RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSIONS

4.1: Wheat plants growth as influenced by different soil conditioners, biofertilization under different soil moisture levels.

Data of Table (3-a) which illustrated by **Fig.(1)** indicate that application of soil conditioners either synthetic in the form of $(NH_4)_2SO_4$ or natural in the form of chicken manure and El Oboor compost increased the dry weight of wheat plants at both periods of growth 45 and 70 days from sowing. However, values of the increment depended on the type of conditioners.

Table (3-a) shows that values of dry weight of wheat plants averaged overall soil moisture levels at 45days from sowing were increased from 2.40 g/pot in the control treatment to 3.79 and 5.83 g/pot when fertilizer N was applied at rates of 30(N_1) and 90(N_2) kg N/fed, respectively. These values were increased to 5.16 and 6.78 g/pot when soil was conditioned with chicken manure at rates of 0.5 and 2%, respectively. However, these values reached to 3.75 and 5.35 g/pot when soil was conditioned with compost. At 70 days of growth,the obtained values were significantly increased from 3.99 g/pot to 5.49, 7.53, 6.81, 9.19, 5.05 and 6.97 g/pot with application of N_1, N_2, CM_1(0.5% chicken manure), CM_2(2% chicken manure), $Comp_1$(0.5% compost), $Comp_2$(2% compost).

As shown in **Table (3-a) and Fig.(2),** values of wheat dry weight averaged overall soil conditioners were decreased with subjecting wheat plants to moisture stress. These values at 45 days of growth decreased from 5.79 g/pot at 100% of field capacity to 4.97 and 3.41 g/pot when plants were subjected to water stress at 80 and 50 % of field capacity. At 70 days of growth, similar trend was observed, however higher values of dry weight were obtained. The obtained values decreased from 7.74 to 6.75 and 4.81 g/pot with decreasing soil moisture levels from 100% to 80 and 50% of the field capacity, respectively.

Regarding the effect of conditioners, the data of **Table (3-a) and Fig.(1)** showed that chicken manure was the best treatment and more effective on the dry matter of wheat plants followed by mineral fertilizer, compost and then control treatment.

The increase in wheat dry matter by application of fertilizer N could be ascribed to the enhanced effects of N on stimulating the meristmatic activity for producing more tissues and organs stimulation of cell division, internodes elongation.Also, N is one of the most important components of cytoplasm, nucleic acids and plays a major role 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 plant growth. These results are confirmative to those obtained by **Mengel and Kirkby (1987), Zahran and Mosalem (1993), Bassal *et al* (2001), El- Shafie-Fatma (2001) and Ismail *et al* (2006).**

The positive action of organic manure as soil conditioners may be due to increasing the soil water retention and contribution of such materials to the physico-chemical properties and nutritional status of soil. Beside that, the decomposition of organic manure in soil might have induced a slow release of nutrients supply for the growing plants.

Moreover, organic manure enhances the plants to absorb more water and nutrients and consequently increase photosynthesis activity and this in turn increase cell division and stem elongation. Also, soil physical properties were improved and this in turn increased roots penetration and extension causing more water and nutrients uptake by plants. Meanwhile, using conditioners helps in dealing with moisture stress. Similar results were obtained by **El-Morsy(1997), Hesham *et al.*, (1997), El-Mansi *et al.*, (1999), Abdel Aal *et al.*, (2003), El-Sharawy *et al.*, (2003) , El-Shouny (2006)** and **Ibrahim (2007)**.

Data of **Table (3-a)** indicate that application of biofertilizer either alone or in combination with soil conditioners minimized the negative effect of water deficit on wheat growth. Such results might be attributed to that the bacteria may produce growth promoting substances such as auxins, gibberellins and cytokinins which may improve plant growth. These results are confirmed with those obtained

Table (3-a):Effect of soil moisture stress on dry weight of wheat plants (g/pot) as affected by soil conditioners and biofertilizers.

Soil conditioners		Control		N1		N2		CM1		CM2		Comp1		Comp2		Mean
M.L (F.C.)	Bio.	Non.	Inoc.	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc.	Non.	Inoc	
100%	45days	2.93	3.36	4.58	5.19	6.67	7.46	6.34	6.51	8.00	8.31	4.33	4.75	6.18	6.48	5.79
	70days	4.66	5.32	6.32	7.18	8.60	9.58	7.89	8.32	10.45	11.09	5.71	6.42	8.17	8.57	7.74
80%	45days	2.49	2.79	3.77	4.35	5.99	6.47	5.04	5.44	6.78	7.08	3.97	4.22	5.51	5.74	4.97
	70days	4.02	4.62	5.48	6.20	7.43	8.39	6.85	7.25	9.35	9.68	5.09	5.64	7.12	7.42	6.75
%50	45days	1.33	1.53	2.19	2.63	4.02	4.41	3.65	3.99	5.12	5.40	2.50	2.75	3.93	4.24	3.41
	70days	2.47	2.88	3.58	4.17	5.21	5.96	5.16	5.38	7.17	7.39	3.53	3.92	5.15	5.41	4.81
Mean	45days	2.40		3.79		5.83		5.16		6.78		3.75		5.35		
	70days	3.99		5.49		7.53		6.81		9.19		5.05		6.97		

L.S.D. at 0.05 for moistrue level at 45 days = 0.063 *L.S.D. at 0.05 for moistrue level at 70 days = 0.079*
L.S.D.at 0.05 for soil conditioners at 45 days = 0.096 *L.S.D. at 0.05 for soil conditioners at 70 days = 0.295*
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 45 days = 0.235
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 70 days = 0.121

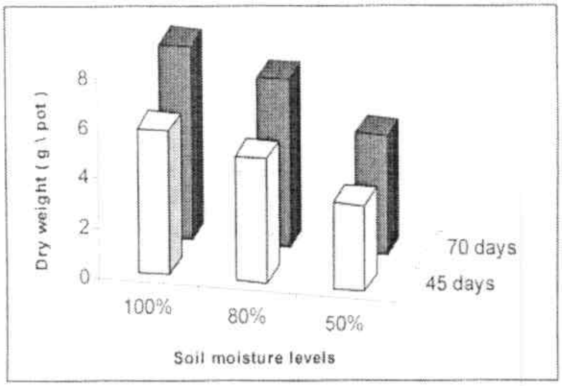

Fig. (1) : Effect of soil moisture levels on dry weight of wheat plants (g/pot).

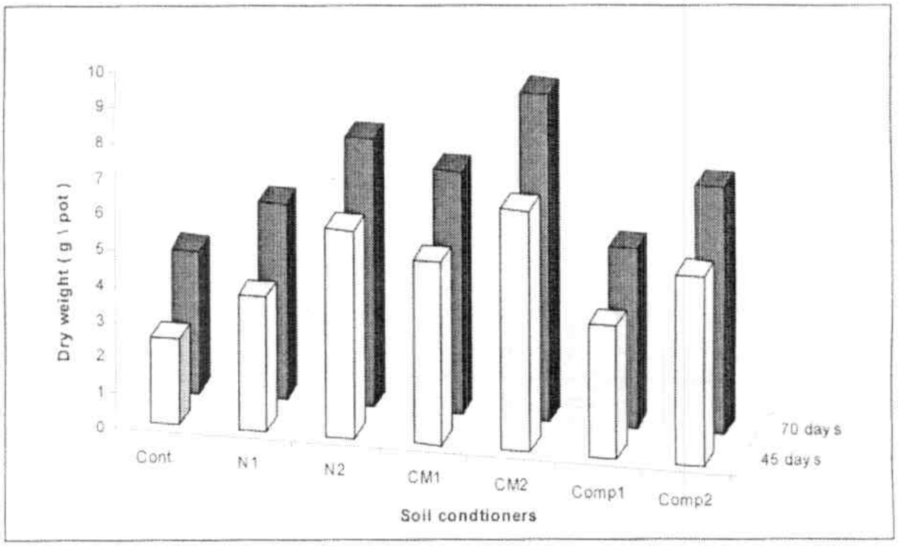

Fig. (2) : Effect of soil conditioners on dry weight of wheat plants (g / pot).

by **Jagnow *et al.*, (1991)** and **El Sayed (1999).** Also, compost and other organic materials tend to increase the water holding capacity and improve the physical condition of most soils. Increasing soil moisture in the root zone may lead to increasing the free protein concentration and abcisic acid formation, which cause the stomata closure during the stress and reducing the photosynthesis activity **(Hussein-Magda and El- Mahgoby,2006).**

The exudates of bacteria strains acts as plant growth promoters and apparently stimulate growth mainly throughout modifying root development which improve water uptake particularly in the early stages of plant development(**El-Komy *et al.*, 1998).**

Data of **Table (3-a)** indicated that straw yield of wheat under compost treatment was lower than chicken manure (CM). This result may be attributed to the lower content of nutrients and wide C/N ratio in compost manure.

It is clearly shown that chicken manure treatment either alone or combined with biofertilizer was superior to compost manure. and other treatments. This may be due to its superior properties as conditioning agent and it has an extra advantage of being a good source of plant nutrients, its higher content of available nutrients and its narrow C/N ratio which enhance the continuous biodegradation throughout the growth period, providing more elements in easily absorbable forms. Also, chicken manure application improved the soil structure as previously mentioned in review and hence encourages the growth of wheat plants. These results are coincided with those obtained by **Sabry (1990), El-Koumey (1999) and El-Shafie- Fatma and El- Shikha (2003).**

Data of **Table (3-a) and Fig.(1)** indicate that the superiority of mineral N fertilizer treatment in increasing dry matter of wheat plants as compared with the compost one. The superiority of mineral fertilizer is logically predicted since the readily available N or the water soluble N occurs in a relative high amounts, while in case of compost organic N mineralized slowly in soil and the release of available N from organic compost was slow and took a longer time through microbial activity. Similar results were obtained by **Sisworo** *et al.*, **(1990), Barker (1997), Ghowail-Salma and El-Koumy (2002), Mostafa** ***et al.*****, (2004) and Abdel-Ghani and Bakry (2005).** Also, **Keeling** ***et al.*****, (2003)** stated that the presence of compost as the only source of applied N resulted in substantial yield decreases compared to the optimum.

It is quite obvious from the data presented in **Table(3-b) and Figs.(3&4)** that the interaction effect between moisture level and soil conditioners significantly affected the dry weight of wheat plants. The greatest growth was recorded at the high rate of chicken manure accompanied with the highest level of soil moisture (100% of field capacity). At 100% of field capacity, values of 6.43 and 8.16 g/pot were achieved by 45 days from sowing with application of chicken manure at rate of 0.5 and 2% , respectively. These values were increased with increasing growth period up to 70 days and reached 8.11 and 10.77 g/pot. Decreasing soil moisture level significantly decreased wheat plants growth where the above-mentioned values decreased at 80% of field capacity to reach 5.24 and 6.93 g/pot at 45 days and 7.05 and 9.52 g/pot at 70 days then continuously decreased at 50% of field capacity to reach 3.82 and 5.26 g/pot at 45 days and 5.27 and 7.28 g/pot at 70 days when chicken manure was applied at rates of 0.5 and 2%, respectively.

It can be noticed from the data presented in **Table (3-b)** that mineral nitrogen fertilizer had superior effect in increasing growth of wheat plants than compost manure which exhibit better effect than control.

The superiority of mineral nitrogen fertilizer on wheat growth might be due to its higher content of readily available or the water soluble N. Similar results were obtained by **Bassal** ***et al.*****, (2001), Abdel Aal** ***et al.*****, (2003), Abdel- Ghani and Bakry (2005), Ismail** ***et al.*****, (2006)** and **Ibrahim (2007).**

Data of **Table (3-c) and Figs.(5&6)** represent the interaction effect between biofertilizer and soil conditioners on growth of wheat plants. This interaction affected significantly on the values of dry

Table (3-b): The effect of interaction between moisture level(M.L.)and soil conditioners on dry weight (g/pot)of wheat plants.

Soil conditioners / M.L. (F.C.)		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
100%	45days	3.14	4.89	7.06	6.43	8.16	4.54	6.33
	70days	4.99	6.75	9.09	8.11	10.77	6.07	8.37
80%	45days	2.64	4.06	6.23	5.24	6.93	4.10	5.63
	70days	4.32	5.84	7.91	7.05	9.52	5.37	7.27
50%	45days	1.43	2.41	4.22	3.82	5.26	2.63	4.09
	70days	2.68	3.88	5.59	5.27	7.28	3.72	5.28

L.S.D. at 0.05 for 45 days = 0.166
L.S.D. at 0.05 for 70 days =0.209

Table (3-c): The effect of interaction between biofertilizers and soil conditioners on dry weight (g/pot) of wheat plants.

Soil conditioners / Biofertilizers		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
Non inoculation	45days	2.25	3.51	5.56	5.01	6.63	3.60	5.21
	70days	3.72	5.12	7.08	6.63	8.99	4.78	6.81
Inoculation	45days	2.56	4.06	6.11	5.31	6.93	3.91	5.49
	70days	4.27	5.85	7.98	6.98	9.39	5.33	7.13

L.S.D. at 0.05 for 45 days = 0.136
L.S.D. at 0.05 for 70 days = 0.170

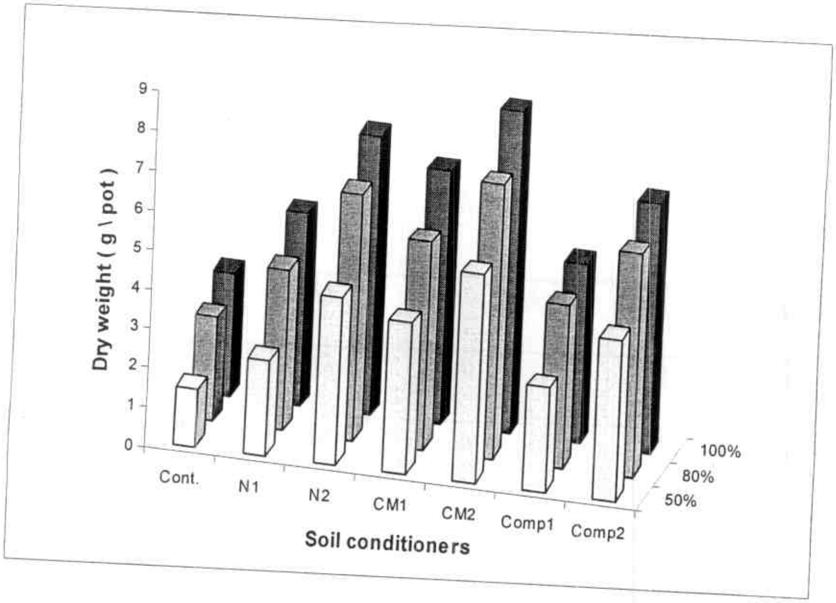

Fig. (3) : The effect of interaction between moisture levels and soil conditioners on dry weight of wheat plants (g / pot) at 45 days .

