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WHEAT PRODUCTION AND PLANT CHEMICAL COMPOSITION UNDER DIFFERENT MINERAL AND BIOFERTILIZER TREATMENTS

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ABSTRACT

Two field experiments were conducted during 2010/2011 and 2011/2012 winter growing seasons in the Experimental Farm of Faculty of Agriculture, Cairo University at Giza, Egypt. The aim of this investigation was to study the response of two wheat cultivars via, Sakha 69 and Gemmiza 10 to five fertilizer treatments (1) 100% NPK recommended dose, as a contro (2) 50% NPK + microbin, (3) 50% NPK + phosphorin, (4) 50% NPK + potassiomage, (5) 50% NPK + microbin + phosphorin + potassiomage .The recommended quantities of NPK fertilizer (R. Q. F.) which are (75 kg N/fed, 100 kg P_2O_5/fed and 24 kg K_2O/fed). Data obtained clearly revealed that:

Varieties and bio chemical fertilizers had a significant effect on most of traits under study where Gemmiza 10 variety was superior in plant height, weight of 1000-grain, No. of tillers/m^2, spike length, grains weight/spike, No. of grains/spike in both seasons and No. of spike/m^2 and weight of spike (first season). Use of 50 % NKP + microbin + phosphorin + potassiomage was superior in plant height, 1000-grain weight, No. of tillers/m^2, spike length, No. of grains/spike, weight of grains/spike, No. of spikes/m^2, biological and grain yields /fed in both seasons and harvest index in only the first season.

The interaction between varieties and fertilizer treatments significantly affected most of characters. Gemmiza 10 with 50 % NPK + microbin + phosphorin potassiomage + was superior in plant height, spike length, No. of spikes/m^2, No. of grains/spike and No. of tillers/m^2. Use of 50 % NPK + potassiomage with Sakha 69 or Gemmaiza 10 gave the highest average of harvest index while use of 100 % NPK with Sakha 69 or Gemmiza 10 gave the highest in straw yield (first season). Use of 50 % NPK + microbin + phosphorin + potassiomage with Gemmiza 10 gave the highest averages of grain yield and biological yield/fed. The shoot and wheat grain contents from mainly N,P and K as well as total sugars, total free amino acids,proteins and total indols were also increased due to this mineral and biofertilization treatments in both wheat cultivars.

Keywords : wheat , Biofertilizer, growth promoting , Chemical Composition

INTRODUCTION

Wheat (*Triticum aestivum* L.) is considered the most imported cereal crop in Egypt. Improvement of wheat productivity is a goal in order to minimize the gap between production and consumption through using promising wheat cultivars and adding recommended doses of NPK fertilizers and/or using bio fertilizers to reduce environmental pollution. Using free living bacteria which fix atmospheric nitrogen has been recommended in this respect. New bio fertilizers are used in order to compensate a part of the mineral fertilizers doses, taking in consideration the complementary or synergestic effect of such combination between bio and mineral fertilization.

Minimizing the used doses of mineral fertilizers helps consequently reducing agricultural costs as well as soil pollution.

Biofertilizers are increasingly used in modern agriculture due to the extensive knowledge in rhizosphere biology and discovery of the promotive function of special groups of microorganisms known as plant growth promoting rizobacteria .The beneficial effects of plant growth in promoting rizobacteria could be attributed to the biological nitrogen fixation and , production of phytohormones gibberlines, cytokinins and auxins that promote root development and prolifertation resulting in efficient uptake of water and nutrients (Haahtela *et al.*,1990).

Many researches in this field indicated that, application of bacterial inoculants as biofertilizers resulted in improvement of growth and productivity of cereal crops in addition to saving of their N requirements to about 50% of the recommends doses. Monged *et al.* (1996) *Amera* and Dahdoh (1997); Kennedy *et al.* (1997) Rashad and Ismail (2000 a and b) and Ghallab and Salem (2001). Biofertilization including microbial inoculations is capable of enhancing soil fertility and increase crops fertilizer use efficiency and consequently crop growth and yield (El-Naggar *et al.*, 2005) and Badran (2009). Several studies reported that an increase in non-legumes yield and its components due to inoculation with biofertilizer *Azotobacter* and/or *Azospirillum* under supplemental chemical N rates lower than the recommended (Hassanein and Hassouna,1997; Hamed,1998; Said,1998; Mohamed ,2000; Ghallab and Salem,2001; Abd El -Maksoud,2002; Khafagy,2003 and Youssef Soad *et al.* ,2004). Also Badran (2009) found that, grain yield, No. of spikes/m^2, No. of kernels/spike, 1000-kernel weight, straw yield, and biological yield, except harvest index were highly significantly increased due to inoculation of wheat grains by Nitrobin or microbin compared with uninoculated ones. Increasing doses of mineral nitrogen fertilizer showed significant increase in all studied traits except harvest index up to 196 kg N/ha.(82.4 Kg N/fad.)

Many studies revealed that the application of N mineral fertilizer exhibited much significance for maintaining high wheat yield (Saleh,2001 and 2003; Ahmed, 2002 and Abd El-Hamed ,2005).

Khaled (2007) found that application of 70 kg N/fed + nitroben significantly increased plant height, No. of spikes/m^2 No. of kernels/spike, 1000-kernel weight, kernels weight/spike straw, grain and biological yields and harvest index.

