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Effect of Biofertilization with Different Levels of Nitrogen and Phosphorus on Wheat and Associated Weeds under Weed Control Treatments

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Abstract: Two field trials were conducted at the Agricultural Experimental Station of National Research Centre, Egypt, to study the influence of dual biofertilization (phosphate dissolving bacteria and *Azospirllum spp.*) with different levels of nitrogen (50, 75 and 100%) and phosphorus (25, 50 and 100%) of recommended rates under weed control treatments (hand weeding, isoproturon, bifenox and tribenuron-methyl herbicides) on yield components of wheat plants and associated weeds.
The highest N and P contents in wheat grains were found in plants treated by biofertilization with 75% N and 50% P of recommended rates under weed-free by bifenox herbicide application. The data showed a positive relationship between the weed weights and the rates of N and P elements. On the other hand, biofertilization had no effect on weed weights under different treatments.The application of biofertilization increased grain yield by 6.49% over the non-biofertilized treatments. Generally, no significant differences were observed in grain yield between nitrogen and phosphorus of recommended rates and with either 100% N + 50% P or 75% N + 100% P under biofertilization with isoproturon herbicide application.

Key words: Wheat-biofertilization-weed control-nitrogen and phosphorus

Introduction

Wheat crop has a leading position among world crops since it has many natural advantages as food. In Egypt, it is the main winter cereal crop.
The chemical fertilizers may cause soil and water pollution, and the escalating costs of fertilizers there has been an increasing interest in the use of biofertilizers. Several reports emphasized the role of asymbiotic N-fixing bacteria in increasing yield and improving nutrient uptake of field crops. Radwan and El-Nimr (1996) and Aly *et al*. (1999) found highly significant increases in growth, grain yield and yield components of wheat by inoculation of crop seeds with multistrain inoculants of asymbiotic N-fixing bacteria. Nitrogen and phosphorus nutrients were the most important and affecting on the characteristics evaluated (grain yield, yield components, phytomass production, hectoliter weight, plant height and harvest index of wheat), Mellado *et al*. (1992). The interaction of weed control methods and N levels was significant (Azad and Singh, 1997).
Uncontrolled weed growth reduced wheat yields by 61.0% relative to the weed-free control (Hucl, 1998). The grain yield of wheat, on average, was higher in herbicide treatments by 12.86% over hand weeding (Azad *et al*., 1997).
The aim of this investigation is to study the effect of weed control, biofertilizer and nitrogen and phosphorus levels and their interaction on wheat yield and its components as well as weed association.

Materials and Methods

Two field experiments were conducted at the Agricultural Experimental Station of National Research Centre at Shalakan, Kalubia Governorate, Egypt, during the winter seasons of 1997/1998 and 1998/1999.
The soil is clay loam with total nitrogen 0.12%, available P 14.3 ppm, organic matter 1.62% and pH 8.10. The experiments were performed to study the effect of weed control and biofertilization treatments on wheat under different levels of nitrogen and phosphorus elements. Each experiment included 40 treatments, which were the combination of 4 weed control, two biofertilization and five N and P levels treatments.
Different treatments were arranged in split-split-plot design with four replications. Biofertilization treatments were randomly arranged in the main plots, N and P levels were assigned at random in sub-plots, whereas the weed control treatments were allocated in the sub-sub-plots. Experimental unit area was 10.5 m^2 (1/400 feddan).

The treatments were as follows:
Main plots (Biofertilization):
1. Untreated control (non-biofertilzer)
2. Biofertilizer

Sub-main plots (N & P levels):
1. Nitrogen (100%) + phosphorus (100%) of recommended.
2. Nitrogen (75%) + phosphorus (100%) of recommended.
3. Nitrogen (50%) + phosphorus (100%) of recommended.
4. Nitrogen (100%) + phosphorus (50%) of recommended.
5. Nitrogen (100%) + phosphorus (25%) of recommended.

Sub-sub-plots (Weed control):

1. Hand weeding was under taken two times at 21 and 45 days after sowing (DAS).
2. Isoproturon herbicide (IP FLO 50% EC) at the rate of 1.25 L./feddan.
3. Bifenox herbicide (Modown 48% EC) at the rate of 0.6 L./feddan.
4. Tribenuron-methyl herbicide(Granstar 75 DF) at the rate of 8 g/feddan.