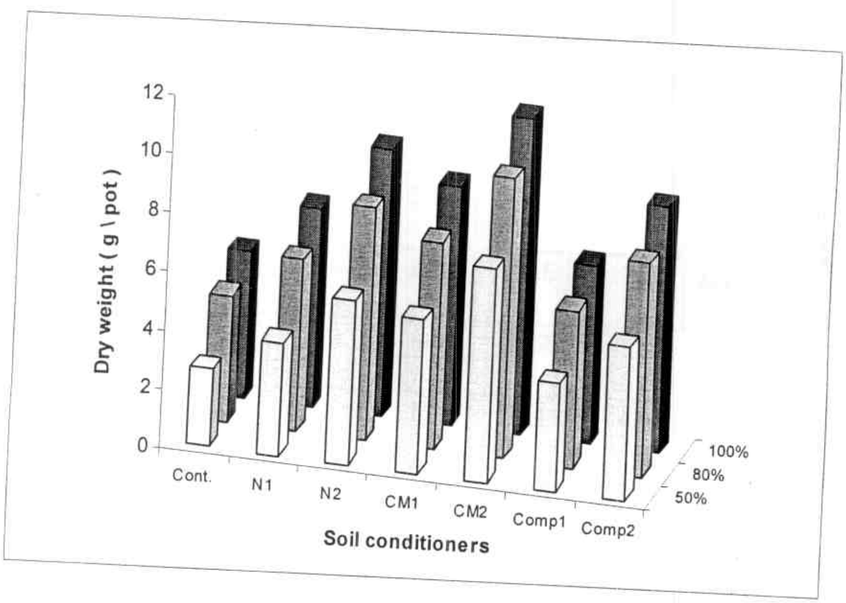

Fig. (4) : The effect of interaction between moisture levels and soil conditioners on dry weight of wheat plants (g / pot) at 70 days .

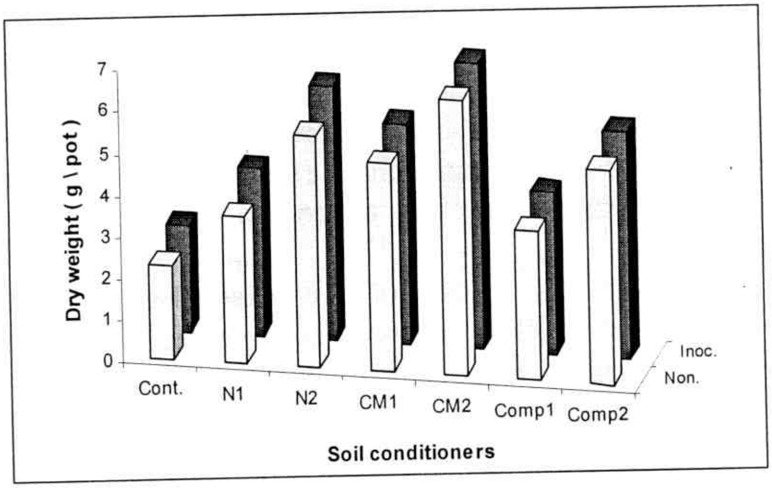

Fig. (5) : The effect of interaction between biofertilizers and soil conditioners on dry weight of wheat plants (g / pot) at 45 days .

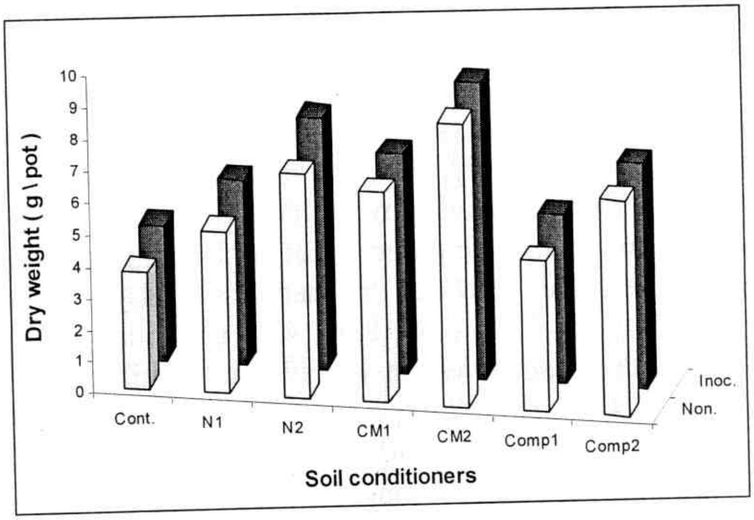

Fig. (6) : The effect of interaction between biofertilizers and soil conditioners on dry weight of wheat plants (g / pot) at 70 days .

weight of wheat plants. Conditioning the soil with organic manure (chicken manure or compost) or mineral nitrogen fertilizer either alone or combined with biofertilizer was more effective for increasing dry weight of wheat plants. Such effect was dependent on the period of growth stage and the concerned manure and its chemical composition.

The greatest effect of the interaction was achieved with application of chicken manure accompanied with biofertilizer then compost manure and control. Increasing the rates of applied conditioners was accompanied by a highly significant increase in straw yield of wheat.

It can be seen from **Table (3-c)** that, values of dry weight without inoculation at 45 days were 2.25, 3.51, 5.56, 5.01, 6.63, 3.6 and 5.21 g/pot for control, applied N at 30(N_1) and 90(N_2) kg N/fed., applied chicken manure at 0.5(CM_1) and 2% (CM_2)and applied compost at 0.5 ($Comp_1$)and 2%($Comp_2$), respectively. Inoculation of wheat plants with Associative diazotrophs significantly increased dry matter yield of wheat plants either at 45 or 70 days from planting. At 45 days from planting the above mentioned values were increased to reach 2.56, 4.06, 6.11, 5.31, 6.93, 3.91 and 5.49 g/pot for the same treatments, respectively. It is of interest to notice that in the second period of plant growth that passed from 45 to 70 days from planting, the plants acquired great and significant amounts of dry matter. The values of wheat dry matter at 70 days without inoculation were 3.72, 5.12, 7.08, 6.63, 8.99, 4.78 and finally 6.81 g/pot. These values in the case of wheat inoculation significantly increased and reached to 4.27, 5.85, 7.98, 6.98, 9.39, 5.33 and then 7.13 g/pot for control, 30 kg N/fed.(N_1), 90 kg N/fed.(N_2), 0.5% (CM_1), 2% (CM_2), 0.5% ($Comp_1$) and 2% ($Comp_2$), respectively.

It is worthy to mention that inoculation of wheat grains at sowing with the biofertilizers increased dry matter weight of wheat plants either at lower rates of applied conditioners or at higher ones. Such effect was more pronounced at different moisture levels. The beneficial effect of biofertilizers on plant growth might be attributed to stimulates of root growth, changes root morphology, enhances uptake of minerals and its possible involvement in phytohormones production which all together might cause promotion of vegetative growth. These results are in a good agreement with those obtained by **Sabry (1990), Carletti *et al*.,(1996), El-Sayed (1999), Janssen (1996), Noel *et al*.,(1996), El-Komy *et al*., (1998) and El-Shafie-Fatma (2001)** who stated that the increment of wheat dry matter by biofertilizer treatment could be due to different reasons: 1) beneficial effects of rhizosphere bacteria which often based on increased plant growth, faster seed germination and better seedling emergence .2) biofertilizers may induce growth promotion through production of phytohormones,improving the availability and acquisition of nutrients, non symbiotic N_2 fixation and stimulation of disease resistance mechanisms . Also, **Abdel - Ghani and Bakry (2005)** reported that inoculation of biofertilizer in combination with 30 and 60 kg N-mineral fertilizer significantly increased wheat straw and grain yields as compared to addition of the same quantity of mineral fertilizer alone.

Concerning the interaction effect between moisture level and biofertilization on dry weight of wheat plants, data in **Table (3-d) and Figs.(7&8)** indicate the significancy of such effect.
It is worthy to note that the dry matter yield of wheat plants was decreased as soil moisture decreased, i.e. when plants subjected to moisture stress, values of wheat dry matter without inoculation and averaged over all conditioners treatments were; 5.58 and 7.40 g/pot at 45 and 70 days from planting when soil moisture was 100% of field capacity. These values were decreased to 4.97 and 3.25 g/pot at 45 days and to 6.48 and 4.61 g/pot at 70 days when soil moisture decreased to 80 and 50% of field capacity, respectively.

Inoculation of wheat with Associative diazotrophs significantly increased values of wheat dry matter either at 45 or 70 days from planting. The values of wheat dry matter at 100% of field capacity were 6.01 and 8.07 g/pot at 45 and 70 days, respectively. These values were 5.16 and 7.03 g/pot at 80% of field capacity and 3.57 and 5.02 g/pot when plants subjected to moisture stress at 50% of field capacity at 45 and 70 days from planting, respectively.

Table (3-d):The effect of interaction between moisture level and biofertilizers on dry weight (g/pot) of wheat plants.

Soil moistrue % of (F.C.) *Biofertilizers*		*100%*	*80%*	*50%*
Non inoculation	*45days*	**5.58**	**4.79**	**3.25**
	70days	**7.40**	**6.48**	**4.61**
Inoculation	*45days*	**6.01**	**5.16**	**3.57**
	70days	**8.07**	**7.03**	**5.02**

L.S.D. at 0.05 for 45 days = 0.089
L.S.D. at 0.05 for 70 days = 0.112

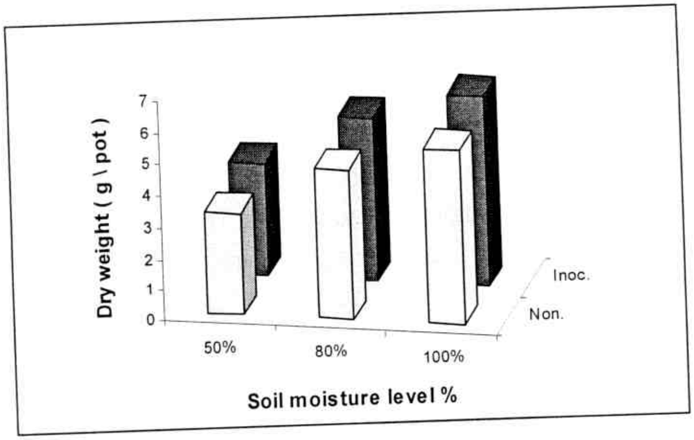

Fig. (7) : The effect of interaction between soil moisture levels and bio-fertilizers on dry weight of wheat plants (g / pot) at 45 days

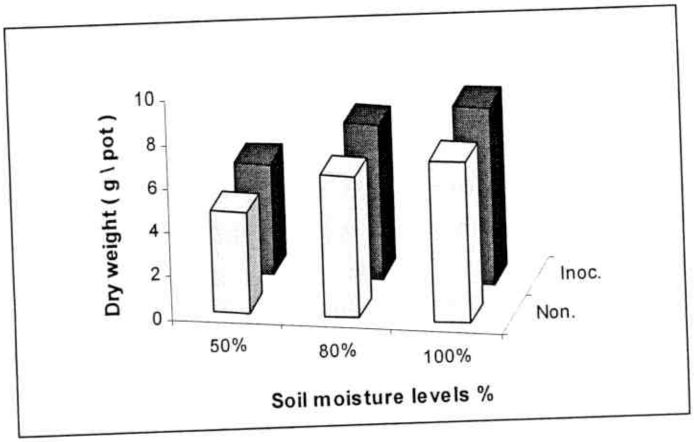

Fig. (8) : The effect of interaction between soil moisture levels and bio-fertilizers on dry weight of wheat (g / pot) plants at 45 days .

The maximum growth of wheat plants was obtained when plants were irrigated at 100% of field capacity and conditioning the soil with biofertilizer and chicken manure. Meanwhile exposing wheat plants to water deficit resulted in significant reduction in plant height and number of tillers per plant and caused the reduction in straw yield. This could be attributed to the deleterious effect on the growth and physiological process of the growing plants as affected by soil moisture stress and nutrients balance disorder in root medium which may suppressing cell enlargement and division and also retardation of the enzymatic and photosynthetic processes. These results are in accordance with those found by **Copper(1980)** and **Sharma *et al.,(*1984)** who stated that the reduction in growth and wheat yields due to skipping on irrigation might be attributed to lack of water absorbed and inhibition of photosynthetic efficiency under insufficient water conditions. Also,**Abdel-Nasser** and **El-Shazly (2000) and Munir *et a*l., (2000)** stated that there were significant differences between irrigation treatments for dry weight of wheat plants where these characters were significantly increased with increasing soil moisture level.

Such effect of moisture stress might be attributed to lack of absorbed water and inhibition of photosynthetic efficiency under insufficient water conditions. On the other hand the beneficial effect of biofertilizer on wheat plant growth might be due to stimulate root growth, changes root morphology,enhances uptake of minerals, involvement in phytohormones production which all together might cause promotion of vegetative growth. These results are confirmative to those obtained by **Hussein-Magda and El- Mahgoby (2006)** for moisture effect and **Noel *et al.,(*1996), El-Shafie-Fatma (2001)** for biofertilization effect.

4.2: Nitrogen uptake by wheat plants as influenced by soil conditioners and biofertilization under different soil moisture levels.

Table (4-a) which illustrated by **Fig.(9)** showed values of N-uptake by wheat plants. These values were significantly affected by soil moisture level, soil conditioners either mineral or organic and biofertilizer. Results indicate that conditioning the soil with mineral fertilizer $(NH_4)_2SO_4$ or organic manures increased values of nitrogen uptake by wheat plants. The magnitude of the increase depends on the type of the organic materials as well as the application rate, the higher the application rate, in which the higher the total nitrogen uptake. Inoculation of conditioning materials with microorganisms produced significant and higher amounts of N-uptake by wheat plants.

It is evident that chicken manure either alone or inoculated with biofertilizer was the most effective conditioner where a maximum increase in N- uptake was recorded. This most probably due to its superior properties as a conditioning agent and because it has an extra advantage of being a good source of plant nutrients.

Meanwhile more N-uptake was observed with inoculated treatments of narrow C/N ratio (chicken manure) than the treatment inoculated with wider C/N ratio (compost).

The beneficial effect of organic manure on N- uptake may be due to regulation of soil temperature, conservation of soil moisture and improvement of humic content of the soil which are important factors in increasing the number and activity of microflora and hence stimulate nitrogen mineralization and its uptake by plants. Similar results were cope with those of **Gaur and Mukherjee (1980)** and **Schnurer and Rosswall (1987).**

Data presented in **Table (4-a)** show that the plants of wheat required a great a mount of N-uptake when soil was conditioned with mineral or organic manures as compared to control treatment (without added conditioners) either at 45 or 70days of growth.

Values of N-uptake averaged overall soil moisture level and biofertilization were significantly increased from 30.88 mg/pot in case of control treatment at 45 days from sowing to reach 76.51,167.92, when fertilizer nitrogen was applied at rates of 30(N_1) and 90(N_2) kg N/ fed., respectively. These values significantly and continuously increased to reach their higher values when soil amended with chicken manure. Meanwhile, values of 180.18 and 290.0 mg N/pot were achieved at 45 days for 0.5 and 2% of chicken manure, respectively. On the other hand, application of compost produced lower values of N- uptake compared with the other treatment but still significant and higher than those values obtained in control treatment where values of 64.82 and 112.28 mg N/pot were obtained.