Abd El Monem *et al.*(2001) reported that the application of Azospirillum brasilense or commercial biofertilizer cereline with half nitrogen rate of 60 kg N/fed significantly increased wheat grain yield.

Sharief *et al.* (1998) reported that using 75 kg N/fed resulted in a significant increase in plant height, No. of tillers/m^2, spike length, spike weight, No. of grains/spike, grain weight/spike and 1000-grain weight which in turn increased, grain, straw and biological yields/fed . Inoculation wheat with syrialln increased plant height, spike length and grain, straw and biological yields while No of tillers/m^2, spike length, grains weight/spike were insignificantly affected compared with that uninoculated treatments.Moreover,

Sief El Nasr and Zahran (1998) working on wheat found that use of

90 kg N + 45 kg P_2O_5 + 36 kg K_2O increased growth characters and wheat grain and straw yields/fed.

Therefore, the present investigation was designed to study effect of mineral and bio-fertilization on growth, productivity of two wheat cultivars in order to protect the environment against pollution caused by use of extra chemical NPK fertilizer application

MATERIALS AND METHODS

The present investigation was carried out during 2010/2011 and 2011/2012 seasons in the Experimental Farm of Faculty of Agriculture Cairo University at Giza, Egypt to evaluate the influence of recommended mineral fertilizer addition as a control,(75 kg N, 15.5kg P_2O_5/and 24 kg K_2O/fed) 50% NPK + microbin, 50% NPK + phosphorin, 50% NPK + potassiomage and 50% NPK + microbin + phosphorin + potassiomage on two wheat cultivars, i.e. Sakha 69 and Gemmiza 10.

A split plot design with four replicates was used. The main plots were allocated to the two wheat cultivars and the sub plots were occupied with the five fertilizer treatments

The sub plots area was 4.2 m^2 (3.5 × 1.2 m).Nitrogen in the form of urea (46 % N) was applied in three equal portions before the first and the second irrigations and the third one before heading. The field was ploughed and ordinary calcium superphosphate (15.5 % P_2O_5) was applied during seedbed preparation. Potassium sulphate (48% K_2O) was broadcasted before the first irrigation. The preceding crop was cotton in both seasons.

Wheat grains were sown on November 15th in both seasons at a rate of 70 kg/fed. The soil of experimental field was clay loam in texture Data of the main soil chemical and physical properties of the experimental field before sowing are shown in Table 1.

Table 1 : Soil chemical and mechanical properties of the upper 50 cm soil depth in 2011and 2012 seasons

Soil variable	2010	2011
EC ds/m	0.96	0.85
pH (1:2.5, soil : water)	8.3	8.6
Available nitrogen (ppm)	22.2	25.3
Available phosphorus (ppm)	6.9	7.8
Available potassium (ppm)	250	240
Organic matter (%)	1.9	1.7
Fine sand (%)	15.23	14.46
Silt (%)	39.23	34.73
Clay (%)	42.71	48.29
Texture class	Clay loam	Clay loam

Wheat grains were thoroughly washed in water prior to biofertilizer treatments to remove any pesticides added for pest control during storage. The grains were coated just before sowing with bacteria inoculants at rate of 500 g inculations/40 kg by 5% adhesive agent) Arabian gum.

Biofertilizers were provided by Soil Microbiology Research Department, A.R.C. , Giza.

All other cultural practices were conducted as recommended. Data were statistically analyzed according to the method outlined by Snedecor and Cochran (1981). Means of treatments were compared at 5% level of probability using least significant differences test.

A- Yield and yield attributes:

At harvest, (145 days after sowing) ten guarded plants of one square meter of each sub plots were taken at random to determine the following characters

1- Plant height(cm): including spike length
2- No. of tillers/m^2 by counting all tillers per square meter
3- Number of spikes/$m^2$by counting all spikes per square meter
4- Spike length (cm) as average of ten spikes
5- Spike weight (g) as average weight of ten main spikes
6- Number of grains/spike as average of grains number per ten main spikes
7- Grain weight/spike (g) as average weight grains per ten main spikes
8- Thousand grain weight (g)
9- Grain yield in ton/fed was determined from plants of one square meter of each sub plot .After threshing, grains at 13% moisture were weighed in kg then the weight was converted to ton/fed
10- Straw yield in ton/fed straw of harvested samples was determined in kg/m^2 then converted to ton/fed
11- Biological yield in ton/fed was estimated from addition of grain yield in kg/fed + straw yield in kg/fed and then converted to ton/fed
12- Harvest index % (grain yield/total yield × 100)

B - Chemical analysis

The shoot and produced grains in the two seasons were chemically analyzed in order (145 days after sowing) to determine their chemical composition as follows:

Total nitrogen of the dried material was determined by using the modified- Micro-Kjeldahel method as described by Jones et al. (1991). Crude protein (C.P.) was calculated as follows :- (C.P.) = total nitrogen % x 5.83. Determination of P, K, Ca and Na were carried out on the ground dry material. The samples were digested as recommended by Piper (1947). Phosphorus was determined sepectrophotometerically by using stannous chloride method according to (A.O.A.C.,1980). Potassium, calcium and sodium were determined by Flamephotometer(BWB1) .