Seeds of wheat (*Triticum aestivum* L.) c.v. Sakha 69 was sown on 21th November in the two successive seasons. The three herbicidal treatments were sprayed at the 4th leaf stage of wheat growth. Phosphorus fertilizer was applied during soil preparation as calcium super-phosphate (15.5% P_2O_5). Nitrogen fertilizer was applied as ammonium sulfate (20.6% N) in two equal doses, before the first and second irrigation.

Preparation and application of biofertilizer: Dual biofertilizer (*Azospirillum sp.* and phosphate dissolving bacteria) was prepared by mixing highly efficient strains in equal amounts of each strain broth after separately grown in specific nutrient broth for 48 hours at 30°C in a rotary shaking incubator. Peat moss was used as a carrier for dual biofertilizer and arabic gum solution (40%) as sticker just before sowing.
The experimental area was irrigated, immediately after sowing. All the normal cultural treatments for wheat crop were practiced.

Data recorded: - Counts of *Azospirillum sp.* and phosphate dissolving bacteria in the biofertilized rhizosphere of wheat plants were enumerated successively after 4, 8, 12 and 16 weeks from sowing under different treatments.
- Weeds were hand pulled from one m^2 of each plot at two times namely 45 and 75 days from sowing and total dry weight of weeds / m^2 was recorded.
At harvest (1st week of May), the spike grain weight (g), 1000-grain weight (g), grain and straw yield (kg) per feddan (Feddan = 4200 m^2) and harvest index were determined. Nitrogen and phosphorus contents of wheat grains (mg/plant) were estimated according to Jackson (1971).
Statistical analysis was performed according to Snedecor and Cochran (1967). Treatments means were compared by L.S.D test. Combined analysis was made for the two growing seasons as results followed similar trend.

Results and Discussion

Effect of treatments on efficiency of added microorganisms:
Counts of phosphate dissolving bacteria (PDB) and *Azospirillum spp.* in the biofertilized rhizosphere of wheat plants were enumerated successively after 4,8,12,16 weeks under different weed control treatments and nitrogen + phosphorus levels (Fig. 1).
The obtained results indicate pronounced differences in the counts of tried microorganisms in biofertilized rhizosphere under different herbicides application. However, PDB counts were generally higher in the rhizosphere compared to *Azospirillum spp.* under different treatments. Counts of tested microorganisms reached their maximum in between 8 to 12 weeks.
Generally, biofertilized rhizosphere receiving isoproturon herbicide contained always higher counts of the applied microorganisms in comparison with either bifenox or tribenuron-methyl herbicides. This trend may be due to the isoproturon did not exert marked depressive effect on the tried microorganisms, but on the contrary it seemed stimulate the growth of microorganisms. Hand weeding treatment recorded higher counts of applied microorganisms compared to tried herbicides, except isoproturon herbicide application.
On the other hand, counts of PDB and *Azospirillum spp.*in the biofertilized rhizosphere of wheat plants were recorded lower counts under N 100% and P 100% application. Higher counts of PDB and *Azospirillum spp* were found in the rhizosphere of plants which fertilized with N 100% + P 50% and N 50% + P 100%, respectively. Similar results were reported by El-Demerdash *et al.* (1992) and Attallah and El- karamity (1997).

Effect of treatments on weeds
Effect of weed control treatments: In both growing seasons, the dominant weeds were *Beta vulgaris* L., *Ammi majus* L., *Chenopodium album* L., *Sonchus oleraceus* L., *Avena fatua* L. and some other rare weeds such as *Medicago hispida* Gaertn and *Rumex dentatus* L.
Data in Table 1 showed that isoproturon herbicide was more toxic for wheat weeds followed by tribenuron-methyl herbicide, whereas bifenox and hand weeding treatments recorded the largest dry weight of weeds at 45 days after sowing (DAS). While at 75 DAS, hand weeding treatment surpassed other treatments in weed dry weight reduction. This may be due to a flush of weeds emergence occurring some time after the application of herbicides (Grundy *et al.*, 1996). However, no significant difference was found between hand weeding and isoproturon herbicide in this respect. These result are in agreement with those obtained by Yadav *et al.* (1995) Azad (1997) and Azad *et al.* (1997).