The same trend was observed at 70 days of growth, however higher values of N-uptake by wheat plants were achieved than those at 45 days. Meanwhile, values of 58.57, 126.98, 240.2, 254.82, 423.4, 100.38 and 171.12 mg N/pot were produced for control, 30, 90 kg N/fed (N_1,N_2), 0.5 and 2% chicken manure (CM_1,CM_2) and 0.5 and 2% compost ($comp_1$,$comp_2$), respectively.

It is quite obvious from the obtained results that addition of nitrogen in mineral form was more effective as compared to either control or compost treatment. This finding is logically predicted since the readily available N or the water soluble N occurs in a relative high amounts in soil treated with inorganic fertilizer.

The lowest values of N- uptake when soil treated with compost manure indicate that this compost which contained a wider C/N ratio could be cause immobilization at early growth stages and hence the release of available nitrogen from such organic sources was low and took a longer time, Therefore the N should be less available to plant.Similar results were obtained by **Mostafa *et al.,* (2004)**, and **Abdel- Ghani and Bakry (2005).**

The superiority of chicken manure over other treatments might be attributed to its higher nutrient especially nitrogen content to cover the requirement of the plants from such element and consequently it has narrow C/N ratio than compost manure. Such finding was obtained by **Sabry (1990), Wahdan *et al.,* (1996), Barker (1997) and El- Shafie, Fatma and El-Shikha (2003).** Also, **Ismail *et al.,* (2006)** found that increasing nitrogen rates up to 150 kg N/fed. increased N-uptake in wheat plants and this may be attributed to the increase in root surface per unit of soil volume and accordingly increased the rate of nutrient up-take. On the other side the high capacity of the plants supplied with N-fertilizer in building metabolites, which might be contributed much to the increase of the dry matter content and subsequently increased nitrogen uptake by plants.

Data of **Table(4-a)** and **Fig.(10)** indicate that increasing soil moisture level progressively and significantly increased values of N-uptake by wheat plant at the two growth periods 45 and 70 days from sowing of wheat. Meanwhile, subjecting wheat plants to moisture stress stunt plant growth and hence decreased uptake of nitrogen and other nutrients by plants may be attributed to the deleterious effect on the growth, physiological. process of the growing plants and nutrients balance disorder in root media.

Values of N-uptake by wheat plants averaged overall treatments were 179.70 and 261.98 mg/pot when soil moisture was 100% of field capacity at 45 and 70 days, respectively. These values decreased at 45 days of growth to reach 133.8 and 81.88 mg N/pot at 80 and 50% moisture of field capacity but reached to 199.65 and 127.8 mg N/pot at 70 days of growth at above-mentioned levels of soil moisture, respectively. These results agree with those obtained by **Abdel-Nasser and Hussein (2001), Wang** ***et al*** **(2005) and Hussein-Magda and El- Mahgoby (2006)** whose results stated that increasing soil moisture content significantly increased N-uptake by wheat plants.This may be due to that increasing soil moisture in the zone may lead to increasing free protein concentration and abcisic acid formation, which caused the stomata closure during the stress and reducing the photosynthesis activity and carbohydrate accumulation in the plant and then increased the nitrogen compounds concentration.

Data of **Table (4-b) and Figs.(11&12)** represent the interaction effect between moisture level (M.L.) and soil conditioners on nitrogen uptake by wheat plants. Such effect was significant, meanwhile application of different conditioners increased N- uptake as compared with control treatment (non amended soil). Moreover, treated the soil

Table (4-a):Effect of soil moisture stress on nitrogen uptake by wheat plants(mg/pot) as affected by soil conditioners and biofertilizers.

Soil conditioners		Control		N1		N2		CM1		CM2		Comp1		Comp2		Mean
M.L (F.C.)	Bio.	Non.	Inoc.	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc.	Non.	Inoc	
100%	45days	41.01	49.16	98.75	120.8	212.9	245.6	240.7	251.9	371.8	411.1	82.75	92.61	142.2	154.6	179.70
	70days	73.51	89.03	153.1	201.0	304.9	355.5	322.2	350.1	513.6	580.5	125.9	146.7	213.4	238.3	261.98
80%	45days	29.38	36.5	68.73	89.25	162.7	180.4	173.5	192.4	270.4	304.5	63.64	72.75	109.5	120.2	133.80
	70days	54.71	68.82	115.0	147.1	219.4	259.0	249.0	278.0	402.1	440.8	92.6	111.3	157.5	194.62	199.65
%50	45days	12.59	16.65	34.68	46.89	96.33	109.6	106.3	116.3	178.7	203.7	35.69	41.63	68.74	78.85	81.88
	70days	27.74	37.63	63.43	82.27	139.3	163.0	158.1	171.5	290.0	313.6	57.02	68.51	98.75	118.93	127.80
Mean	45days	30.88		76.51		167.92		180.18		290.0		64.82		112.28		
	70days	58.57		126.98		240.2		254.82		423.4		100.38		171.12		

L.S.D. at 0.05 for moistrue level at 45 days = 2.44
L.S.D.at 0.05 for soil conditioners at 45 days = 3.73
L.S.D. at 0.05 for moistrue level at 70 days = 3.25
L.S.D. at 0.05 for soil conditioners at 70 days = 4.96
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 45 days = 9.14
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 70 days = 12.15

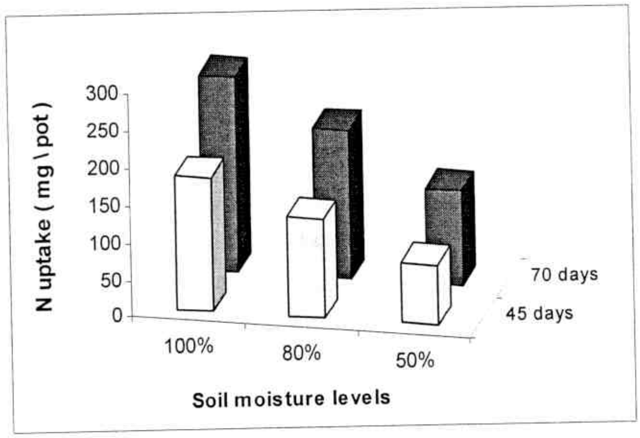

Fig. (9) : Effect of soil moisture levels on nitrogen uptake (mg / pot) by wheat plants.

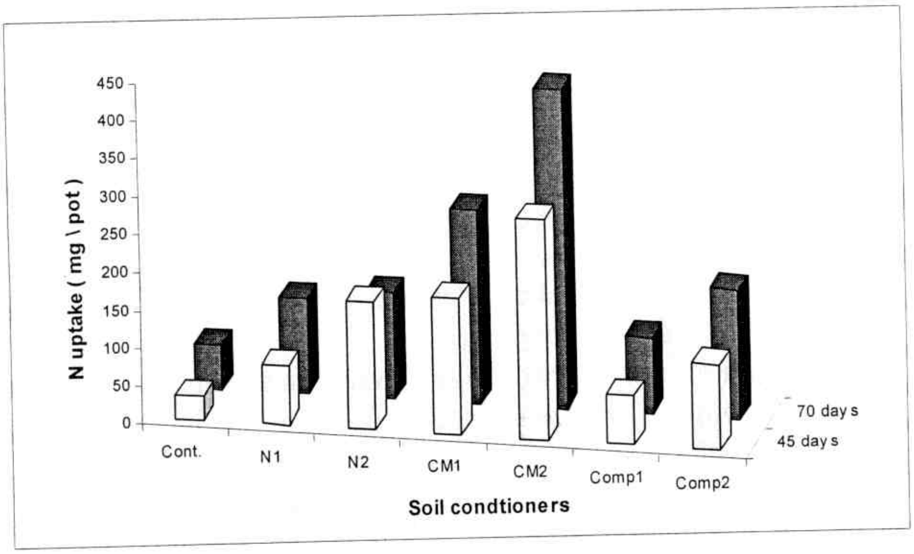

Fig. (10) : Effect of soil conditioners on nitrogen uptake (mg / pot) by wheat plants.

with 2% chicken manure for 50% of field capacity at 70 days of growth produced values of nitrogen uptake (301.8 mg N/pot) nearly similar or quite lower those obtained with the high rate of applied mineral nitrogen (recommended dose, 90kg N/fed.) for the same period of growth (70days) at 100% of field capacity (330.2 mg N/pot).

This finding confirmed that without an adequate supply of soil moisture, the yield and hence the nutrient uptake are severely depressed. The addition of organic materials in the form of manure has beneficial effects on the fertility of such soils, beside the amount of some plant nutrients in mature organic manures that can be higher than that applied as chemical fertilizers. Similar finding was obtained by **Zeidan and El Kramany (2001), Abdel Aal *et al* (2003), Dahdoh *et al* (2005) and El-Shouny (2006).**

Data of **Table (4-b)** confirmed the superiority of chicken manure and soil moisture interaction followed by mineral nitrogen and soil moisture interaction then compost manure and soil moisture interaction which produced a significant and higher interaction than control treatment. These results agreed with those shown by **El-Shafie-Fatma and EL-Shikha (2003).**

Table (4-c) which illustrated by **Figs.(13&14)** shows a significant interaction effect between biofertilizer and soil conditioners on nitrogen uptake by wheat plants at two periods of growth; 45and 70 days from sowing.

Application of mineral N or organic manure as soil conditioners combined with biofertilizer was more effective for increasing N-uptake by wheat plants at the two growth periods. Such effect was dependent on the concerned manure and its chemical composition. It is evident that inoculation of wheat grains before sowing increased values of N-uptake from 27.66, 67.38, 157.3, 173.5, 273.6, 60.65 and 106.8 mg N/pot at 45 days without inoculation to 33.9, 85.64, 178.5, 186.8, 306.4, 68.98 and 117.76 mg N/pot with inoculation for control, N_1, N_2, CM1, CM_2, $Comp_1$ and $Comp_2$, respectively.

Increasing periods of growth progressively increased values of N-uptake by wheat plants. The greatest values of N-uptake were recorded with chicken manure accompanied with biofertilization followed by mineral N than compost manure which produced higher amounts than control treatment (non conditioned soil). These results are in agreement

Table (4-b):The effect of interaction between moisture level(M.L.)and soil conditioners on nitrogen uptake(mg/pot) by wheat plants.

Soil conditioners M.L(F.C.).		*Control*	*N1*	*N2*	*CM1*	*CM2*	*Comp.1*	*Comp.2*
100%	*45days*	45.09	109.8	229.3	246.3	391.5	87.60	148.4
	70days	81.27	177.1	330.2	336.2	547.00	136.3	225.98
80%	*45days*	32.71	78.99	171.6	182.9	287.4	68.20	114.8
	70days	61.76	131.00	239.2	263.5	421.5	102.0	178.59
50%	*45days*	14.62	40.78	103.00	111.3	191.2	38.66	73.66
	70days	32.69	72.85	151.1	164.8	301.8	62.85	108.8

L.S.D. at 0.05 for 45 days = 6.46
L.S.D. at 0.05 for 70 days = 8.59

Table (4-c):The effect of interaction between biofertilizers and soil conditioners on nitrogen uptake (mg/pot)by wheat plants.

Soil conditioners Biofertilizers		*Control*	*N1*	*N2*	*CM1*	*CM2*	*Comp.1*	*Comp.2*
Non inoculation	*45days*	27.66	67.38	157.3	173.5	273.6	60.65	106.8
	70days	51.99	110.5	221.2	243.1	401.9	91.83	156.6
Inoculation	*45days*	33.95	85.64	178.5	186.8	306.4	68.98	117.76
	70days	65.16	143.4	259.2	266.5	445.0	108.9	185.7

L.S.D. at 0.05 for 45 days = 5.26
L.S.D. at 0.05 for 70 days = 7.02

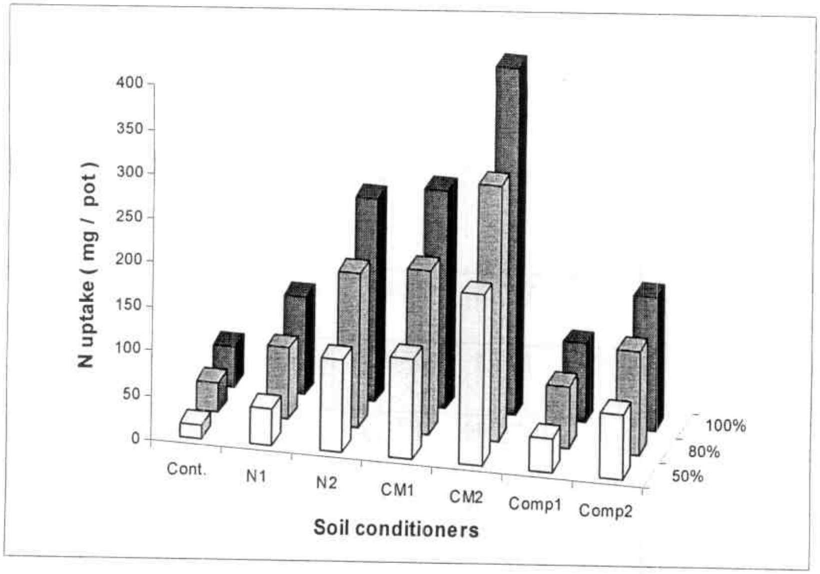

Fig. (11) : The effect of interaction between moisture levels and soil conditioners on nitrogen uptake (mg / pot) by wheat plants at 45 days .

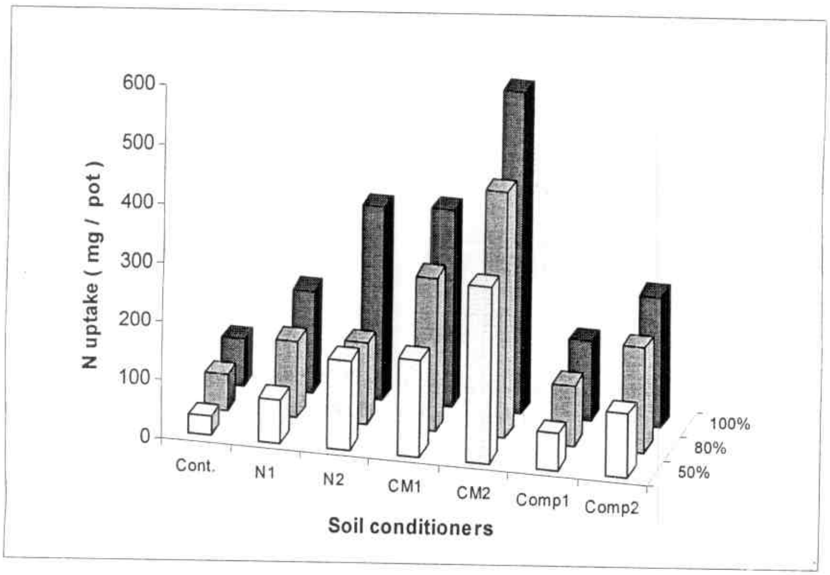

Fig. (12) : The effect of interaction between moisture levels and soil conditioners on nitrogen uptake (mg / pot) by wheat plants at 70 days .