Ethanol extract was used to fore determination of total sugar was determined by phosphomolibdic acid method according to (A.O.A.C.,1975) Total free amino acids was determined by using ninhydrin reagent (Moore and Stein,1954).Total soluble phenols were estimated using the Folin-ciocalteau colorimetric method of (Swain and Hillis,1959).Total indols were determined by Larson *et al.* (1962).

RESULTS AND DISCUSSIONS

A-Yield and yield attributes

A-1- Varietal differences:

From data in Tables 2 and 3 it is obvious that, cultivars had a significant effect on plant height, No. of spikes/m^2, No. of kernels/spike, 1000-grain weight, spike length, No. of tillers/m^2 and weight of grains/spike. In this regard, Gemmiza 10 was superior with highly significant difference regarding the most of characters under study as compared to the second cultivar (Sakha 69). The superiority of Gemmiza 10 CV resulted in the highest grains weight per spike and its components i.e. No of grains per spike and 1000-grains weight.

The variation among wheat varieties was previously reported by Eissa *et al.* (1990) ; Abd EL-Ghany (1997) ; Bader Elham *et al.*,(2001).
Cultivars also varied significantly in straw yield, total yield in both seasons, grain yield (2 nd season) and harvest index in the first seasons were Gemmiza 10 was superior than Sakha 69 in these traits.

A-2- Fertilizer treatments effect

Regarding the effect of mineral and biofertilizers on yield and its components the data in Tables 2 and 3 indicated that wheat plants which received 50% NPK combined with microbin + phosphorin + potassiomage significantly recorded the highest averages, of plant height, No. of spikes/m^2, No. of kernels/spike, spike length, 1000 grain weight, weight of grains/spike, and No. of tillers as compared to the control treatment (100% NPK). This result may indicate that the biofertilizers promoted cell elongation enhancing and improving the naturally existing nutrient transformation activities in soil. The beneficial effect of inoculation wheat grains with bio fertilizers resulted in vigorous growth as obtained that by Palm *et al.* (2001) El Kalla *et al.* (2002) and Abbas *et al.* (2007) .However, Zaki Nabila *et al.* (2007) reported that, the positive effect of mineral N fertilization on growth characters of wheat plant may be attributed to the role of nitrogen in protoplasm formation proteins, amino acids, nucleic acids many enzymes and energy transfer materials and that N also accelerates both cell division and elongation due to its great action in stimulating nutritional status and the growth parameters.

Bio-fertilizers did not significantly affect weight of spike in both seasons but significantly increase on grain yield/fed, straw yield/fed, biological yield/fed and harvest index in both seasons where 50% NPK combined with microbin + phsphoroin + potassiomage gave the highest averages. These results revealed the importance of No. of spikes/m^2 as an effective yield component markedly influenced harvest index and grain yield/fed and responded the combined addition of three biofertilizers along with 50% of the recommended NPK .

Table 2 : Main effects of varieties and fertilizer treatments on some yield and attributes and components of wheat in the two seasons

Main effect	Plant height (cm)		1000 grain weight (g)		No. of tillers/m^2		No.of spikes/m^2	Spike length (cm)		Weight of spike (g)		No. of grains/spike		Grains weight/spike(g)	
seasons / treatment	2010	2011	2010	2011	2010	2011	2010 2011	2010	2011	2010	2011	2010	2011	2010	2011
Sakha 69	86.40	85.60	38.00	37.70	537.76	553.84	307.40 314.58	13.06	12.79	2.25	2.22	37.88	37.12	1.44	1.28
Gemmiza 10	93.80	96.20	43.90	44.50	553.68	563.97	343.62 320.56	13.71	13.68	2.67	2.64	42.20	39.73	1.75	1.69
F. test	*	*	*	*	*	*	* ns	*	*	*	ns	*	*	*	*
100% NPK (control)	93.00	94.50	44.00	44.00	575.44	570.68	351.53 354.80	13.75	13.19	2.95	2.95	41.36	39.96	1.73	1.89
50% NPK + Microbin	87.50	89.00	39.20	40.90	558.02	573.15	317.05 260.10	12.45	13.80	1.99	2.29	38.70	38.99	1.38	1.40
50% NPK + potassiomage	84.00	82.00	29.30	30.20	511.16	522.40	314.89 296.30	13.15	12.65	2.13	1.90	37.99	36.66	1.45	1.22
50% NPK + phosphorin	85.50	87.00	35.00	40.50	494.02	544.80	274.27 273.80	13.11	13.22	2.30	1.94	38.30	35.66	1.24	1.14
50% NPK + microbin potassumage	101.50	102.00	57.30	50.20	590.07	588.36	370.03 402.85	14.10	14.12	2.91	3.09	43.94	41.38	1.98	2.00
LSD at 0.05	2.80	2.20	2.03	1.88	20.80	35.80	15.40 16.08	1.10	0.90	ns	ns	1.60	2.01	0.22	0.31

Table 3 : Main effects of varieties and fertilizer treatments on final yield /fed. and harvest index of wheat in the two seasons