Effect of biofertilization: Results in Table 1 revealed that biofertilization treatments had no significant effect on dry weight of weeds at 45 and 75 days from sowing.
There is lack of review literature on the effect of the biofertilization on weed growth. Therefore, further study is required to prove the proper information in this respect.

Effect of nitrogen and phosphorus levels: Results in Table 1 showed a positive relationship between the total dry weight of weeds recorded at 45 and 75 DAS (Days after sowing) and the level of nitrogen and phosphorus fertilization. High rates of N and P led to more dry weed weights. Similar result was obtained by Prasad and Singh (1995) and Singh (1997). They stated that weed dry matter increased with increasing N rate. Patterson (1995) noticed that weed growth in low phosphate treatments was very poor. On the contrary, Azad and Singh (1997) and Naik *et al.* (1997) observed that vigorous crop stand and growth due to higher nitrogen levels assert a strong smothering effect on growth and development of weeds.
The data also indicated that the role of N fertilizer in increasing the dry weight of weeds was more evident than phosphorus fertilizer. In this respect, Zimdahl (1993) stated that N is the first nutrient to become limiting in most instances of weed-crop competition and competition for phosphorus is more likely to occur after plants are mature and have extensive, over lapping root development.

Effect of interaction: The interaction effect between weed control treatments (W.C.T) X biofertilization (B), B X N and P levels and the interaction between the three factors studied had no significant effect on wheat weeds. While the interaction effect between W.C.T. X N and P levels on dry weight of weeds was significant. This result was true at 45 and 75 days after sowing.
Data in Table 2 indicated that the lowest dry weight of weeds at 45 DAS was achieved by the application of tribenuron-methyl herbicide combined with the rate of N 100% + P 25%, while at 75 DAS, the same herbicide with the full recommended rate of nitrogen and phosphorus (N and P) treatment recorded the heaviest weed dry weight. Similar results were obtained by Clasrson and Hill (1985). On the contrary, Yadav *et al.* (1995) and Azad *et al.* (1997) mentioned that an increase in N level with the application of isoproturon herbicide increased the weed control efficiency and reduced weed biomass.

Effect of treatments on wheat yield and its components:
Effect of weed control treatments: The data in Table 1

Table 1: Effect of weed control, biofertilization, nitrogen and phosphorus levels treatments and their interactions on wheat yield and associated weeds (Combined analysis of two seasons)

Treatments	Dry weight of weeds (g/m^2) 45 DAS	Dry weight of weeds (g/m^2) 75 DAS	Grain yield kg/fed.	Straw yield kg/fed.	Harvest index	1000-grain weight (g)	Grain weight/ spike (g)	Grain nitrogen content (mg/plant)	Grain phosphorus content (mg/plant)
Weed control (W.C.)									
Hand weeding	15.0	18.9	3097	4926	38.6	49.0	1.98	139.8	30.8
Isoproturon	10.0	24.8	3313	5074	39.5	49.3	2.04	146.8	32.7
Bifenox	14.9	34.9	3031	4662	39.4	48.2	2.12	143.5	31.0
Tribenuron-methyl	11.2	26.2	2903	4446	39.5	48.3	1.97	126.8	28.4
LSD at 5%	3.3	6.1	133	379	NS	NS	0.13	NS	NS
Biofertlization (B)									
Non biofertilized	12.4	26.8	2989	4655	38.6	48.2	1.94	137.4	28.9
Biofertilized	13.2	25.6	3183	4899	39.9	49.2	2.11	141.1	32.5
LSD at 5%	NS	NS	*	NS	*	*	*	NS	*
N and P levels									
N 100% +P 100%	18.1	32.6	3336	5325	38.5	50.8	2.29	182.7	34.2
N 75% + P 100%	16.1	25.6	3107	4875	38.9	48.2	2.03	139.6	31.1
N 50% + P 100%	12.4	22.6	2810	4446	38.7	46.2	1.82	111.5	28.2
N 100% +P 50%	9.0	26.6	3213	4815	40.0	50.0	2.12	139.6	31.2
N 100% +P 25%	8.5	23.7	2964	4424	40.1	48.3	1.87	123.1	29.0
LSD at 5%	3.7	6.8	148	422	1.3	0.7	0.15	26.1	1.4
LSD for the interaction									
W.C. X B.	NS	NS	NS	NS	*	NS	*	NS	*
W.C. X N and P	*	*	*	*	NS	NS	NS	NS	NS
B. X N and P	NS	NS	*	NS	*	NS	*	NS	NS
W.C X B X N and P	NS	NS	*	NS	NS	NS	*	*	*