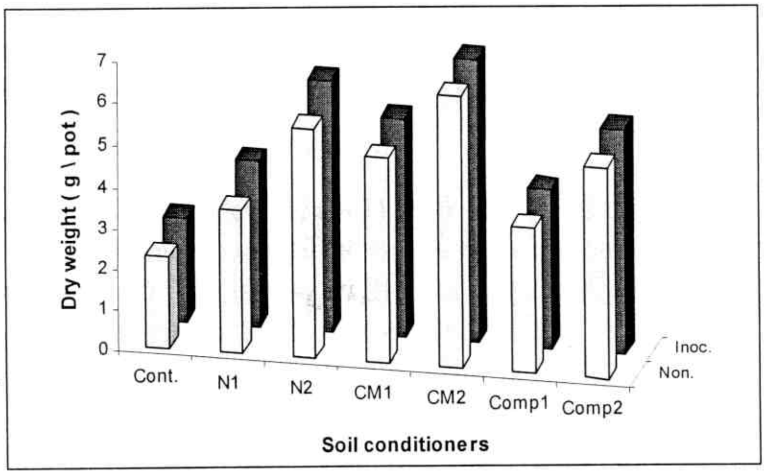

Fig. (13) : The effect of interaction between biofertilizers and soil conditioners on nitrogen uptake (mg / pot) by wheat plants at 45 days .

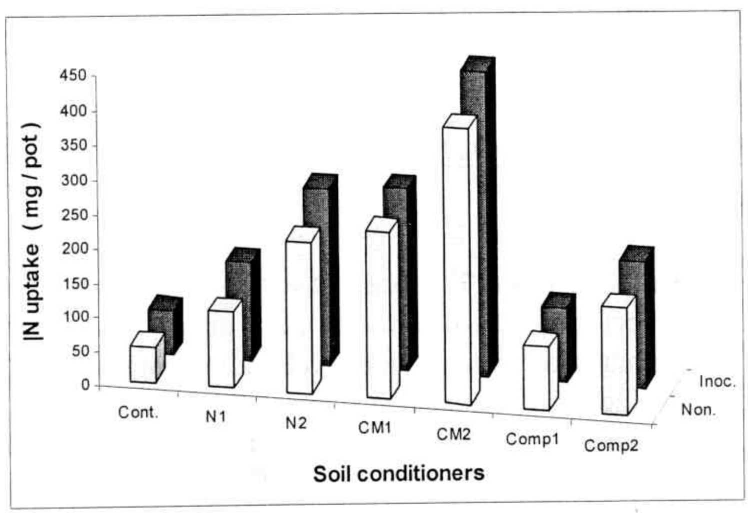

Fig. (14) : The effect of interaction between biofertilizers and soil conditioners on nitrogen uptake (mg / pot) by wheat plants at 70 days .

with those clarified obtained by **Jagnow *et al.*, (1991), Acea and Carballas (1996), El-Mancy(1998),Goyal *et al.*, (1999) and El-Shafie- Fatma (2001).**

Data of **Table (4-d)** and **Figs.(15&16)** represent the interaction effect between soil moisture level and biofertilizers on nitrogen uptake by wheat plants. Such interaction effect was significant. Meanwhile, inoculation of wheat grains before sowing minimized the negative effect of water deficit. It is quite obvious that inoculation of wheat grains increased values of nitrogen uptake from 170, 125.4 and 76.14 mg N/ fed at 45 days growth (without inoculation) to 189.4, 142.2 and 87.61 mg N/pot (with inoculation) at the same period for 100,80 and 50% of field capacity. These values at 70 days growth were increased from 243.8, 184.3 and 119.18 mg N/pot without inoculation to reach 280.21, 214.96 and 136.50 mg N/pot (with inoculation) for the above moisture levels, respectively. Similar results were obtained by **El-Komy *et al.*, (1998) and Hussein-Magda and El- Mahgoby(2006).**

4.3: Phosphorus uptake by wheat plants as influenced by soil conditioners and biofertilization under different soil moisture levels.

Table (5-a) and Fig.(17) represent values of P-uptake by wheat plants and their effects by soil conditioners either in mineral form (ammonium sulphate) or organic form (chicken manure or compost manure), biofertilizer and soil moisture stress.

It is quite obvious from the obtained results that values of P-uptake were significantly increased and differed among treatments, Meanwhile the magnitude of the increase depends on the type of the added manure as well as the application rate. The higher the application rate, the higher P-uptake. On the other hand, higher values of P-uptake were accompanied by application of chicken manure or compost manure as compared with mineral fertilizer $(NH_4)_2SO_4$ or control.

Table (4-d): The effect of interaction between moisture level and biofertilizers on nitrogen uptake (mg/pot) by wheat plants.

Soil moistrue % of (F.C.) / Biofertilizers		100%	80%	50%
Non inoculation	45days	170.00	125.40	76.14
	70days	243.80	184.30	119.18
Inoculation	45days	189.40	142.20	87.61
	70days	280.21	214.96	136.50

L.S.D. at 0.05 for 45 days = 3.45
L.S.D. at 0.05 for 70 days =4.59

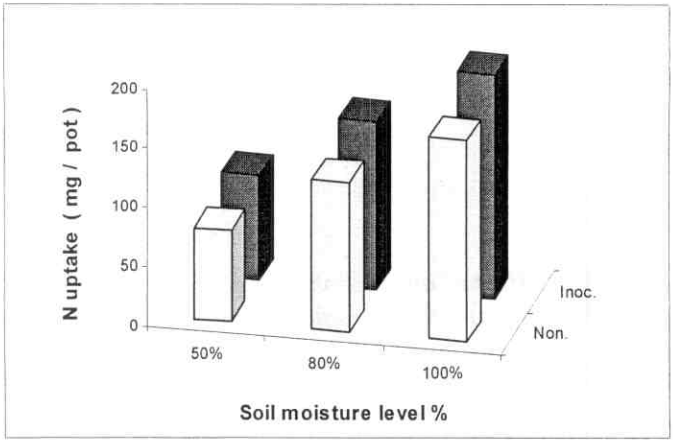

Fig. (15) : The effect of interaction between soil moisture levels and bio-fertilizers on nitrogen uptake (mg / pot) by wheat plants at 45 days

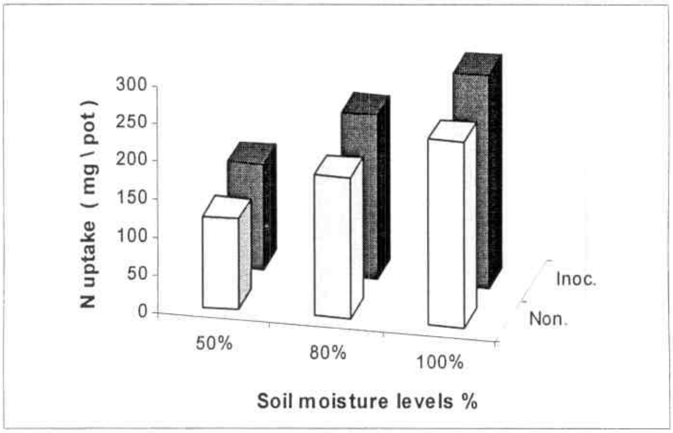

Fig. (16) : The effect of interaction between soil moisture levels and bio-fertilizers on nitrogen uptake (mg / pot) by wheat plants at 70 days

Data of **Table (5-a)** reveal that application of mineral nitrogen $(NH_4)_2SO_4$ significantly increased values of P-uptake averaged overall soil moisture level from 2.07 to 4.14 and 6.95 mg P/pot at 45 days growth when fertilizer nitrogen was applied at rates of 30 and 90 kg N/fed. respectively. These values were increased with increasing periods of growth (70days) and reached to 3.59, 6.80 and 11.51 mg P/pot for both levels of applied nitrogen, respectively. Such results might be referred to the ability of nitrogen in increasing root surface per unit of soil volume which affect the growth of the plants and consequently deeper penetration of roots in soil causing higher nutrients uptake. On the other side, the high capacity of the plants supplied with N-fertilizer in buliding metabolites might be contributed much to increase the dry matter content and subsequently increased nutrient uptake by plants. Similar results were obtained by **Wahdan *et al.*, (1996), Atta Allah and Mohamed (2003), Abdel Ghani and Bakry (2005), Ismail *et al.*, (2006) and Mohamed *et al.*, (2006).**

Application of organic manures produced higher values of P-uptake by wheat and such effect was dependent on the concerned manure and its chemical composition. When compost manure was applied, values of P-uptake achieved at 45 days growth increased over those obtained by control or mineral fertilizer to reach 9.37 and 12.02 mg P/pot at rates of 0.5 and 2%, respectively. These values were 14.28 and 16.59 mg P/pot at 70 days growth for the rate of applied compost, respectively.

The obtained results indicated that application of chicken manure continuously and significantly increased P-uptake by wheat plants. The values of P-uptake by wheat increased to reach 11.23 and 15.04 mg P/pot at 45 days when chicken manure was applied at 0.5 and 2%, respectively. With increasing period of growth to 70 days these values reached to the highest one and recorded 15.91 and 23.21 mg P/pot at the above-mentioned rates of applied manure, respectively. The capability of organic manures in increasing P-uptake may be attributed to that the organic fertilizer improved the soil phosphorus supply power through direct and indirect effects. The direct effects includes the continuous release of inorganic P in available form, while the indirect one is the role of organic and inorganic acid which yielded upon mineralization of such organic materials. These acids are capable for solubilizing phosphorus from insoluble form to be more soluble and available to plants. These results coincided with those obtained by **Allam (1999), Saleh *et al.*, (2000), Ali (2001), Mostafa *et al.*, (2004) and Abdel Ghani and Bakry (2005).**

The superiority of chicken manure on elevating the plant content of phosphorus could be confirmed by its higher nutrients content and its continuous biodegradation throughout the growth period, providing such elements in easily absorbable form. These results are in agreement with those obtained by **Eissa (1996), El-Koumey (1999) and El-Shafie- Fatma and El-Shikha (2003).**

Data of **Table (5-a) and Fig.(18)** indicate also, that subjecting wheat plants to soil moisture stress led to decrease values of P-uptake by wheat plants. These values averaged overall treatments were decreased at 45 days growth from 11.3 mg P/pot at 100% of field capacity to 8.32 then decreased to reach 6.45 mg P/pot at 80 and 50% of field capacity, respectively. The obtained values at 70 days growth were greater than those ones obtained at 45 days and showed a similar trend. At 70 days growth 16.4 mg P/pot was achieved, with decreasing soil moisture to 80 and 50% of field capacity, the values of P-uptake were decreased to 13.55 and 9.44 mg P/pot, respectively.

The opposite effect of moisture stress could be attributed to the deleterious effect on the growth and physiological process of the growing plants and hence nutrients balance disorder in root medium which may suppress the cell enlargement and retardation of the photosynthetic processes. Similar results were obtained by **El-Sherif and El-Shrief (1973), He *et al.*, (2002), Wang *et al.*, (2005)** and **Hussein-Magda** and **El-Mahgoby (2006)**.

Concerning the interaction effect between moisture level and soil conditioners on P-uptake by wheat plants, data presented in **Table (5-b)** and illustrated in **Figs.(19&20)** indicate that this interaction was significant. Meanwhile application of soil conditioners minimized the negative effect of water deficit on wheat plants. At 45days growth and

Table (5-a):Effect of soil moisture stress on phpsphorus uptake by wheat plants(mg/pot) as affected by soil conditioners and biofertilizers.

Soil conditioners		Control		N1		N2		CM1		CM2		Comp1		Comp2		Mean
M.L (F.C.)	Bio.	Non.	Inoc.	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc.	Non.	Inoc	
100%	45days	2.48	3.11	5.12	6.22	8.67	10.18	13.26	15.89	18.69	21.76	10.62	12.98	13.96	15.2	11.3
	70days	5.00	5.27	7.88	10.33	13.98	16.71	18.80	20.83	27.88	31.05	16.3	17.40	18.17	19.94	16.4
80%	45days	2.08	2.39	3.84	4.42	6.16	7.52	9.64	11.73	13.06	14.08	8.6	9.56	10.65	12.79	8.32
	70days	3.30	3.85	5.98	7.51	10.62	11.98	15.08	17.72	22.4	25.52	14.76	15.76	16.81	18.6	13.55
%50	45days	1.13	1.25	2.39	2.87	4.3	4.85	7.1	9.78	9.87	12.8	6.74	7.83	8.74	10.79	6.45
	70days	1.88	2.23	3.92	5.21	7.66	8.09	10.16	12.89	14.52	17.93	10.18	11.26	12.04	13.96	9.44
Mean	45days	2.07		4.14		6.95		11.23		15.04		9.37		12.02		
	70days	3.59		6.80		11.51		15.91		23.21		14.28		16.59		

L.S.D. at 0.05 for moistrue level at 45 days = 0.248 *L.S.D. at 0.05 for moistrue level at 70 days= 0.182*
L.S.D.at 0.05 for soil conditioners at 45 days = 0.380 *L.S.D. at 0.05 for soil conditioners at 70 days = 0.277*
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 45 days = 0.93
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 70 days = 0.680

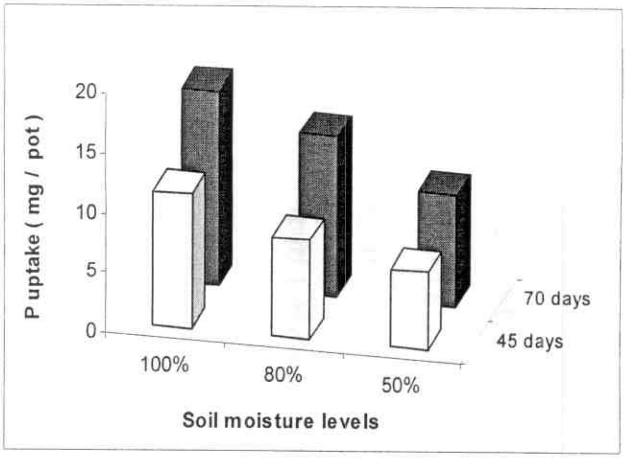

Fig. (17) : Effect of soil moisture levels on phosphorus uptake (mg / pot) by wheat plants.