Main effect	Biological yield/fed (ton)		Grain yield/fed (ton)		Straw yield/fed (ton)		Harvest Index (%)	
seasons / treatments	2010	2011	2010	2011	2010	2011	2010	2011
Sakha 69	4.57	4.73	1.57	1.63	3.00	3.10	34.83	34.71
Gemmiza 10	4.56	4.84	1.56	1.68	2.99	3.11	35.21	34.90
F. test	*	*	ns	*	*	*	*	ns
100% NPK (control)	5.12	5.08	1.58	1.75	3.53	3.33	30.90	34.49
50% NPK + Microbin	4.79	4.61	1.51	1.56	3.27	3.05	31.66	34.20
50% NPK + potassiomage	3.65	3.99	1.45	1.44	2.20	2.55	39.70	36.27
50% NPK + phosphorin	4.12	4.35	1.50	1.44	2.62	2.90	36.47	33.47
50% NPK + microbin + phosphorin + potassiomage	5.16	5.36	1.80	2.12	3.35	3.29	34.88	39.18
LSD at 0.05	0.038	0.04	0.039	0.155	0.058	0.177	2.79	3.17

Abd EL-Rasoul *et al.* (2003), Ibrahim *et al.*(2004) Zeidan *et al.* (2005) and Dewdar *et al.* (2008) found that, importance of bio fertilizers in photosynthesis and hence dry matter accumulation as represented in economic grain yield

Palm *et al.* (2001) and Ibrahim *et al.*, (2005) suggested that the importance of applied biofertilizer was not only takes as a criterion for increasing income for crop or rationalize of costly mineral N fertilizer but also for minimizing the possibly adverse effects on both human health and environmental risks resulted from high use of mineral NPK fertilizers. These results are in agreement with those obtained by many investigators of them Ashoush and Abd El-Moniem (2001) Hassanien *et al.* (2001) EL-Kalla *et al.* (2002) Abd El-Rasoul *et al.* (2003), Ibrahim *et al.* (2004) Zeidan *et al.* (2005) and Dewdar *et al.*(2008) they found that inoculation wheat grains with microbin and cerealine significantly improved wheat plant growth, yield and its components

Singh and Bisoy (1995) indicated that bio-fertilizers have an effective role for N fixation and biomass accumulation beside their favorable effect on mineralization of soil N and hence balance of soil N positive role of nitrogen in increasing photosynthesis which, increases more floret fertility, grains per sipke. This, in turn stimulates plant capacity in building more metabolites that increase grain yield. as reported by Abd El-Hameed 2005).

3- Interaction effects

Data in Tables 4 and 5 showed that the interaction effects between varieties and bio fertilizer treatments had a significant effect on all characters under study in both seasons except weight of grains/spike and weight of spike in both seasons and grain yield/fed (second season). Use of 50% NPK combind with microbin + phosphorin + potassiomage with Gemmiza 10 variety was superior in most traits under study such as No. of spike/m^2, No. of grains/spike, grain yield/fad and biological yield/fad in both seasons while use of 50% NPK with potassiomage with Sakha 69 gave the highest value of

harvest index in the first season, while in the second season use of 50% NPK + microbin + phosphorin + potassiomage was superior in harvest index

The significant favorable effects of the combination between NPK fertilizer doses and bio fertilizers especially between the 50% the recommended dose and the three bio fertilizers may be explained on the basis of the beneficial effects of bacteria on the nutrient availability, vital enzymes, hormonal stimulating effects on plant growth and photosynthetic activity

Wheat plants inoculated with 50% NPK + mecrobin + potassiomage + phosphorin produced the highest values of grain yield, straw yield, biological yield, No. of spikes/m^2 ,spike length ,No. of kernel/spike, 1000 kernel weight and plant height in both seasons . On the other hand uninoculated wheat plants which received 100% NPK produced lower values. El-Nagar *et al.* (2005) observed that plants which treated with biofertilizer and received the rates of mineral fertilizer showed significant enhancement of vegetative growth parameters, chemical compositions of plant leaves and availability of N, P and K in the soil

The beneficial effect of N biofertilizer on grain yield and its components might be attributed to the vigorous growth of plants as well as to the roles of bio fertilizers in improving the absorption of nutrients especially P, Fe, Zn, Mn and Cu which play important role in activation the metabolic processes

Agamy *et al.*(2012) reported that the application of Bio and/or FM in combination with NPK significantly increased all growth characters i.e., plant height, number of spikes plant, leaf area and fresh and dry weight of both shoot and spikes plant. Hassain *et al* .(2006) and Badran (2009) , also, indicated that bio fertilizer effect on growth traits may be attributed to many factors such as release of plant promoted substances, mainly indoleacetic acid (IAA) gibbrelic acid (GA_3) and cytokinin which may stimulate plant growth synthesis of some vitamins such as B_{12} , increasing amino acids content enhancing the productivity of biologically active fungistatic substance which may change the microflora in ryhizosphere and hence affect the balance between harmful and beneficial organisms and finally increase water and minerals uptake due to increase of root surface area, root hairs and root elongation.