* : Significant NS : Non significant

Table 2: Effect of the interaction between weed control and nitrogen and phosphorus levels treatments on some wheat yield characters (Combined analysis of two seasons)

Treatments	Weed dry weight (g/m^2) 45 DAS* Hand weeding	Isoproturon	Bifenox	Tribenuron-methyl	Weed dry weight (g/m^2) 75 DAS Hand weeding	Isoproturon	Bifenox	Tribenuron-methyl
N100% + P100%	21.7	12.7	18.8	19.2	19.1	37.9	34.5	38.8
N75% + P100%	20.9	8.9	21.1	13.7	18.8	24.8	33.9	24.8
N50% + P100%	14.6	13.4	10.3	11.3	18.2	18.5	31.5	22.1
N100% + P50%	8.9	7.6	12.6	6.7	17.0	21.8	38.3	29.4
N100% + P25%	9.0	8.1	11.8	5.2	21.2	20.9	36.5	16.1
LSD. at 5 %	7.4				13.6			

Treatments	Grain yield (kg/fed.) Hand weeding	Isoproturon	Bifenox	Tribenuron-methyl	Straw yield (kg/fed.) Hand weeding	Isoproturon	Bifenox	Tribenuron-methyl
N100% + P100%	3348	3588	3322	3085	5149	5904	5352	4846
N75% + P100%	3140	3351	3094	2845	4823	4815	4958	4279
N50% + P100%	2768	3014	2708	2750	4552	4420	3988	4051
N100% + P50%	3236	3453	3219	2946	4861	4890	4455	4479
N100% + P25%	2992	3159	2750	2892	4388	4710	3943	4080
LSD at 5%	297				847			

* DAS : Days after sowing

Table 3: Effect of the interaction between weed control , biofertilization and N and P levels on grain yield and N and P contents of wheat plants (Combined analysis of two seasons)

Treatments	Non-biofertilized N100% P100%	N75% P100%	N50% P100%	N100% P50%	N100% P25%	Biofertilized N100% P100%	N75% P100%	N50% P100%	N100% P50%	N100% P25%
Grain yield (kg/feddan)										
Hand weeding	3255	2961	2634	3184	2936	3441	3318	2901	3282	3048
Isoproturon	3473	3200	2936	3348	3120	3702	3502	3092	3557	3197
Bifenox	3219	2916	2627	3169	2716	3425	3272	2788	3269	2912
Tribenuron-methyl	2969	2773	2645	2871	2822	3200	2916	2855	3020	2961
LSD. at 5 %	422									
Spike grain weight (g)										
Hand weeding	2.19	1.97	1.62	2.05	1.69	2.20	2.00	1.82	2.14	1.92
Isoproturon	2.34	1.93	1.61	1.98	1.85	2.58	2.03	1.84	2.21	2.04
Bifenox	2.39	2.00	1.73	2.18	1.70	2.46	2.22	2.10	2.36	2.08
Tribenuron-methyl	2.09	1.93	1.90	1.96	1.60	2.08	2.10	1.93	2.09	1.97
LSD at 5 %	0.42									

indicated that the highest grain yield per feddan was obtained by the application of isoproturon herbicide, which exceeded that of hand weeding, bifenox and tribenuron-methyl treatments by 7.0, 9.3 and 14.1%, resepctively.Naik *et al.* (1997) mentioned that grain yield/ha was significantly higher with isoproturon treatment than hand weeding.