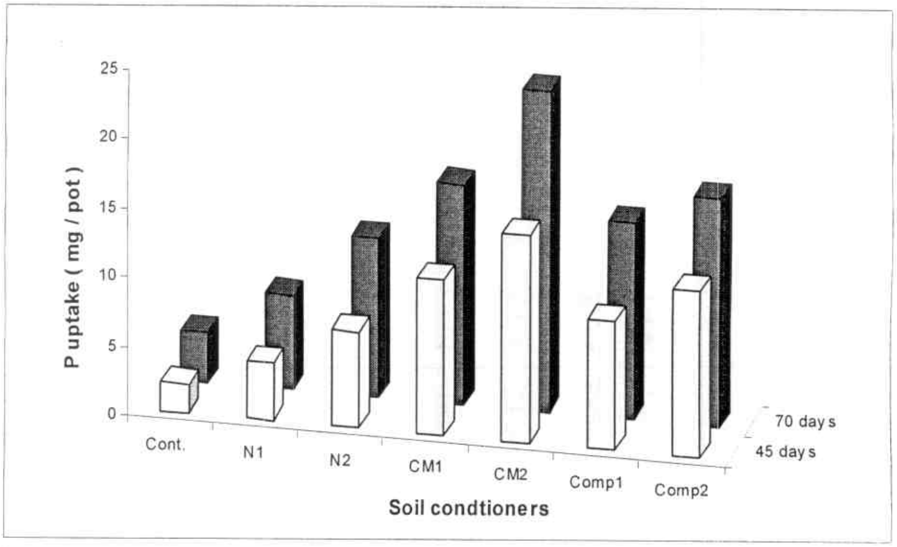

Fig. (18) : Effect of soil conditioners on Phosphorus uptake (mg / pot) by wheat plants

100% of field capacity, values of P-uptake were decreased from 2.78, 6.67, 9.43, 14.57, 20.22, 11.80 and 14.58 mg P/pot to reach 1.19, 2.63, 4.58, 8.44, 11.34, 7.24 and 9.70 mg P/pot at 50% of field capacity for control, N_1, N_2, CM_1, CM_2., $Comp_1$ and $Comp_2$, respectively .

The above mentioned values were increased at 70 days growth and exhibit similar trend whereas values of P-uptake decreased from 5.13, 9.10, 15.34, 19.81, 29.47, 16.85 and 19.06 mg P/pot at 100% of field capacity to reach lower values at 50% of field capacity, i.e.2.06, 4.57, 7.88, 11.53, 16.33, 10.72 and 13.00 mg P/pot for control, N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively.

These results are in harmony with those found by Ismaiel (2002) who reported that uptake of N, P and K in plant tissues was decreased by water stress and increased by conditioners. Moreover using conditioners helps to offset such effect. Also, Abdel Aal et al., (2003) and El-Shouny (2006) observed the beneficial effect of conditioners on soil water properties and consequently nutrients uptake by plants.

Table (5-c) and **Figs.(21&22)** represent a significant interaction effect between biofertilizer and soil conditioners on P-uptake by wheat plants. At 45 days of growth, values of P-uptake increased from 1.90, 3.78, 6.38, 10.00, 13.87, 8.65 and 11.11 mg P/pot without inoculation to reach 2.52, 4.50, 7.52, 12.46, 16.21, 10.09 and 12.93 mg P/pot with inoculation for control , N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively. With increasing periods of plant growth to 70 days, higher amounts of P-uptake were obtained and showed similar trend where these values increased from 3.39, 5.92, 10.75, 14.68, 21.67, 13.75 and 15.67 mg p/pot to reach 3.78, 7.68, 12.26, 17.15, 24.75, 14.81 and 17.50 mg P/pot for the above-mentioned conditioners, control, N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively. The positive effect of organic conditioners could be ascribed to their effect on lowering the fixation of P through chelation and formation of organic complexes relatively available for plants or through production of CO_2 during organic compost decomposition, thus, formation of H_2CO_3 which contributes to phosphate solubility.

Table (5-b): The effect of interaction between moisture level(M.L.)and soil conditioners on phosphorus uptake(mg/pot) by wheat plants.

Soil conditioners M.L. (F.C.)		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
100%	45days	2.78	6.67	9.43	14.57	20.22	11.80	14.58
	70days	5.13	9.10	15.34	19.81	29.47	16.85	19.06
80%	45days	2.24	4.13	6.84	10.69	13.57	9.08	11.72
	70days	3.58	6.74	11.30	16.40	23.84	15.26	17.70
50%	45days	1.19	2.63	4.58	8.44	11.34	7.24	9.70
	70days	2.06	4.57	7.88	11.53	16.33	10.72	13.00

L.S.D. at 0.05 for 45 days = 0.658
L.S.D. at 0.05 for 70 days = 0.481

Table (5-c):The effect of interaction between biofertilizers and soil conditioners on phosphorus uptake (mg/pot)by wheat plants.

Soil conditioners Biofertilizers		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
Non inoculation	45days	1.90	3.78	6.38	10.00	13.87	8.65	11.11
	70days	3.39	5.92	10.75	14.68	21.67	13.75	15.67
Inoculation	45days	2.25	4.50	7.52	12.46	16.21	10.09	12.93
	70days	3.78	7.68	12.26	17.15	24.75	14.81	17.50

L.S.D. at 0.05 for 45 days = 0.54
L.S.D. at 0.05 for 70 days = 0.392

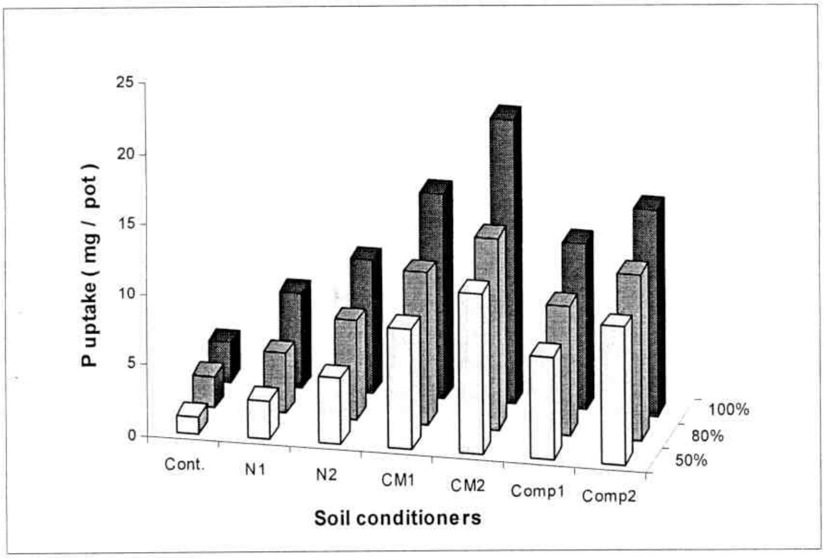

Fig. (19) : The effect of interaction between moisture levels and soil conditioners on phosphorus uptake (mg / pot) by wheat plants at 45 days .

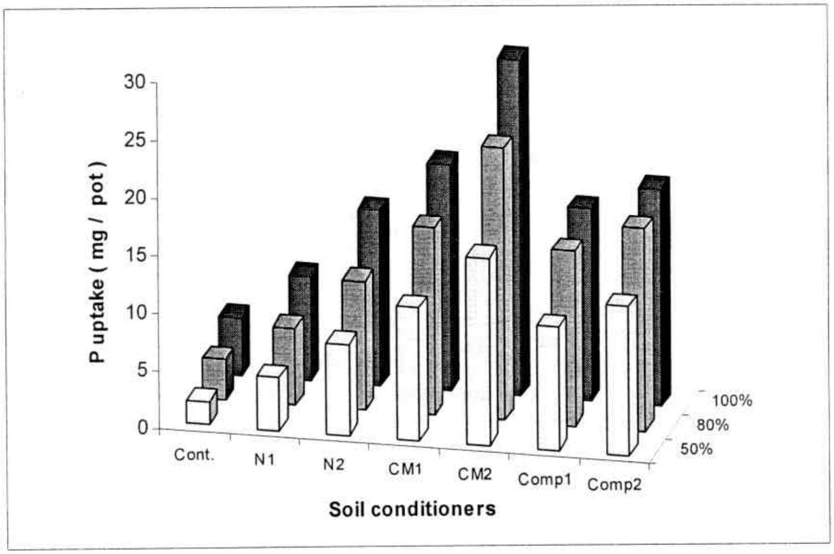

Fig. (20) : The effect of interaction between moisture levels and soil conditioners on phosphorus uptake (mg / pot) by wheat plants at 70 days .

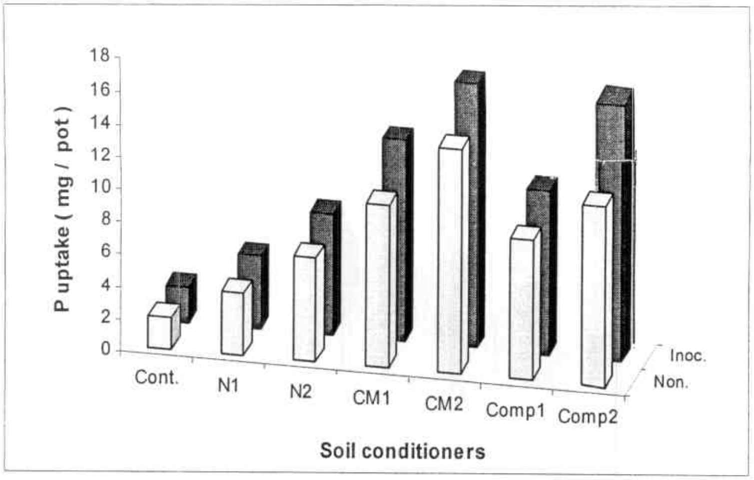

Fig. (21) : The effect of interaction between biofertilizers and soil conditioners on phosphorus uptake (mg / pot) by wheat plants at 45 days .

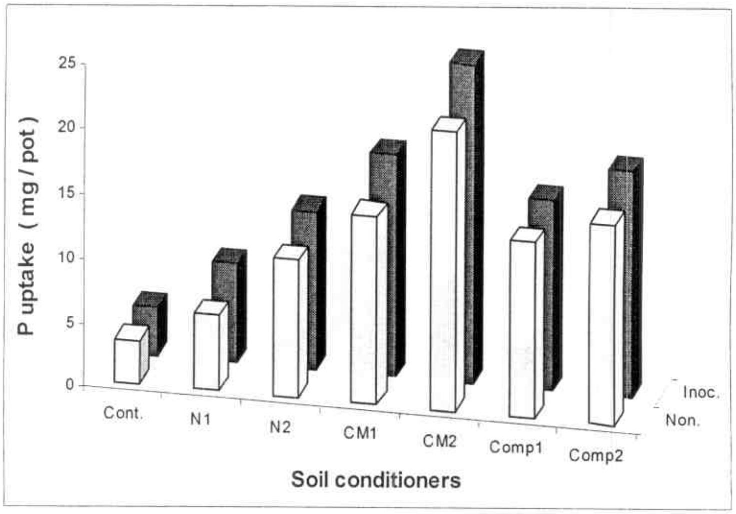

Fig. (22) : The effect of interaction between biofertilizers and soil conditioners on phosphorus uptake (mg / pot) by wheat plants at 70 days .

On the other side, application of organic matter increased the microbial population and activity in the soil, as well as, there was a significant increase in macronutrients uptake by plants. These results agree with those obtained by **Vidyorthy and Nisra (1982), El-Leboudi *et al.*,(1988), Wahdan *et al.*, (1996), Barsoom(1998)** and **Dahdoh *et al.*, (2005).**

It is quite evident to indicate that the promoting effect of biofertilizer might be due to the ability of the free-living bacteria in change root morphology, increase root growth and hence enhance nutrients uptake. Biofertilizers increased nutrients availability through altering the root surface characteristics involved in nutrient uptake as mentioned by **Malik and Bilal (1988)**. Also, **Abdel-Ghani and Bakry (2005)** stated that addition of compost (N-organic) under biofertilizer significantly affected wheat yields and their NPK content. While **Aftab et al.,(2005)** reported that the highest P content was obtained with organic manures+PSM(Phosphorus Solubilizing Micro-organisms).These bacteria able to produce organic and inorganic acids as well as CO_2 which consequently increase soil acidity, that help to convert the insoluble forms of phosphorus into soluble ones.

Concerning the interaction effect between soil moisture level and biofertilizer on P-uptake by wheat plants, data in **Table (5-d)** and **Figs.(23&24)** showed a significant and positive interaction. At 45 days growth values of P-uptake without inoculation were; 10.40, 7.72 and 5.75 mg P/pot for 100, 80 and 50% of field capacity, respectively. These values were increased (when wheat grains inoculated) to reach 12.19, 8.93 and 7.15 mg P/pot for the above-mentioned levels of soil moisture, respectively. At 70 days of growth a significant increase in values of P-uptake was obtained where values of 15.43, 12.70 and 8.65 mg P/pot were achieved without inoculation for 100, 80 and 50% of field capacity, respectively. Inoculation of wheat increased the above-mentioned values to 17.36, 14.39 and 10.23 mg P/pot for the same levels of moisture, respectively.

From the obtained results, it could be concluded that however, lower values of P-uptake were recorded by subjecting wheat plants to moisture stress, inoculation of wheat plants with biofertilizer

Table (5-d):The effect of interaction between moisture level and biofertilizers on phosphorus uptake (mg/pot) by wheat plants.

Soil moistrue % of (F.C.) Biofertilizers		100%	80%	50%
Non inoculation	45days	10.40	7.72	5.75
	70days	15.43	12.70	8.65
Inoculation	45days	12.19	8.93	7.15
	70days	17.36	14.39	10.23

L.S.D. at 0.05 for 45 days = 0.352
L.S.D. at 0.05 for 70 days = 0.257

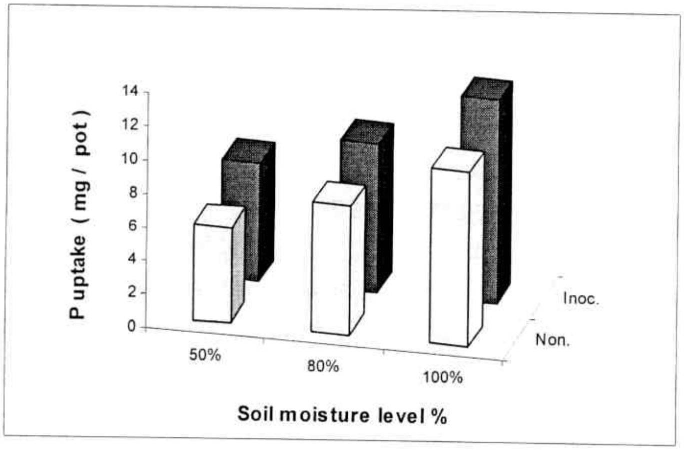

Fig. (23) : The effect of interaction between soil moisture levels and bio-fertilizers on phosphorus uptake (mg / pot) by wheat plants at 45 days

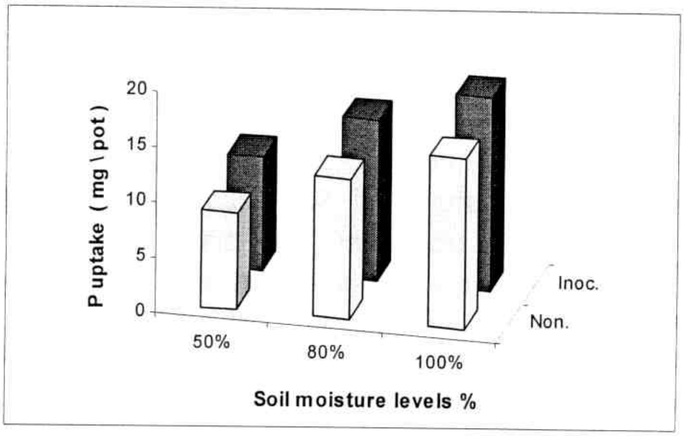

Fig. (24) : The effect of interaction between soil moisture levels and bio-fertilizers on phosphorus uptake (mg / pot) by wheat plants at 70 days minimized the negative effect of moisture stress on wheat growth and hence increased the nutrients uptake.