Table 4: The effect of interaction between varieties and fertilizer treatments on some yield and yield components of wheat in the two seasons

Varieties	seasons / Treatment	Plant height (cm)		1000 grain weight (g)		Spike length (cm)		No. of spike/m²		No.of grain/spike	
		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
V1	100%NPK(contro)l	81.00	88.00	39.00	39.00	13.20	12.18	311.56	319.7	38.51	39.11
	50%NPK +Micro.	84.00	81.00	33.30	36.70	12.60	13.11	310.40	290.6	37.5	38.00
	50%NPK +Potas.	81.00	76.00	27.70	30.30	13.09	12.21	303.88	303.5	37.33	35.11
	50% NPK +Phos	81.00	81.00	31.70	36.00	13.13	13.19	280.64	317.9	36.51	33.20
	50%NPK+Micro+ Phosph+. potassio..	99.00	102.00	58.30	46.70	13.30	13.26	330.95	341.2	39.59	40.2
V2	100%NPK(control	99.00	101.00	49.00	49.00	14.20	14.20	391.50	389.9	44.22	40.82
	50%NPK+Micro..	91.00	97.00	45.00	45.00	12.9	12.90	323.71	229.4	39.90	39.19
	50% NPK +Potas.	87.00	88.00	31.00	30.00	13.1	13.10	325.91	289.1	38.66	38.21
	50% NPK+Phos.	90.00	93.00	38.30	45.00	13.25	13.25	267.91	229.7	40.11	37.90
	50%NPK+Micro +Phosph.+potassio.	102.00	102.00	56.30	53.70	14.99	14.99	409.11	464.5	48.30	42.56
LSD at 0.05		3.9	2.9	2.9	2.7	1.5	1.2	16.04	17.91	2.33	2.92

Table (5): The effect of first order interaction between varieties and fertilizer treatments on yield and some yield components of wheat in the two seasons

Varieties	seasons / treatment	No. of tillers/m²		Grain yield ton/fed		Straw yield/fed (ton)		Biological yield/fed (ton)		Harvest Index (%)	
	Seasons	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
V1	100% NPK control)	563.90	560.2	1.58	1.83	3.55	2.28	5.14	5.11	30.79	35.78
	50% NPK +Microbin	535.90	592.1	1.52	1.56	3.42	3.53	4.94	5.10	30.73	30.75
	50% NPK +Potassiomage	500.10	492.7	1.46	1.47	2.21	2.50	3.67	3.98	39.78	37.12
	50% NPK +Phosphorin	499.31	540.3	1.52	1.36	2.51	3.20	4.03	4.60	37.77	29.51
	50%NPK+micro.+Phoph .+potassio.	589.8	583.9	1.79	2.01	3.30	2.97	5.09	4.88	35.16	40.36
V2	100% NPK (control)	586.99	581.17	1.58	1.67	3.41	3.39	5.09	5.06	31.00	33.00
	50% NPK + Microbin	580.15	554.2	1.51	1.55	3.13	2.57	4.64	4.12	32.54	37.62
	50% NPK +Potassiomage	522.22	552.1	1.43	1.42	2.19	3.60	3.62	5.02	39.50	28.28
	50% NPK +Phosphorin	488.72	549.3	1.48	1.53	2.73	2.56	4.22	4.9	35.50	37.42
	50%NPK+micro+Phosph +potassio.	590.35	593.12	1.82	2.23	3.41	3.61	5.23	5.84	34.79	39.27
LSD at 0.05		22.39	29.3	0.017	ns	0.054	0.251	0.054	0.055	5.39	4.48

B - Chemical composition

B-1- Nutrients

The effect of different treatments on the mean values of macronutrients concentrations (N, P, K ,Ca) and Na in the shoots and grains of wheat cultivars (Sakha 69 and Gemmiza 10) plants grown in the two seasons (Tables 6&7) were similar to those recorded for plant height, grain yield, straw yield, biological yield. The obtained data strongly confirmed the superiority of the half recommended NPK levels combined with the dual treatment of microbin + phosphorin + potssiomage which resulted in the highest promotive effects on the nutrients accumulation .The means of treatments in both cultivars showed that accumulation of N,P,K and Ca of Gemmiza 10 were more accumulated than in Sakha 69 . This treatment accumulated the highest level of minerals in shoots and grains in both cultivars. This strongly emphasizes that the mixture; ex. microbin + phosphorin+ potssiomage in enhancement the uptake and accumulation of various nutrients in both shoots as well as the produced grains. This means that the inoculation of wheat grains resulted in a promotive effect on root development and consequently their function in the uptake of both water and nutrients .Similar results were reported by Kumar *et al.*(1998) on *zea mays* an d *sorghum* and Rashad and Ismail (2000 a) on wheat. They found that *Azospirllum* inoculation greatly enhanced the uptake of NO_3^-, NH_4^+ ,P,K and Fe as well as accumulation of those minerals in stems and leaves. Furthermore ,data in tables 5&6 indicated that plants receiving only half dose of the recommended NPK quantities and inoculated with biofertilizer , accumulated more nutrients in shoots and grains than those receiving the complete recommended NPK level without inoculation . This means that the reduction in the NPK fertilizer into half dose of the recommended NPK could be compensated by inoculation with microbin , potssiomage and phosphorin. This finding clearly suggests that N_2 fixation is involved in such

promotive effects. The roles of phosphorin and potassiomage cannot be reglecked in this respect , since the inoculation treatment could reduce the demanded quantities of mineral fertilizers. This was also mentioned by Kloeppper *et al.* (1988), El-Sersawy *et al.* (1997) and Saleh *et al.* (2001).

Table 6 : Effect of mineral and biofertilizer treatments on N %,P, K , Ca and Na (mg/g dry weight) at 145 days in the shoots of the two wheat cultivars in 2011 and 2012 seasons .

