.91	0.17	0.07
N x Bio		n.s	n.s	n.s	n.s	1.32	0.23	0.13

***Ardab=150Kg**

It is worth to mention that the dual bio-inoculation by Azotobacter and Azospirillum recorded the highest values of grain and straw yields (18.95, 21.88 ard./fed and 4.6, 4.84 ton/fed., respectively) at 60 and 80 kg N/fed. In addition, the yield at 80kg N/fed without inoculation recorded lower result than inoculation treatments at 60kg N/fed. Also, the same result was obtained with 60kg N/fed without inoculation and with inoculation treatments at 40 kg N/fed. Thus, bio-inoculation N- amount about 20 units of N fertilizer and that saving was economically feasible.

Therefore, it seams from data that the recommended dose of chemical N-fertilizer could be reduced by using biofertilizers, which in turn minimizing the production costs and environmental pollution, due to avoiding the excess use of N- mineral fertilizers.

With respect to wheat yield components (Table 3), bio-inoculation of wheat grains by dual bacterial strains in combined with high levels of inorganic nitrogen (60 and 80kg N/fed) recorded the highest values of grain weight /spike, number of grains/spike, spike length and 1000-grain weight, followed by either Azospirillum inoculation or Azotobacter as solely treatments. Also, at low level of N (40 kg N/fed), the mixed bio-inoculation with Azospirillum gave the highest results followed by results than the uninoculated. The same trend was reported by **Shams El-Din** and **Abdrabou (1995), Kotb (1998)** and **Metwally (2000)** stated significant increase in number and weight of grain/spike by inoculation of wheat grains by N_2-fixing bacteria.

IV-Nitrogen uptake of wheat plant

The results illustrated in Table (4) showed that increasing the rate of applied nitrogen fertilizer gradually increased the amount of nitrogen uptake by both wheat grains and straw at maturity stage. The highest amounts of N-uptake were recorded by application of 80 kg N/fed., this might be attributed to the role of nitrogen in increasing the root surface per unit of soil volume. Also, the high capacity of the plant supplied with N enhances building metabolites and increases the dry matter content and subsequently increases nutrients uptake by wheat plants.

These results are in line with the findings of **Sabry *et al.*, (2000)** on wheat plants and **Ibrahim *et al.*, (2005).**

The results presented in Table (4) showed that a pronounced increase in N-uptake at the end of wheat life cycle in all bio-inoculated treatments over the uninoculated one, but the dual bio-inoculation gave highest N-uptake, especially with the use of high level of inorganic nitrogen followed by Azospirillum and Azotobacter inoculation. The increasing of N-uptake reflected on the protein content of grains and straw.

Ali *et al.*, (2002) showed that increasing nitrogen uptake and protein content (%) can be attributed to the ability of Azospirillum and Azotobacter to fix atmospheric nitrogen together with high production of growth promoting substance that enhance root development and function and stimulate seed germination, shoot and root length, and subsequently increased nutrients uptake by wheat plants.

They also show that the N-fertilization of wheat plants increased the protein content and subsequently improves 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 corporation into grain protein. **Magda *et al.*, (2010)** indicated that any increase in N- fertilization was followed by increase in protein percentage in wheat grain. These results are in agreement with those obtained by **Metwally (2000) and Kotb (2005).**

Concerning the interaction among the inoculation treatments and nitrogen rates, data in Table (4) demonstrated that adding 80 kg N/fed under the treatment of bio-inoculation with Azotobacter and Azospirillum, recorded the highest values N-uptake of grain and straw. In addition, it could be noticed that, treated plants with nitrogen fertilizer at the rate of 60 kg N/fed and dual bio-inoculation with biofertilizers gave results generally similar or more than those of treatment of application of 80 kg N/fed without bio-inoculation.

Table (4): Effect of N-mineral and bio-fertilization of on N-uptake and protein content of wheat at harvesting (during 2008/2009 and 2009/2010 seasons).

Treatments: N-levels kg/fed	Treatments: Bio-inoculation	Grain yield (Kg/fed.)	Grain: N (%)	Grain: N-uptake kg/fed	Grain: Protein %	Straw yield (Kg/fed.)	Straw: N (%)	Straw: N-uptake kg/fed	Straw: Protein %	Total N-uptake (kg/fed)
40	Uninoculation	1987.5	1.70	33.79	9.78	3650	0.34	12.41	1.96	46.20
	Azotobacter	2181.0	1.84	40.13	10.58	3790	0.37	14.02	2.13	54.15
	Azospirillum	2247.0	1.95	43.82	11.21	3850	0.42	16.17	2.42	59.99
	Dual inoculation	2367.0	2.07	49.00	11.90	3970	0.45	17.87	2.59	66.87
	Mean	2195.6	1.89	41.69	10.87	3820	0.40	15.12	2.28	56.80
60	Uninoculation	2347.5	1.77	41.55	10.18	4080	0.38	15.50	2.19	57.05
	Azotobacter	2542.5	1.92	48.82	11.04	4350	0.44	19.14	2.53	67.96
	Azospirillum	2698.5	2.09	56.40	12.02	4540	0.47	21.34	2.70	77.74
	Dual inoculation	2842.5	2.31	65.66	13.28	4600	0.52	23.92	2.99	89.58
	Mean	2607.7	2.02	53.11	11.63	4390	0.45	19.98	2.60	73.08
80	Uninoculation	2823.0	1.89	52.50	10.63	4450	0.46	20.47	2.65	72.97
	Azotobacter	2997.0	2.11	63.24	12.13	4670	0.49	22.88	2.82	86.12
	Azospirillum	3088.5	2.20	67.95	12.65	4750	0.55	26.13	3.16	94.08
	Dual inoculation	3282.0	2.40	78.77	13.80	4840	0.59	28.56	3.39	107.33
	Mean	3047.6	2.15	65.62	12.36	4680	0.52	24.51	3.01	90.13
Average overall	Uninoculation	2386.0	1.79	42.61	10.28	4060	0.39	16.13	2.27	58.74
	Azotobacter	2573.5	1.96	50.73	11.25	4270	0.43	18.68	2.49	69.41
	Azospirillum	2678.0	2.08	56.06	11.96	4380	0.48	21.21	2.76	77.27
	Dual inoculation	2830.5	2.26	64.48	12.99	4470	0.52	23.45	2.99	87.93
L.S.D at 0.05										
N-rate		16.50	0.02	0.54	0.30	0.04	0.04	0.43	0.09	0.72
biofertilizer		25.50	0.025	0.67	0.18	0.07	0.07	0.96	0.12	1.45
N x Bio		34.50	0.032	1.10	n.s	0.13	0.13	1.12	n.s	1.68