The beneficial effect of biofertilizer might be attributed to production of promoting substances by these bacteria such as auxins, gibberellins and cytokinins which may improve plant growth and increased the surface area per unit root length and were responsible for root hair branching with an eventual increase in uptake of nutrients,as mentioned by **Jagnow et al., (1991), El-Mancy (1998)** and **EL-Sayed (1999).**

4.4: Potassium uptake by wheat plants as influenced by soil conditioners and biofertilization under different soil moisture levels.

Data presented in **Table (6-a)** and illustrated by **Fig. (25)** represent values of K-uptake by wheat plants and their effects by conditioners, biofertilizers and soil moisture stress.

The obtained results indicate that addition of mineral fertilizer (ammonium sulphate) either with or without biofertilization significantly increased values of K-uptake by wheat plants as compared with the control treatment. The magnitude of the increase depends on the period of growth, inoculation with bacteria and the rate of nitrogen application. At 45 days of growth,application of mineral nitrogen at rate of 30 kg N/fed. (N_1) increased value of K-uptake averaged overall soil moisture from 52.54 (control) to 99.45 mg K/pot. Increasing the rate of applied N up to 90 kg N/fed.(N_2) significantly and continuously increased the above-mentioned value to 180.7 mg K/pot. When period of wheat growth reached to 70 days, values of K- uptake continued to increase and changed from 93.57 (control) to 151.2 and 242.5 mg K/pot with increasing the rate of applied N from 30 (N_1) to 90 kg N/fed (N_2), respectively. Such effect of nitrogen on K-uptake could be ascribed on the basis that nitrogen affects growth of the wheat plants. Consequently deeper penetration roots in soil causing higher nutrients uptake. Similar results were obtained by **Ahmed (1995), Wahdan *et al.*, (1996), El-Zaher *et al.*, (2001) and Mohamed *et al.*,(2006).**

Addition of organic conditioners; chicken manure(CM) and compost manure (Comp) either with biofertilizer or without significantly and progressively increased values of K-uptake over the other treatments. On the other hand, chicken manure treatment (CM) was superior to compost manure (Comp).

Data, also indicate that increasing the rate of applied manure from 0.5 to 2% was accompanied by increasing the values of K-uptake. Values of K-uptake at 45 days growth were increased from 52.54 (control) to 203.1 and 301.9 mg K/pot when chicken manure was applied at rates of 0.5 and 2%, respectively. When compost manure was applied the achieved values were 130.3 and 195.7 mg K/pot at the above-mentioned rates 0.5 and 2%, respectively.

Increasing the period of growth up to 70 days significantly and continuously increased values of K-uptake by wheat plants. The values of K-uptake increased from 93.57 mg K/pot (control) to 273.2 and 417.6 mg K/pot when chicken manure was applied and to 182.5 and 265.3 mg K/pot when compost manure was applied at 0.5 and 2%, respectively.

Such effect of organic amendments may be due to one or more of the following: 1- The decomposition of organic manure in soil might have induced a slow release of nutrient supply for the growing plants. 2- improving the soil physical, chemical and biological properties which preparing suitable bed for germination and development of plant growth and its nutrient uptake. These results are in harmony with those obtained by **El- Morsy (1997), Abdel-Aal *et al.*, (2003), Dahdoh *et al.*,(2005) and El-Shouny (2006).**

The obtained results as presented in **Table (6-a)** and **Fig.(26)** show that subjecting wheat plants to soil moisture stress was accompanied by reduction in potassium uptake either at 45 or 70 days of growth. However, values of K-uptake at 70 days were much higher than those at 45 days of growth. Decreasing soil moisture from 100% to 80% then to 50% of field capacity significantly decreased values of K-uptake from 244 to 162.9 and then to 91.81 mg K/pot at 45 days ,

Table (6-a):Effect of soil moisture stress on potassium uptake by wheat plants(mg/pot) as affected by soil conditioners and biofertilizers.

Soil conditioners		Control		N1		N2		CM1		CM2		Comp1		Comp2		Mean
M.L(F.C.)	Bio.	Non.	Inoc.	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc.	Non.	Inoc	
100%	45days	78.79	93.24	144.9	175.7	247.1	290.0	289.8	311.1	414.5	437.7	177.6	203.2	265.2	287.3	244.0
	70days	134.2	161.0	213.8	255.2	329.9	388.3	368.0	405.3	552.4	593.7	244.2	288.4	366.7	392.1	335.2
80%	45days	46.68	55.14	84.94	107.6	166.6	192.3	180.3	205.0	284.0	303.4	123.5	141.9	184.5	205.1	162.9
	70days	82.75	101.9	128.9	162.7	214.6	258.6	252.1	278.9	399.8	425.6	167.3	192.1	248.7	269.5	227.4
%50	45days	18.04	23.37	36.57	47.07	87.62	100.3	110.1	122.5	177.2	194.7	64.33	71.27	105.3	126.8	91.81
	70days	36.26	45.22	64.03	82.63	118.3	145.5	162.9	171.8	258.0	276.4	93.54	109.4	147.6	167.0	134.2
Mean	45days	52.54		99.45		180.7		203.1		301.9		130.3		195.7		
	70days	93.57		151.2		242.5		273.2		417.6		182.5		265.3		

L.S.D. at 0.05 for moistrue level at 45 days = 2.61 *L.S.D. at 0.05 for moistrue level at 70 days = 3.47*
L.S.D.at 0.05 for soil conditioners at 45 days = 3.98 *L.S.D. at 0.05 for soil conditioners at 70 days = 5.3*
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 45 days = 9.76
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 70 days = 12.99

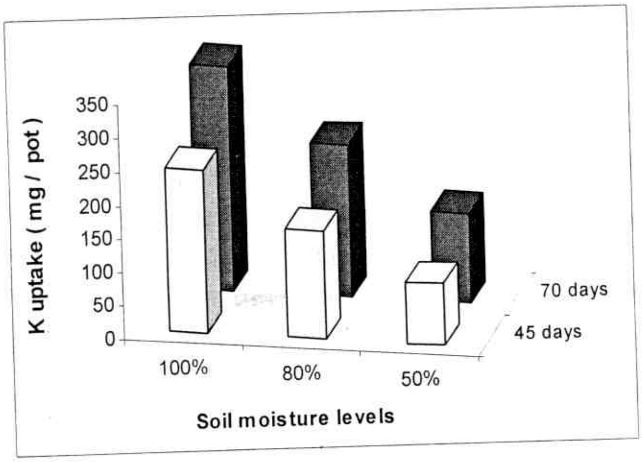

Fig. (25) : Effect of soil moisture levels on potassium uptake (mg / pot) by wheat plants.

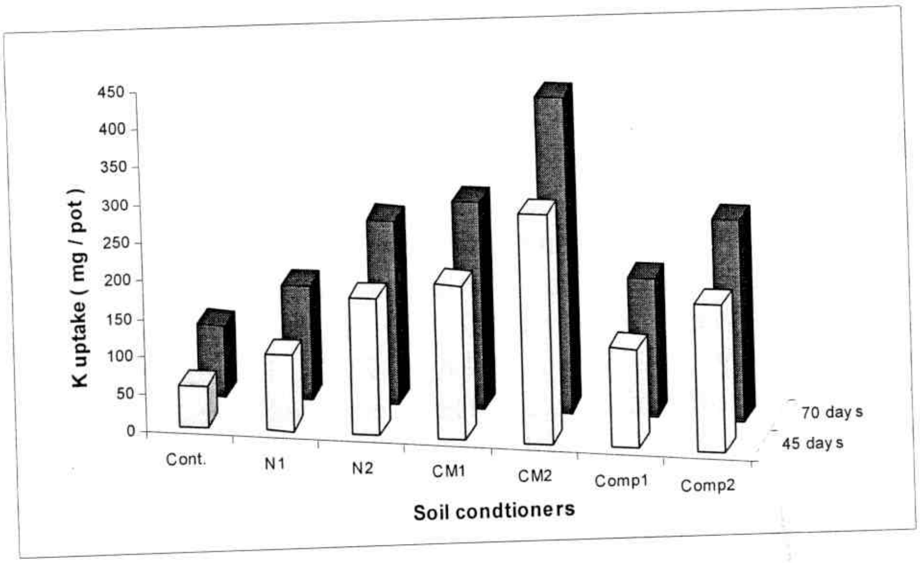

Fig. (26) : Effect of soil conditioners on potassium uptake (mg / pot) by wheat plants.

respectively. These values at 70 days of growth increased from 335.2 to 227.4 and 134.2 mg K/pot for the above-mentioned levels of soil moisture, respectively. The effect of soil moisture in K-uptake might be attributed to the serious losses in most crops by water stress. Also, most of the physiological processes were affected and under severe deficits, nutrients balance disorder in root medium and death of plants may result. These results are consistent with those obtained by **Mc Cutchan and Shacker (1992) and Abdel-Nasser and El-Shazly (2000) and Abdel-Aziz (2003).**

Data of **Table (6-b)** and **Figs.(27&28)** represent a significant interaction effect between soil moisture level (M.L) and soil conditioners either at 45 days or 70 days of growth on K-uptake by wheat plants. At both periods of growth application of conditioners either in mineral form $(NH_4)_2SO_4$ or in organic form (chicken manure or compost manure) improved and significantly increased values of K-uptake as compared to the control treatment.

Data indicate also, that increasing the rate of applied conditioners significantly increased values of K-uptake . However, these values decreased as soil moisture levels decreased. At 45 days of growth and 100% of field capacity values of K-uptake were increased from 86.01 mg K/pot (control) to reach 160.3, 268.6, 300.4, 426.1, 190.4 and 276.2 mg K/pot with application of N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively. However, these values decreased to reach 50.91, 96.25, 179.50, 192.60, 293.70, 132.70 and 194.80 mg K/pot at 80% of field capacity, Then decreased to reach 20.71, 41.82, 93.95, 116.30, 186.0, 67.80 and 116.10 mg K/pot at 50% of field capacity for control, N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$ respectively.

The same trend was observed at 70 days of growth, however the higher values of K-uptake were recorded. Such effect of organic manure could be ascribed on the basis that application of such material improved soil physical properties, hence increased available water in soil and consequently increased nutrients uptake by plants as compared with control. On the other hand , the addition of organic material in the form of manures has beneficial effects on the fertility of soil, beside the amount of some plant nutrients in organic manures liberate in higher amounts than that applied as chemical fertilizers.

Similar results were obtained by **Ismaiel (2002) and Abdel-Aziz (2003)**.

It is quite obvious from the data that chicken manure was superior to organic manures and may be due to its superior to properties as a conditioning agent and because it has an extra advantage of being a good source of plant nutrients. Similar results were stated by **Acea and Carballas (1996) and El-Shafie-Fatma and El-Shikha (2003).**

Data presented in **Table (6-c)** and **Figs.(29&30)** represent a significant interaction effect between biofertilizer and soil conditioners on K-uptake by wheat plants. Application of soil conditioners significantly increased values of K-uptake by wheat plants at both periods of growth 45 and 70 days. Biofertilization of wheat plants in combination with conditioners produced higher values of K-uptake as compared to without biofertilizer. At 45 days and without inoculation values of K-uptake were 47.84 mg K/pot and increased to reach 88.8, 167.1, 193.4, 291.9, 121.8 and 185.0 mg K/pot.

Inoculation of wheat grains before sowing significantly increased these values to reach 57.25, 110.1, 194.2, 212.9, 311.9, 138.8 and 206.4 mg K/pot for control, N_1, N_2, CM_1, CM_2, $Comp_1$ and , $comp_2$, respectively.

At 70 days, similar trend was observed but higher values of K-uptake were achieved. Values of K- uptake at 70 days growth and without inoculation were 84.42, 135.6, 220.9, 261.0, 403.4, 168.4 and 254.3 mg K/pot for control, N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively. These values significantly and progressively increased to reach 102.7, 166.8, 264.1, 285.3, 431.9, 196.6 and 276.2 mg K/pot for the above- mentioned treatments, respectively.

Table (6-b):The effect of interaction between moisture level(M.L.)and soil conditioners on potassium uptake (mg/pot)by wheat plants.

Soil conditioners M.L(F.C.).		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
100%	45days	86.01	160.30	268.60	300.40	426.10	190.40	276.20
	70days	147.60	234.50	359.10	386.60	573.10	266.30	379.40
80%	45days	50.91	96.25	179.50	192.60	293.70	132.70	194.80
	70days	92.35	145.80	236.60	265.50	412.70	179.70	259.10
50%	45days	20.71	41.82	93.95	116.30	186.00	67.80	116.10
	70days	40.47	73.33	131.90	167.30	267.2	101.50	157.30

L.S.D. at 0.05 for 45 days = 6.90
L.S.D. at 0.05 for 70 days = 9.18

Table (6-c):The effect of interaction between biofertilizers and soil conditioners on potassium uptake (mg/pot)by wheat plants.

Soil conditioners Biofertilizers		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
Non inoculation	45days	47.84	88.8	167.1	193.4	291.9	121.8	185.0
	70days	84.42	135.6	220.9	261.0	403.4	168.4	254.3
Inoculation	45days	57.25	110.1	194.2	212.9	311.9	138.8	206.4
	70days	102.7	166.8	264.1	285.3	431.9	196.6	276.2

L.S.D. at 0.05 for 45 days = 5.63
L.S.D. at 0.05 for 70 days = 7.50

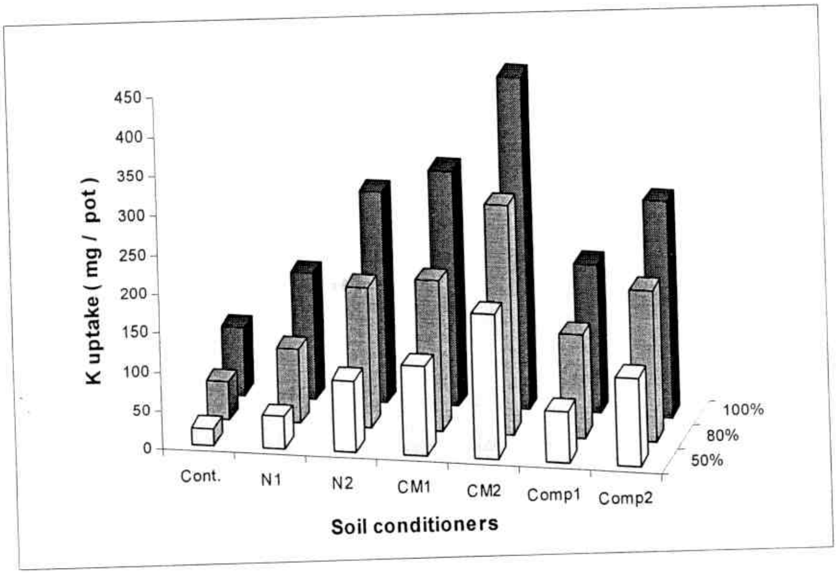

Fig. (27) : The effect of interaction between moisture levels and soil conditioners on potassium uptake (mg / pot) by wheat plants at 45 days .