Varieties	Chemical composition / seasons / Fertilizer treat	Nitrogen%		Phosphorus mg/g d.w.		K mg/gd.w.		Ca mg/g d.w.		Na mg/g d.w.	
		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Sakha 69	100% NPK (control)	0.30	0.32	3.27	2.98	4.16	4.23	1.48	1.98	1.66	1.20
	50% NPK +Microbin	0.40	0.44	3.55	3.60	4.23	4.66	2.52	2.21	1.26	1.31
	50%NPK +Potassiomage.	0.33	0.45	2.34	2.68	5.92	5.26	1.68	2.02	1.00	1.20
	50%NPK Phosphorin	0.38	0.35	5.25	4.97	4.16	4.49	1.96	1.99	1.43	1.51
	50%NPK +Micro+ Phosphorin +Potassio.	0.41	0.39	6.14	5.74	8.46	8.52	3.74	3.11	0.97	0.66
Mean		0.36	0.39	4.11	3.99	5.39	5.43	2.28	2.26	1.26	1.18
Gemmiza 10	100% NPK (control)	0.31	0.34	3.90	2.78	3.96	4.41	2.54	2.12	1.02	0.78
	50%NPK +Microbin	0.43	0.45	3.64	3.41	4.74	4.88	2.80	2.17	0.82	0.60
	50% NPK+ Potassiomage	0.38	0.41	2.89	2.77	5.76	5.92	2.46	2.85	0.69	0.64
	50% NPK +Phosphorin	0.40	0.38	5.96	5.98	4.18	4.94	2.86	2.90	0 76	0.82
	50%NPK+Micro.+ Phosphorin + potassio..	0.49	0.46	7.05	6.66	8.12	8.81	3.42	3.82	0.51	0.67
Mean		0.41	0.41	4.69	4.32	5.35	5.81	2.74	2.77	0.76	0.7

Table 7 : Effect of mineral and biofertilizer treatments on N % , P, K ,Ca and Na (mg/g dry weight) in the grains of the two wheat cultivars in 2011 and 2012 seasons .

Varieties	Chemical composition / seasons / Fertilizer treat	Nitrogen%		Phosphorus mg/g d.w.		K mg/g d.w.		Ca mg/g d.w.		Na mg/g d.w.	
		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Sakha 69	100% NPK (control)	0.37	0.35	1.4	1.18	1.36	1.32	1.41	1.40	0.8	0.83
	50%NPK+Micronin	0.42	0.45	1.22	1.27	1.38	1.46	1.81	1.45	0.44	0.64
	50% NPK +Potassiomage	0.38	0.40	1.75	1.68	1.88	1.76	1.83	1.47	0.63	0.61
	50%NPK+ Phosphorin	0 44	0.39	1.82	189	1.24	1.42	1.46	1.67	0.61	0.81
	50%NPK+Micro..+ Phos + pota.ssio.	0 49	0.46	2.91	2.66	2.01	1.96	2.23	2.89	0.38	0.44
Mean		0.42	0.41	1.82	1.74	1.57	1.58	1.80	1.78	0.57	0.67
Gemmiza 10	100% NPK (control)	0.34	0.39	1.44	1.32	1.48	1.52	1.44	1.45	0.50	0.68
	50%NPK+ Microbin	0.39	0.43	1.46	1.39	1.64	1.61	1.48	1.52	0.64	0.56
	50%NPK+ Potassiomage	0.35	0.39	1.81	1.33	2.13	1.98	1.90	1.61	0.62	0.66
	50%NPK +Phosphorin	0.44	0.40	2.92	2.70	1.92	1.85	2.01	1.67	0.66	0.71
	50%NPK+Micr.+ Phospho + potassio..	0.52	0.48	3.41	2.88	2.64	2.41	2.96	2.88	0.37	0.41
Mean		0.41	0.42	2.21	1.97	1.96	1.87	1.96	1.83	0.56	0.60

B-2- Total sugars , total free amino acids ,total soluble phenols and crude protein

Obtained data in Tables 8 and 9 confirmed the prevous data in Tables 6 and 7 in regards to the gradual increases in sugars , amino acids and phenols concentrations of shoots as well as grains .Crud protein as NPK levels were increased. Similar results were reported by Castro et al (1989); El-Essawi *et al.* (1995)on sorgham plant and by Ghallab and Nesim(1999) on wheat . Also the present data strongly confirmed the superiority of the half recommended NPK levels combined with the dual treatment of microbin + phosphorin+ potssiomage.

Probably the most interesting finding is that plants received only half the dose of the recommended NPK fertilizer together with the dual inoculation recorded considerable increases in sugar and amino acids in their shoots as well as grain crude protein contents. This finding strongly confirmed the previous conclusion drawn about the nutrient concentrations (Tables 6 and 7). The high positive responses induced by intensive biofertilization with respect to nutrients , sugars ,free amino acids , and crude protein suggest the possibility of promoting effects on photosynthetic activity and consequently photosynthetic products ,mainly sugars .Also, increasing the available N enhanced the biosynthesis of amino acids, enzymes as well as some phytohormones such as auxins .The previous obtained results are in agreement with those of Ghallab and Salem(2001) on wheat and El-Essawi *et al.*,(1995) on sorgham plant. Also,Dwivedi *et al.* (1990) found that inoculation of wheat grains with *Rhizobium* significantly increased protein and essential amino acids contents. Hanafy Ahmed *et al.*(2000) found that total sugar and free amino acids concentrations in the leaves of lettuce were increased by all commercial biofertilizer , rhizobacterin rhizobacterin , nitrobien , microbin and biogen. In addition, it is important here to mention that the beneficial effects of biofertilizer inoculation with appropriate strains might be attributed to increase ;1- the symbiotic N fixation in the soil ,2- levels of free amino acids in the cell –sap, development and physiological enzymatic activity and growth rates of roots, multiplication and extension . Similar results were also reported by Agamy et al.(2012) on wheat plant .The author concluded that total carbohydrates and crude protein in leaves as well as grains were significantly increased by all treatments (Bio) (namely, *Azotobacter*, *Azospirillium*, *Rhizobium* and *Pseudomonas*), farmyard manure (FM) (0, 15 ton /fed) and mineral fertilizer (NPK) (0, 25, 50 and 100% of the recommended dose) , particularly the combined treatment of Bio+FM+50% NPK.