Data also showed that, no significant differences in grain yield/fed. were noticed between hand weeding, bifenox as well as tribenuron-methyl treatments. Other experiments have gotten similar results (Singh *et al.*, 1993; Azad *et al.*, 1997). More or less, straw yield per feddan took the same

Table 3: Continue

Treatments	Non-biofertilized N100% P100%	N75% P100%	N50% P100%	N100% P50%	N100% P25%	Biofertilized N100% P100%	N75% P100%	N50% P100%	N100% P50%	N100% P25%
Grain nitrogen content (mg/plant)										
Hand weeding	176.9	141.1	110.5	147.3	118.6	174.9	139.9	118.4	143.1	128.0
Isoproturon	209.0	135.3	115.0	150.2	131.2	182.0	147.2	117.0	159.2	121.5
Bifenox	180.9	159.6	96.9	133.4	133.0	221.8	133.5	117.0	137.4	122.2
Tribenuron-methyl	154.7	136.4	96.8	117.8	103.4	161.0	123.4	120.2	127.9	126.5
LSD. at 5 %					74.3					
Grain phosphorus content (mg/plant)										
Hand weeding	30.1	25.7	26.6	32.1	32.9	35.7	31.6	30.9	31.3	30.6
Isoproturon	33.8	34.9	29.6	35.6	28.0	39.4	36.3	28.6	31.9	28.7
Bifenox	32.5	25.3	27.2	27.5	23.6	40.3	36.7	28.3	35.7	32.8
Tribenuron-methyl	25.8	28.0	25.9	27.1	26.3	35.9	30.2	28.0	28.2	28.7
LSD at 5 %					4.0					

trend of that the grain yield per feddan (Table 1). Isoproturon herbicide treatment gave the heaviest straw yield, while the lowest straw yield was recorded with tribenuron-methyl treatment.

Results in Table 1 denote that harvest index and 1000-grain weight were not significantly affected by the studied weed control treatments. Bifenox herbicide treatment was superior to the other weed control treatments for spike grain weight.

Effect of biofertilization treatments: Data presented in Table 1 demonstrated that inoculated wheat seeds with biofertilizer significantly increased the grain yield/feddan, harvest index, 1000-grain weight and spike grain weight by 6.5, 3.4, 2.1 and 8.8%, respectively, rather than non-biofertilized treatments. Similar findings were reported by Radwan and El-Nimr (1996) and Malakouti and Savaghebi (2000). The relative positive effect of biofertilizer treatment on some yield criteria may be attributed to their N_2-fixing activity and the production of plant growth promoting substances such as IAA, gibbrillin and cytokinine-like substances (El-Demerdash *et al.*, 1992) as well as mineralization of certain macro and micronutrients (El-Shanshoury, 1995).

Effect of nitrogen and phosphorus levels: It is evident from the results in Table 1 that grain and straw yield per feddan, 1000-grain weight and grain weight per spike were increased by increasing nitrogen and phosphorus fertilizer levels, but the differences between levels were not significant in all cases. The largest grain and straw yield per feddan were obtained by the application of full recommended rate of nitrogen and phosphorus fertilizers (70 kg N/feddan + 15.5 kg P_2O_5/feddan).

No significant differences were detected between levels of 100% N + 100% P and 75% N + 100% P and 100% N + 50% P as well as between 75% N + 100% P and 100% N + 25% P in grain yield/fed. These results are in agreement with the finding of Naik *et al.* (1997) Auti *et al.* (1999) and El-Desouky *et al.* (2000). They reported that dry weight of plant organs, shoot : root ratio, assimilation rates, final yield, index of 1000 grains weight and straw yield per feddan were significantly increased by increasing nitrogen levels.

Effect of interaction

Weed control X biofertilization: Weed control X biofertilization treatments had significant effect on spike grain weight, harvest index and grain phosphorus content. The combination between biofertilization and bifenox herbicide significantly improved the spike grain weight, harvest index and grain phosphorus content by 12.0, 4.7 and 25.7%, respectively over the non-fortified treatmens (Fig. 2).

Weed control X nitrogen + phosphorus levels: All weed control treatments produced the heaviest grain and straw yield per feddan, when the full recommended levels of nitrogen + phosphorus were applied (Table 2) while the lowest yield was obtained with low level of both N and P fertilizers. These results are in harmony with those obtained by Prasad and Singh (1995) and Azad and Singh (1997). In this respect, Grundy *et al.* (1996) reported that there was an interaction between herbicide and N levels and yield benefit was only seen at the highest N application.