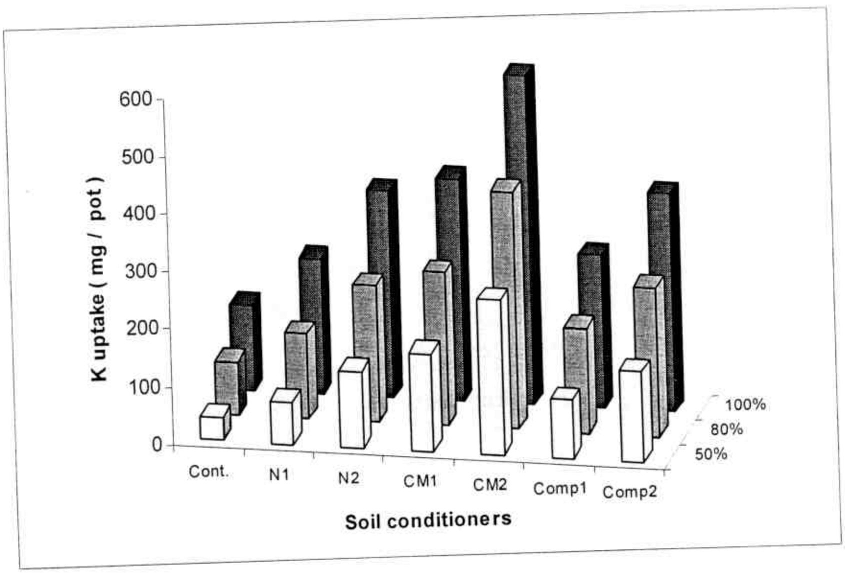

Fig. (28) : The effect of interaction between moisture levels and soil conditioners on potassium uptake (mg / pot) by wheat plants at 70 days .

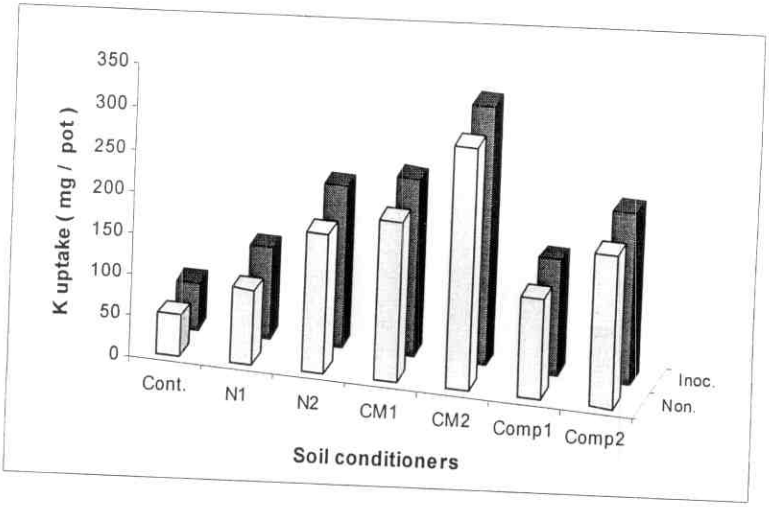

Fig. (29) : The effect of interaction between biofertilizers and soil conditioners on potassium uptake (mg / pot) by wheat plants at 45 days .

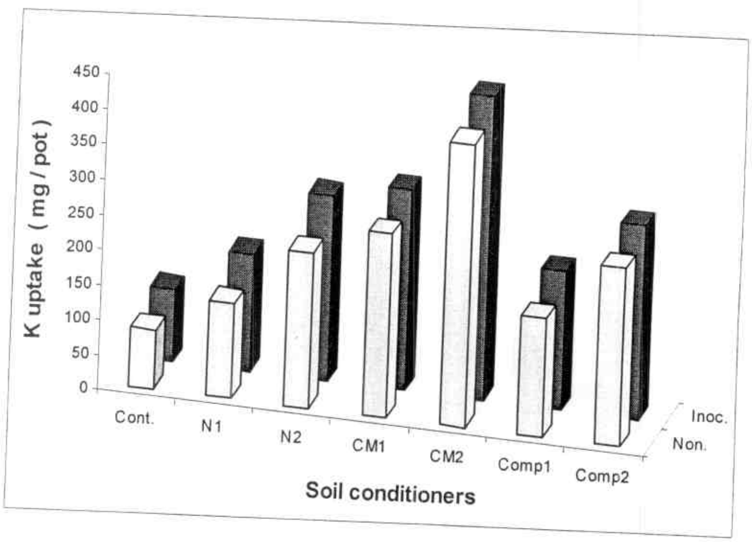

Fig. (30) : The effect of interaction between biofertilizers and soil conditioners on potassium uptake (mg / pot) by wheat plants at 70 days .

The stimulating influence of organic manure in combination with biofertilizer on K-uptake might be attributed to the improved microbial activity in the soil and thus probably improves the availability of the nutrients. Moreover, bacteria existed in biofertilizer may produce growth promoting substances such as auxins, gibberellins and cytokinins which may improve plant growth and nutrients uptake. Such results came along with those reported by **Saber (1993), Carletti *et al.*,(1996), El- Sersawy *et al.*, (1997), El-Komy *et al.*, (1998), El-Sayed (1999), Abdel Aal *et al.*, (2003) and Abdel-Ghani and Bakry (2005).**

It is quite evident that application of chicken manure accompanied by biofertilizer was more effective for increasing values of K-uptake as compared with the other treatments. This may be confirmed by improving the soil structure with chicken manure which contained higher values of K and its continuous biodegradation throughout the growth period, providing such element in easily absorbable forms. Similar results were obtained by **Eissa (1996), El-Koumey (1999) and El-Shafie-Fatma and El-Shikha (2003)**. Also, **Minged *et al.*, (1996)** stated that K increased plant growth and decreased the negative effects of water stress.

Concerning the interaction effect between soil moisture levels and biofertilization on K-uptake, data in **Table (6-d)** and illustrated in **Figs.(31&32)** showed a significant interaction effect, Meanwhile inoculation of wheat grains before sowing significantly increased values of K-uptake by wheat plants and minimized the negative effect of water deficit on wheat growth and their nutrients uptake either at 45 or 70 days of growth.

Without inoculation, values of K- uptake at 45 days growth were; 231.1, 152.9 and 85.61 mg K/pot for 100, 80 and 50% of field capacity. These values increased with inoculation to reach 256.9, 172.9 and 98.01 mg K/pot for the above-mentioned levels of soil moisture, respectively.

At 70 days growth and without inoculation, values of K-uptake were 315.6, 213.5 and 125.8 mg K/pot. However, with inoculation

Table (6-d):The effect of interaction between moisture level and biofertilizers on potassium uptake (mg/pot) by wheat plants.

Soil moistrue % of (F.C.) *Biofertilizers*		*100%*	*80%*	*50%*
Non inoculation	*45days*	**231.1**	**152.9**	**85.61**
	70days	**315.6**	**213.5**	**125.8**
Inoculation	*45days*	**256.9**	**172.9**	**98.01**
	70days	**354.9**	**241.4**	**142.6**

L.S.D. at 0.05 for 45 days = 3.67
L.S.D. at 0.05 for 70 days = 4.91

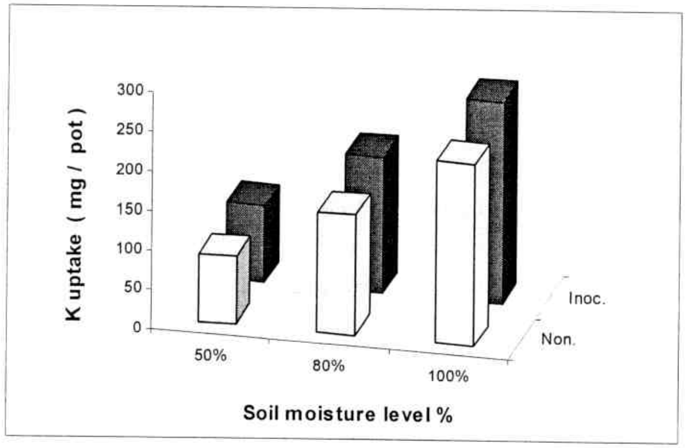

Fig. (31) : The effect of interaction between soil moisture levels and bio-fertilizers on potassium uptake (mg / pot) by wheat plants at 45 days

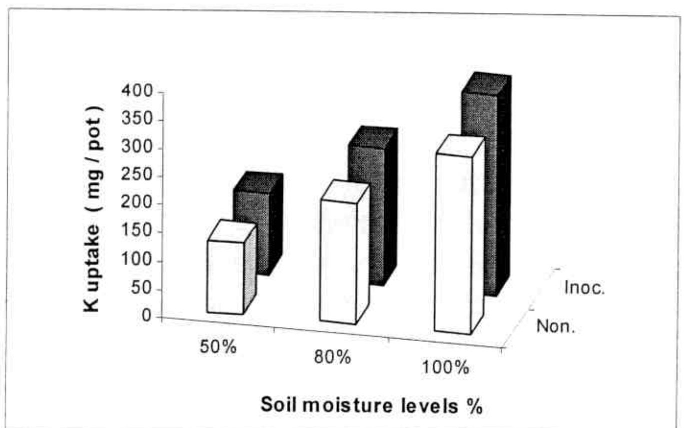

Fig. (32) : The effect of interaction between soil moisture levels and bio-fertilizers on potassium uptake (mg / pot) by wheat plants at 70 days these values reached to 354.9, 241.4 and 142.6 mg K/pot for 100, 80 and 50% of field capacity, respectively.

The enhancing effect of biofertilizer might be due to that free-living bacteria change root morphology, increase root growth and hence enhanced nutrients uptake. Also biofertilizers are considered as products containing living cells of different types of microorganisms, which have the ability to convert nutritionally elements from unavailable to available form through biological processes. Similar findings were achieved by **Malik and Bilal (1988) and Hedge *et al.*, (1999)**. Also, **Wang *et al.*, (2005)** who indicated that water deficit (WD) decreased biomass and inhibited the translocation of assimilates from the vegetative plants part to the head. Translocation of N, P and K were impeded by water deficit.

4.5: Iron uptake by wheat plants as influenced by soil conditioners and biofertilization under different soil moisture levels.

Data of **Table (7-a)** which illustrated by **Fig. (33)** represent values of iron uptake by wheat plants and their effect by soil moisture, soil conditioners and biofertilization. It is quite obvious from the obtained results that values of iron uptake were increased by application of mineral fertilizer, chicken manure and composting manure either at 45 or 70 days of growth and at both of applied rates.

At 45 days of growth, application of mineral nitrogen at 30 (N_1) and 90 (N_2) kg N /fed. increased values of iron uptake averaged overall moisture levels from 197µg Fe/pot for control to 515 and 742µg Fe/pot for both rates of applied N, respectively. The above-mentioned values increased at 70 days of growth to reach 367, 839 and 1071µg Fe/pot for control, N_1 and N_2, respectively.

Application of organic manures significantly increased values of Fe-uptake, however their effects were dependent on the concerned manure, its chemical composition and the rate of applications. Chicken manure (CM) was superior to compost manure either when they were applied solely or in combination with biofertilizers. The obtained values in case of chicken manure at 45 days of growth increased to reach 1054 and 1690µg Fe/pot at the rate of 0.5 and 2% CM, respectively. These values were 1505 and 2465µg Fe/pot when plants grew 70 days from sowing at the above-mentioned rates of application, respectively.

When compost was applied as soil conditioners at rates of 0.5 and 2% , values of Fe-uptake achieved at 45 days growth were 704 and 1112 µg Fe/pot, respectively. These values at 70 days growth were increased to reach 1027 and 1561µg Fe/pot when compost was applied at rates 0.5 and 2%, respectively.

Concerning effect of soil moisture on Fe-uptake by wheat plants data of **Table (7-a)** and **Fig.(34)** indicate that, these values averaged overall applied conditioners had been decreased when wheat plants subjected to water stress. The achieved values decreased from 1201 and 1752µg Fe/pot at 100% of field capacity to 888 and 1316µg Fe/pot at 80% of field capacity and then decreased to reach 488 and 718µg Fe/pot at 50% of field capacity when plants were grown for 45 and 70 days of sowing, respectively. The above-mentioned results are in agreement with those outlined by **Sharma *et al.,* (1984), El-Shafie-Fatma (2001), El-Masry (2001) and Abdel Aal *et al.,* (2003).**

Concerning the interaction effect between soil moisture levels and soil conditioners, data of **Table (7-b)** and **Figs.(35&36)** show a positive and significant interaction effect on values of Fe-uptake by wheat plants at both periods of growth (45 and 70 days). Meanwhile application of conditioners maximized the available moisture content in root zone and/or increased penetration of roots in soil and consequently increased contact distance between roots and soil fractions and hence increased the uptake of nutrients.

Data in **Table (7-b)** indicate that at 45 days of growth decreasing soil moisture from 100% of field capacity to 50% decreased values of Fe-uptake from 294,762, 1050, 1501, 2344, 949 and 1507 µg Fe/pot to 85, 245, 397, 603, 1018, 399 and 672µg Fe/pot for control, N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectivelyn That means, values of Fe-uptake were increased by application of soil conditioners.

Table (7-a):Effect of soil moisture stress on iron uptake by wheat plants (µg/pot) as affected by soil conditioners and biofertilizers.