V-Economic advantage of biofertilization use:-

It is important to evaluate the economic aspect of using biofertilization practices (Azotobacter and Azospirillum) on wheat crop, as shown in Table (5).

The cumulative income of the two inoculants is estimated according to the average of the results of the two seasons.

Generally, using both (Azotobacter and Azospirillum) individually resulted in net profit under using the three levels of nitrogen fertilizers than that using nitrogen fertilizer alone. However, the highest net return (LE1000) was recorded by using the two inoculants together with 60 kg N/fed.

Therefore, the low cost of biofertilization practices causes an increase for farmer income; conserve the environment pollution and at the same time reduce N- mineral application hazards.

Table (5): Economic aspect of bio-fertilization usage

Treatments: N-levels kg/fed	Treatments: Bio-inoculation	Wheat grain yield (ard/fed)	Grain yield increase ard/fed	Value of grain yield increase (LE)	Wheat straw yield (ton/fed)	Straw yield increase ton/fed	Value of straw yield increase (LE)	Total Value-of yield increase (LE)
40	control	13.25	-	-	3.65	-	-	-
60		15.65	-	-	4.08	-	-	-
80		18.82	-	-	4.45	-	-	-
40	Azotobacter	14.54	1.29	348.3	3.79	0.14	29.4	378
60		16.95	1.30	351.0	4.35	0.27	56.7	408
80		19.98	1.46	394.2	4.67	0.22	46.2	440
40	Azospirillum	14.98	1.73	467.1	3.85	0.20	42.0	509
60		17.99	2.34	631.8	4.54	0.46	96.6	728
80		20.59	2.07	558.9	4.75	0.30	63.0	622
40		15.78	2.53	683.1	3.97	0.32	67.2	750
60	Dual bio-inoculation	18.95	3.30	891.0	4.60	0.52	109.2	1000
80		21.88	3.36	907.2	4.84	0.39	81.9	989

Prices: wheat grain = L.E 270/ardab
wheat straw= L.E 210/ton

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تأثير التلقيح الحيوى للبذور على محصول القمح ومكوناته تحت إضافة مستويات مختلفة من التسميد النيتروجينى

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أجريت تجربة حقلية فى منطقة الونايسة - محافظة الفيوم خلال موسمين شتويين متتاليين ٢٠٠٨/٢٠٠٩، ٢٠٠٩/٢٠١٠ لدراسة تأثير إضافة مستويات مختلفة من النيتروجين والتلقيح الحيوى للبذور بالازوتوباكتر والازوسبيريلليم وايضا التفاعل بينهما على حالة النمو ومحصول القمح ومكوناته وايضا الكمية الممتصة من النيتروجين بواسطة الحبوب والقش وكذلك محتوى الحبوب من البروتين، حيث استخدم التصميم الاحصائى للقطع المنشقة فى ثلاث مكررات. وكانت النتائج المتحصل عليها كالاتى:

- هناك زيادة معنوية فى الوزن الجاف للنبات- طول النبات-طول السنبلة- وزن الألف حبه- محصول الحبوب والقش/فدان بزيادة معدل الازوت المعدنى وخاصة مع التلقيح الحيوى المشترك عن التلقيح المنفرد حيث كان تأثير الاخير أكثر وضوحا.
- سجلت جميع المعاملات الملقحة زيادة معنوية فى محصول الحبوب والقش وأيضا النيتروجين الممتص وبالتالى المحتوى البروتينى للحبوب عن المعاملات الغير ملقحة.
- أدت معاملة التلقيح المشترك مع جميع مستويات التسميد الازوتى الى الحصول على أعلى القيم لمحصول الحبوب والقش، وزن حبوب السنبلة ،وزن الألف حبه وكذلك محتوى الحبوب والقش من النيتروجين الممتص وتلاهما التأثير المنفرد للتلقيح بأى من الازوتوباكتر أو الازوسبيريلليم.
- ومن الوجهة الاقتصادية تشير النتائج المتحصل عليها من هذه الدراسة الى أهمية التلقيح بمثبتات النيتروجين الجوى مما يؤدى الى تقليل استخدام السماد الأزوتى المعدنى وذلك يقلل من تكاليف الإنتاج ويحد من التلوث البيئى الناتج عن الإفراط فى استخدام هذه الأسمدة المعدنية.