Biofertilization X nitrogen and phosphorus levels: The effect of the interaction between biofertilization and nitrogen + phosphorus levels on straw yield, 1000-grain weight, and nitrogen and phosphorus content in grains was not statistically significant, consequently, the data were excluded. On the other hand, grain yield per feddan, spike weight and harvest index were significantly affected by the interaction between biofertilization and nitrogen and phosphorus levels (Fig. 3).

Largest grain yield per feddan and spike grain weight were obtained by biofertilization combined with the full recommended level of nitrogen and phosphorus fertilizer (Fig. 3). Similar result was obtained by Radwan and El-Nimr (1996) and Attallah and El-Karamity (1997). Data also showed that the biofertilziation in the presence of 75% N + 100% P or with 100% N and half recommended level of phosphorus gave more grain yield than the full recommended level N and P fertilizer alone. Similar results were obtained by Attalla and El-Karamity (1997) and Sharaan and El-Samie (1999). Aly *et al.* (1999) concluded that about half of the applied N fertilizer could be saved when wheat grains were inoculated with non-symbiotic fixing bacteria, without seriously affecting yield.

Concerning the grain weight/spike, the biofertilization increased significantly the spike grain weight with low levels of N or P fertilizer. This may be attributed to that under the heavy use of mineral N fertilizer, the N-fixing bacteria originally living in the soil may mutate into non-fixing forms (Moharram, 1999). Harvest index was

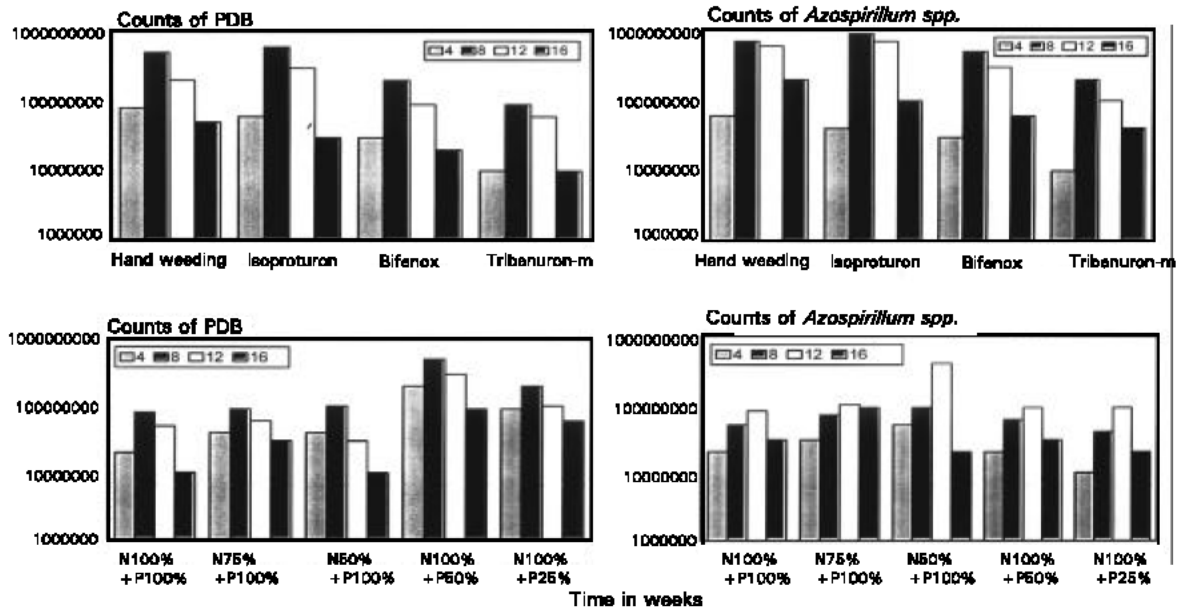

Fig. 1: Count of PDB and Azospirillum spp. In biofertilizad rhizosphere of wheat plants under different weed control and N+P levels

significantly improved, in most cases, by the combination between biofrtilization and nitrogen+phosphorus levels treatments (Fig. 3).