B-3- Total indols

Data in Tables (8&9) confirmed the previus data in Tables (6&7) in regards to the gradual increases of indols in shoots as well in grains . In both shoot and grains of wheat strongly confirmed the superiority of the half recommended NPK levels combined with the dual treatment of microbin + potssiomage + phosphorin. In the successive seasons of both cultivars .In this respect ,it might be suggested that the increase in total indoles and total free amino acids may be attributed to the role of bio-fertlizers in the synthesis or release of some growth – promoting substances such as auxins,

gibberellins and cytokinins, and consequently the formation of natural auxin in plants. These findings are in harmony with those obtained by El Desouky (2004); Abd El-Hady *et al.* (2006) And Dewdar *et al.* (2008).

According to these results,a complementary effect between biofertilization with the three biofertilizers and the use of the half dose of three NPK fertilizers was clearly observed on almost all wheat yield attributes and hence the grain yield /fed. The chemical analysis of shoots and grains supported the view of a hormone effect might have been induced by the use of biofertilizers which stimulated growth and yield through more N,P and K uptake and as well as more metabolites synthesis. Thus, it is highly recommended to cultivate the var. Gemmiza 10 combined with the treatment of 50% NPK levels microbin + phosphorin+ potssiomag reducing the costs of mineral fertilizers, and decreasing the environmental pollution.

Table 8: Effect of mineral and biofertilizer treatments on total sugars, total free amino acids and total soluble Phenols, total indols (mg/g dry weight) and C.P % in the shoots of the two wheat cultivars in 2011 and 2012 seasons .

Varieties	Chemical composition / seasons / Fertilizer treat	Total Sugars		Free amino acids		Total soluble Phenols)		C.P%		Total indols	
		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Sakha 69	100% NPK (control)	38.72	36.26	2.70	2.77	3.02	3.18	1.75	1.85	2.41	2.64
		5.28	5.01	3.68	3.93	2.33	2.56	3.38	3.48		
	50% NPK+Microbin	41.09	40.42								
	50% NPK+Potassiom	49.82	46.22	3.88	4.11	3.57	3.26	1.92	2.62	2.49	2.88
	50% PK+Phosphorin	44.50	42.84	4.17	5.60	3.50	3.36	2.22	2.04	3.04	3.25
	50% NPK+ Micro. .+Phos +Potassio.	58.51	59.74	6.85	7.15	3.89	4.44	2.39	2.27	3.58	3.88
Mean		46.53	45.1	4.58	4.93	3.53	3..63	2.10	2.27	2.98	3.23
Gemmiza 10	100% NPK (control)	36.94	38.48	3.42	3.90	3.18	3.00	1.81	1.98	2.68	2.61
		5.11	4.94	4.00	3.81	2.68	2.62	3.79	3.88		
	50% NPK+Microbin	40.26	44.04								
	50% NPK+Potassiom	50.35	52.50	4.67	4.88	4.01	3.5	2.22	2.39	3.06	3.35
	50% PK+Phosphorin	43.30	45.00	4.13	4.32	3.65	3.56	2.33	2.22	3.39	3.44
	50% NPK+ Micro .+ Phos +Potassio.	59.75	62.00	7.07	6.19	4.11	4.59	2.86	2.62	4.54	5.00
Mean		46.10	48.40	4.89	4.85	3.79	4.29	2.39	2.37	3.49	3.66

Table 9 : Effect of mineral and biofertilizer treatments on total sugars, total free amino acids and total soluble Phenols, total indols ((mg/g dry weight) and C.P % in the grains of the two wheat cultivars in 2011 and 2012 seasons .