Effect of interaction of weed control X biofertilization X N+P levels: Results illustrated in Table 1 showed that the second order interaction effect on straw yield per feddan, harvest index and 1000 grain weight were not statistically significant. These results suggest that weed control, biofertilization and N + P fertilizer levels act independently. Consequently, the data were excluded. On the other hand, grain yield per feddan, grain weight/spike and nitrogen and phosphorus contents in wheat grains were significantly affected by the interaction between the experimental factors (Table 3).

Regarding the grain yield per feddan, data listed in Table 3 showed that the highest yield was produced when wheat seeds was inoculated by the biofertilization under controlling weeds by isoproturon herbicide and fertilized by the full recommended rate of nitrogen and phosphorus fertilizers, which significantly exceeded that of farmer treatment (Hand weeding + 100% N+ 100% P) by 447 kg/feddan (13.73%).

No significant differences were observed in grain yield per spike and per feddan as well as nitrogen and phosphorus content in grains between nitrogen and phosphorus of recommended rates with either 100% N+50% P or 75% N + 100% P under biofertilization with isoproturon herbicide application. These results might be due to the role of biofertilization in developing sustainable soil fertility and supporting plant growth as well as elimination of weeds by isoproturon herbicide treatment.

Effect of treatments on N and P contents of grains

Effect of weed control treatments: Results in Table 1 indicated that N and P contents in wheat grains were not significantly affected by the studied weed control treatments. However, isoproturon herbicide treatment produced the highest grain N and P contents. Similar finding by Azad (1997) was recorded.

Effect of biofertilization treatments: Seed fortification led to a significant increase in P content in wheat grains by 12.5%, compared to untreated, while the increment in N content was slight (2.7%). Malakouti and Savajhebi (2000) found 1.16% increase of protein content in wheat grains due to seed fortification. El-Shanshoury (1995) found that inoculations of wheat seedlings significantly increased the concentration of IAA, P, Mg, N and total soluble sugars in wheat shoots. On the other hand, Rashad and Ismail (2000) reported that biofertilizer did not affect protein in grain wheat.

Effect of nitrogen and phosphorus fertilizer levels: Increasing N fertilizer rates led to a significant increase in N and P contents in grains, while these components were increased significantly by phosphorus fertilizer level only at the full recommended rate. Auti *et al.* (1999) mentioned that N, P and K uptake increased with increasing fertilizer rate.

Effect of interaction: Grain nitrogen content was significantly affected by the interaction between the three experimental factors only, Table 1. Data in Table 3 illustrated that the highest value was obtained by the combination of biofertilization X bifenox herbicide X full recommended rate of N+P fertilizer. This result was expected, since every factor alone recorded the highest nitrogen contents of grains Table 1.

Regarding the phosphorus content in grains, data in Table 1 showed that this trait was significantly affected by the interaction between weed control X biofertilizer as well as

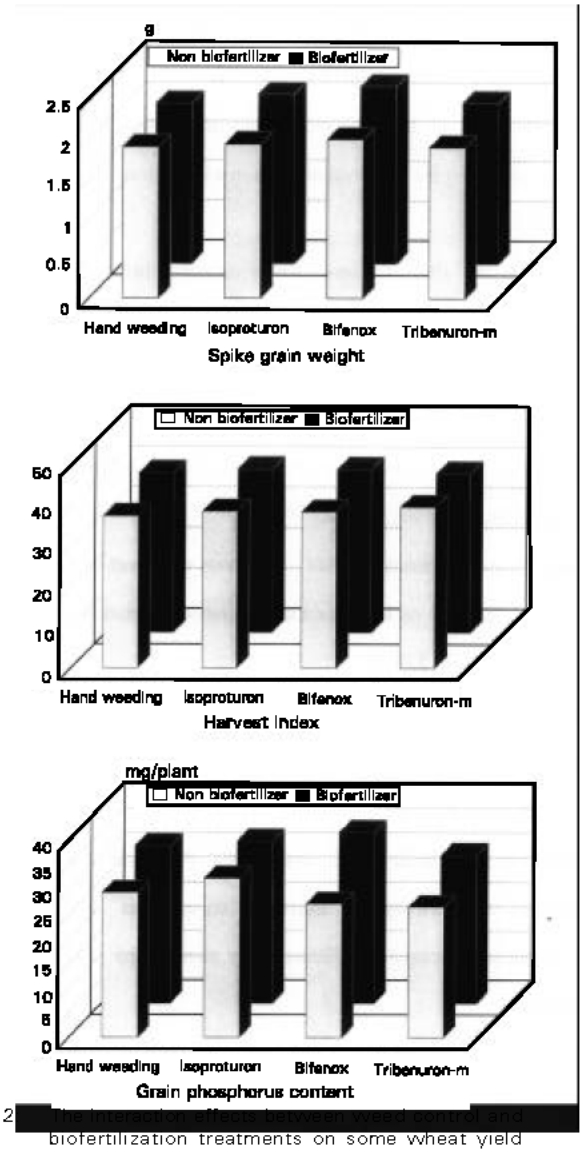

Fig. 2: The interaction effects between weed control and biofertilization treatments on some wheat yield characters

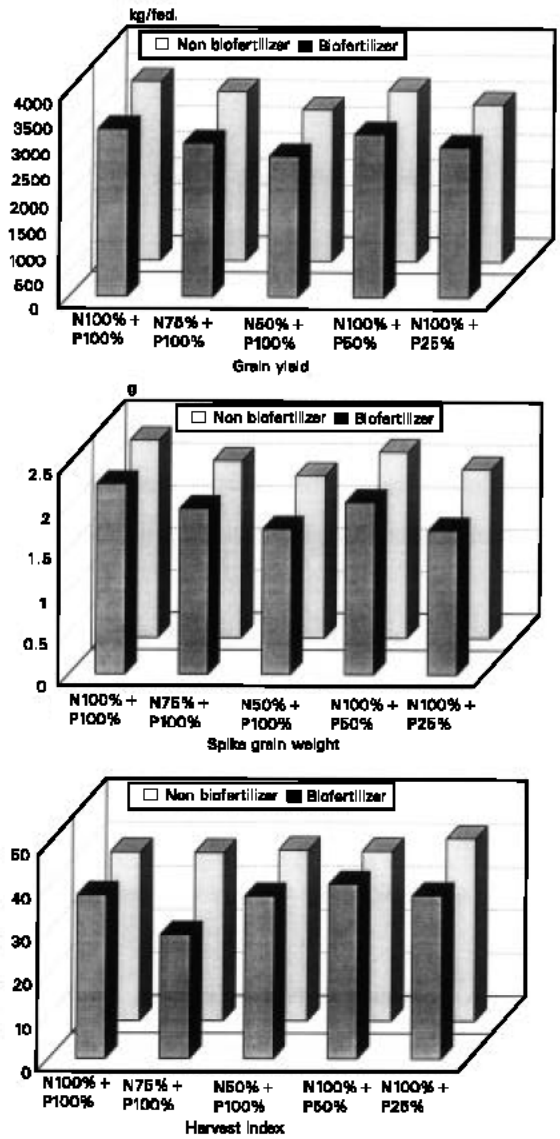

Fig. 3: The interaction effects between biofertilization and nitrogen & phosphorus levels treatments on some wheat yield characters

the interaction between weed control X biofertilization X N+P fertilizer levels treatments. Highest value was obtained by the application of biofertilization coupled with bifenox treatment and all values of phosphorus content in grains were increased with adding the biofertilizer (Fig. 2). Concerning the interaction effect of weed control X biofertilizer X N and P fertilizer level on grain phosphorus content, results in Table 3 illustrated that, more or less, this interaction had significantly increase phosphorus content of grain. Maximum phosphorus content was obtained from plots treated with biofertilizer, bifenox herbicide and supplied by the full recommended rate of N and P fertilizer, which increased it by 33.9%, compared to farmer treatment (Hand weeding + full recommended rate of N and P fertilizers).

From the previous results reported in this study, it can be concluded that weed control and biofertilization play an important role in increasing wheat grain yield. Half of the recommended P and quarter of N mineral fertilization could be saved under biofertilizer application without seriously affecting yield.

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