Varieties	Chemical composition / seasons / Fertilizer treat	total sugars		Free amino acids		Total soluble Phenols		C.P %		Total indols	
		2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Sakha 69	100% NPK (control)	22.26	23.40	1.95	2.14	1.40	1.53	2.16	2.45	1.23	1.43
	50% NPK + Microbin	25.18	26.11		2.15	1.27	1.42	2.04	2.62	1.25	1.50
	50% NPK + Potassiomage	29.24	29.30	1.62	1.97	1.38	1.30	2.22	2.33	1.14	1.17
	50% NPK +Phosphorin	27.58	26.00	1.68	1.83	1.35	1.40	2.56	2.27	1.21	1.32
	50% NPK+ Micro.+ Phosph +Potassio.	39.26	38.80	3.01	2.28	2.19	1.89	2.86	2.68	1.55	1.64
Mean		28.77	28.7	2.08	2.00	1.57	1.46	2.45	2.39	1.31	1.38
Gemmiza 10	100% NPK (control)	23.17	21.96	1.87	2.31	1.96	2.14	1.45	2.11	1.39	2.68
	50% NPK + Microbin	26.82	25.70					1.98	2.27	2.27	2.51
	50% NPK+ Potassiomage	30.11	30.61	2.00	1.89	1.67	1.94	2.04	2.27	1.16	1.17
	50% NPK + Phosphorin	29.22	29.14	1.88	1.51	1.49	1.43	2.56	2.33	1.15	1.18
	50% NPK+ Micro Phosph +potassio..	40.34	39.11	2.84	3.11	2.34	2.21	3.03	2.80	1.43	1.52
Mean		29.93	28.90	2.18	2.12	1.81	1.95	2.39	2.44	1.19	1.24

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انتاج القمح والمحتوي الكيماوي للنبات تحت معاملات تسميد حيوي ومعدني مختلفة

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أجريت تجربتان حقليتان بمحطة التجارب والبحوث الزراعية بكلية الزراعة جامعة القاهرة فى موسمى (٢٠١٠/٢٠١١ و ٢٠١١/٢٠١٢) لدراسة تأثير خمس معاملات تسميد حيوى ومعدنى على نمو وإنتاجيةو المحتوي الكيماوي لصنفين من القمح (جميزة ١٠ و سخا ٦٩) وكانت المعاملات المستخدمة كالتالى :

١- ١٠٠ % من السماد المعدنى الموصى به (٧٥ ن + ١٠٠ فو + ٢٤ بو كم / فدان)

٢- ٥٠% من السماد المعدنى الموصي به + المخصب الحيوى ميكروبين

٣- ٥٠% من السماد المعدنى الموصى به + المخصب الحيوى بوتاسيوماج

٤- ٥٠% السماد المعدنى الموصى به + المخصب الحيوى فوسفورين

٥- ٥٠% من السماد المعدني الموصى به +مخلوط المخصبات الحيوية(ميكروبين + الفوسفورين + البوتاسيوماج)

صممت التجربة فى تصميم القطع المنشقة فى ٤ مكررات حيث وضعت الأصناف فى القطع الرئيسية ومعاملات التسميد فى القطع المنشقة ويمكن تلخيص اهم النتائج المتحصل عليها فيما يلى:

اظهرت الأصناف ومعاملات التسميد (حيوى – المعدنى) تاثير معنوي على معظم الصفات تحت الدراسة حيث تفوق الصنف جميزة ١٠ فى طول النبات ، وزن الالف حبة وعدد الأفرع/م^2 ، وطول السنبلة ووزن الحبوب وعدد الحبوب/السنبلة في كلا الموسمين وعدد السنابل/م^2 ووزن السنبلة (موسم أول) بينما تفوق الصنف سخا ٦٩ معنويا فى المحصول البيولوجى ، محصول القش ، دليل الحصاد (موسم أول). كما تفوقت معاملة التسميد (٥٠% من السماد المعدنى + ميكروبين + بوتاسيوماج + فوسفورين) فى اغلب الصفات تحت الدراسة مثل طول النبات ، وزن الألف حبة ، عدد الافرع/م^2 ، طول السنبلة ، عدد حبوب السنبلة/وزن حبوب

السنبلة ، عدد السنابل/م^2 ، محصول الحبوب ، المحصول البيولوجى فى كلا الموسمين ودليل الحصاد (الموسم الثانى) .

اظهر التفاعل بين الأصناف ومعاملات التسميد تاثيرا معنويا على معظم الصفات تحت الدراسة حيث تفوق الصنف جميزة ١٠ مع معاملة (٥٠% سماد معدنى + ميكروبين + فوسفورين + بوتاسيوماج) على طول النبات ، وزن الألف حبة ، طول السنبلة ، عدد السنابل/م^2 ، عدد الحبوب/السنبلة ، عدد الأفرع/م^2، محصول الحبوب والمحصول البيولوجى فى كلا الموسمين ، محصول القش في (الموسم الأول) . و كانت للمعاملة (٥٠% سماد معدنى + ميكروبين + فوسفورين + بوتاسيوماج)تاثير معنوي علي معظم صفات النمو للصنفين مقارنة بالمعاملات الاخري و كذلك علي التقديرات الكيماوية حيث انتجت أعلي القيم للسكريات الكلية والاحماض الامينية الحرة و الفينولات الكلية الحرة الذائبة والاندولات الكلية والنسبة المئوية للبروتين وكذلك العناصر المعدنية مثل الفوسفور و البوتاسيوم و الكالسيوم بينما انخفض قيم عنصر الصوديوم لهذه المعاملة مقارنة بالمعاملات الاخري .

لذا من خلال النتائج المتحصل عليها يمكن التوصية باستخدام المخصبات الحيوية ميكروبين و فوسفورين و بوتاسيوماج بالاضافة إلي ٥٠% من مستويات التسميد النتروجيني و الفوسفاتي و البوتاسي بهدف تحسين حالة النمو الخضري و المحصول ومكوناته والمحتوي الكيميائي لنباتات القمح وتقليل استخدام الاسمدة الكيماوية لخفض تلوث البيئة وكذلك تكاليف الانتاج.

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