Soil conditioners		Control		N1		N2		CM1		CM2		Comp1		Comp2		Mean
M.L (F.C.)	Bio.	Non.	Inoc.	Non.	Inoc.	Non.	Inoc.	Non.	Inoc.	Non.	Inoc.	Non.	Inoc.	Non.	Inoc.	
100%	45days	258	329	699	825	977	1122	1456	1545	2273	2415	898	999	1456	1558	1201
	70days	469	580	1096	1308	1410	1624	1972	2164	3261	3545	1290	1476	2073	2254	1752
80%	45days	188	234	490	587	736	821	991	1125	1659	1760	735	797	1133	1179	888
	70days	361	432	801	945	1029	1204	1469	1147	2469	2618	1058	1163	1567	1666	1316
%50	45days	75	95	218	272	371	424	566	640	976	1059	375	422	638	707	488
	70days	157	204	400	485	525	632	846	931	1394	1501	549	626	872	931	718
Mean	45days	197		515		742		1054		1690		704		1112		
	70days	367		839		1071		1505		2465		1027		1561		

L.S.D. at 0.05 for moistrue level at 45 days =15.6 *L.S.D. at 0.05 for moistrue level at 70 days= 21.56*
L.S.D.at 0.05 for soil conditioners at 45 days = 23.83 *L.S.D. at 0.05 for soil conditioners at 70 days = 32.94*
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 45 days = 58.38
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 70 days =80.69

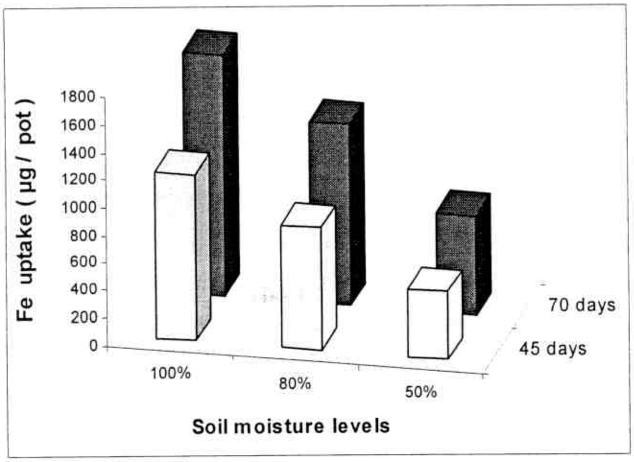

Fig. (33) : Effect of soil moisture levels on iron uptake (µg / pot) by wheat plants.

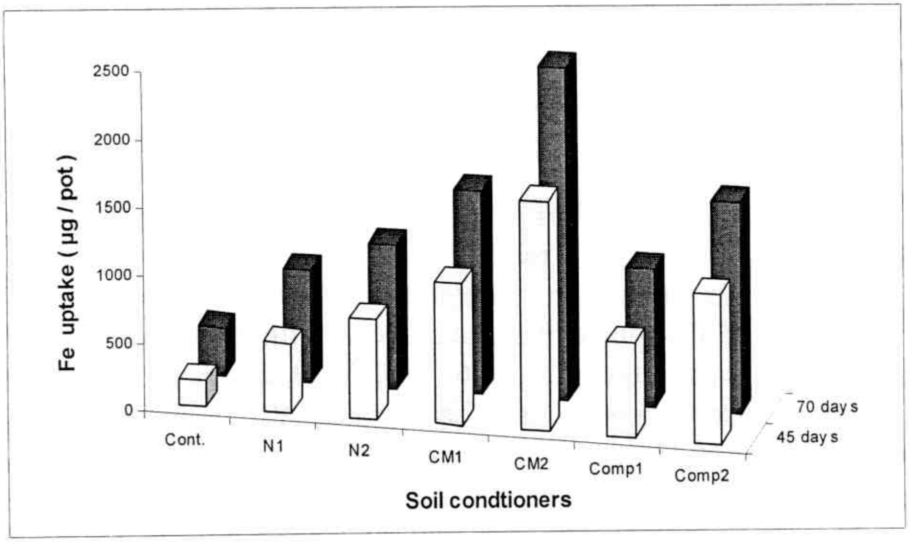

Fig. (34) : Effect of soil conditioners on iron uptake (µg / pot) by wheat plants.

At 70 days of growth, similar trend was observed, however higher values of Fe-uptake were achieved. It is clearly shown that organic conditioners gave higher values of Fe-uptake as compared to the control and mineral nitrogen treatments. However, chicken manure was more superior to compost. On the other hand, chicken manure at both rates of application achieved values of Fe-uptake at 70 days of growth and 80% of field capacity higher than those values obtained with application of mineral nitrogen or compost at both rates of application and 100% of field capacity. Similar results were mentioned by **Heggy *et al.,* (1993), El-Koumey (1999), Munir *et al.,* (2000), and El-Shafie-Fatma and El-Shikha (2003).**

Data in **Table (7-c)** and **Figs.(37&38)** show a positive and significant interaction effect between biofertilization and soil conditioners on Fe-uptake by wheat plants. Meanwhile, inoculation of wheat grains before sowing maximized the values of Fe-uptake as compared to without biofertilization.

At 45 days of growth and without inoculation, values of Fe-uptake were; 174, 469, 695, 1004, 1636, 670 and 1076 μg Fe/pot for control, N_1, N_2 , CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively. These values significantly increased when wheat grains were inoculated to reach 219, 562, 789, 1103, 1745, 739 and 1148 μg Fe/pot for the above-mentioned treatments, respectively.

At 70 days of growth, similar trend was observed, however higher values of Fe-uptake were achieved. Without biofertilization, values of Fe-uptake were; 329, 766, 988, 1429, 2375, 966 and 1504 μg Fe/pot. These values when wheat grains were inoculated were significantly increased and reached to 405, 913, 1153, 1581, 2555, 1088 and 1617 μg Fe/pot. It can be noticed that chicken manure applied to the inoculated wheat gave the highest values of Fe-uptake as compared to other treatments. These results coincided with those obtained by **Carletti *et al.,* (1996), Amara and Dahdoh (1997) , El-Shafie-Fatma (2001) and El-Shafie-Fatma and El-Shikha (2003).**

Table (7-b): The effect of interaction between moisture level(M.L.) and soil conditioners on iron uptake(μg/pot) by wheat plants.

Soil conditioners / M.L. (F.C.)		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
100%	45days	294	762	1050	1501	2344	949	1507
	70days	524	1202	1517	2068	3403	1383	2164
80%	45days	211	539	779	1058	1709	766	1156
	70days	396	873	1117	1558	2543	1111	1616
50%	45days	85	245	397	603	1018	399	672
	70days	180	443	579	888	1448	588	902

L.S.D. at 0.05 for 45 days = 41.28
L.S.D. at 0.05 for 70 days =57.06

Table (7-c): The effect of interaction between biofertilizers and soil conditioners on iron uptake (μg/pot)by wheat plants .

Soil conditioners / Biofertilizers		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
Non inoculation	45days	174	469	695	1004	1636	670	1076
	70days	329	766	988	1429	2375	966	1504
Inoculation	45days	219	562	789	1103	1745	739	1148
	70days	405	913	1153	1581	2555	1088	1617

L.S.D. at 0.05 for 45 days = 33.71
L.S.D. at 0.05 for 70 days =46..59

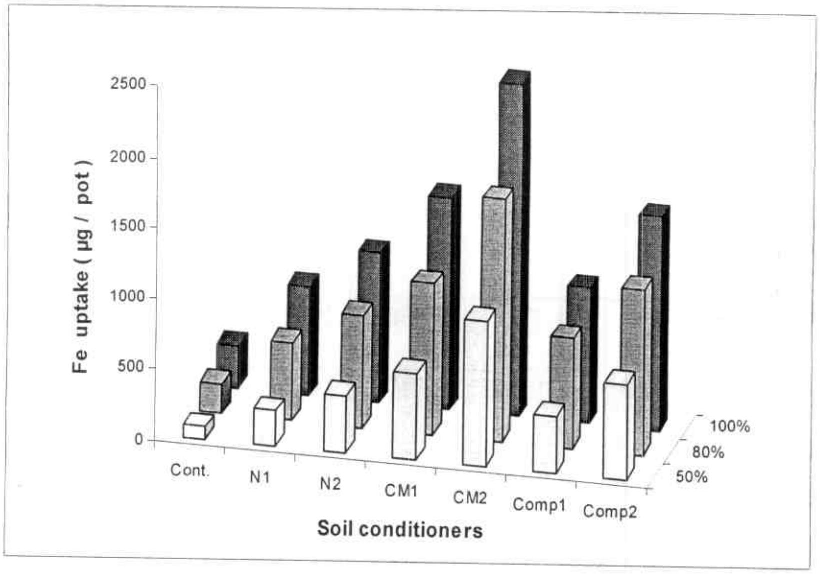

Fig. (35) : The effect of interaction between moisture levels and soil conditioners on iron uptake (µg / pot) by wheat plants at 45 days .

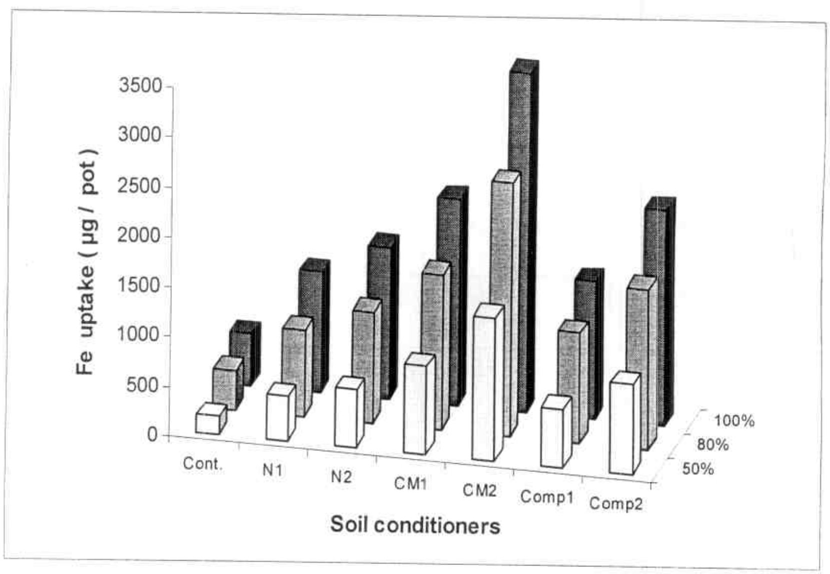

Fig. (36) : The effect of interaction between moisture levels and soil conditioners on iron uptake (µg / pot) by wheat plants at 70 days .

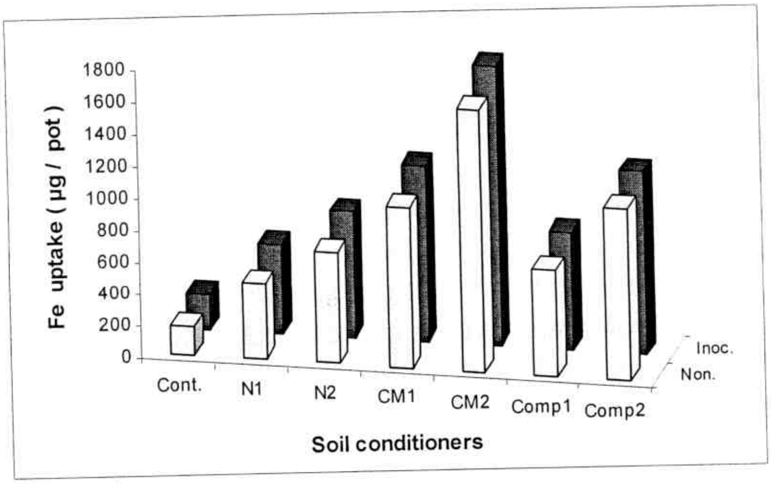

Fig. (37) : The effect of interaction between biofertilizers and soil conditioners on iron uptake (µg / pot) by wheat plants at 45 days .

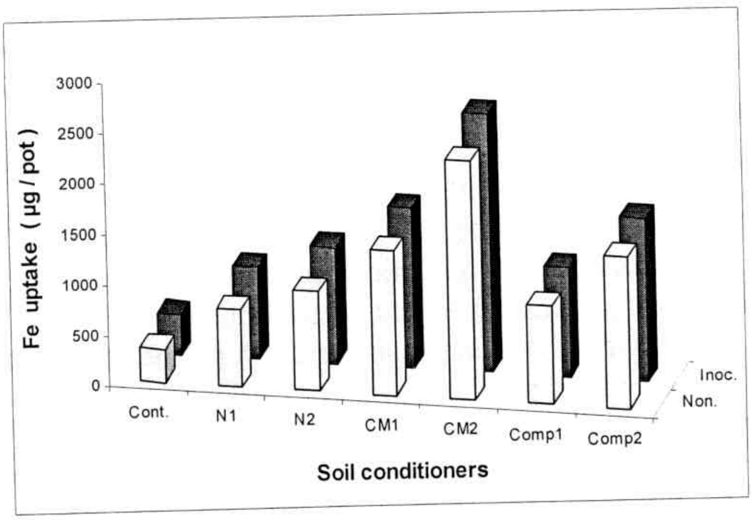

Fig. (38) : The effect of interaction between biofertilizers and soil conditioners on iron uptake (µg / pot) by wheat plants at 70 days .

It can be noticed from the data of **Table (7-d)** and **Figs.(39 &40)** that the interaction between soil moisture level and biofertilization significantly affected the values of Fe-uptake by wheat plants. Meanwhile biofertilization of wheat grains before sowing minimized the negative effect of water deficit on wheat growth. Such effect might be due to that the exudates of bacteria strains act as plant growth promoters and apparently stimulate growth mainly throughout modifying root development which improve macro and micronutrients and water uptake, particularly in the early stages of plant development. Such interpretation was outlined by **El-Komy *et al.*, (1998).** Similar results were found by **Carletti *et al.*, (1996), El-Mancy(1998) and El-Shafie- Fatma (2001).**

4.6: Zinc uptake by wheat plants as influenced by soil conditioners and biofertilization under different soil moisture levels.

Values of Zn-uptake as presented in **Table (8-a)** which illustrated by **Fig. (41)** show that, these values were significantly affected by application of soil conditioners and soil moisture levels. On the other hand, the effect of soil conditioners was dependent on the type of conditioners and its chemical composition. As well as the effect of soil moisture was dependent on soil moisture levels.

It is quite evident that increasing growth periods from 45 to 70 days significantly increased values of Zn-uptake by wheat plants. At 45 days, values of Zn-uptake significantly increased from 111 μg Zn/pot for control treatment to 304 and 489 μg Zn/pot when mineral conditioner in the form of $(NH_4)_2SO_4$ at rates of 30 (N_1) and 90 (N_2) kg N/fed. When organic conditioners in the form of chicken manure or compost manure were applied, values of Zn-uptake increased as compared with control or applied mineral nitrogen. However, the greatest values were achieved with application of chicken manure either alone or accompanied with biofertilizers.

The values of Zn-uptake when chicken manure was applied, were increased to reach 679 and 1143 μg Zn/pot at application rates of

Table (7-d): The effect of interaction between moisture level and biofertilizers on iron uptake (μg/pot) by wheat plants.

Soil moistrue % of (F.C.) *Biofertilizers*		*100%*	*80%*	*50%*
Non inoculation	*45days*	**1145**	**848**	**460**
	70days	**1653**	**1250**	**678**
Inoculation	*45days*	**1256**	**929**	**517**
	70days	**1850**	**1382**	**759**

L.S.D. at 0.05 for 45 days = 22.1
L.S.D. at 0.05 for 70 days = 30.5

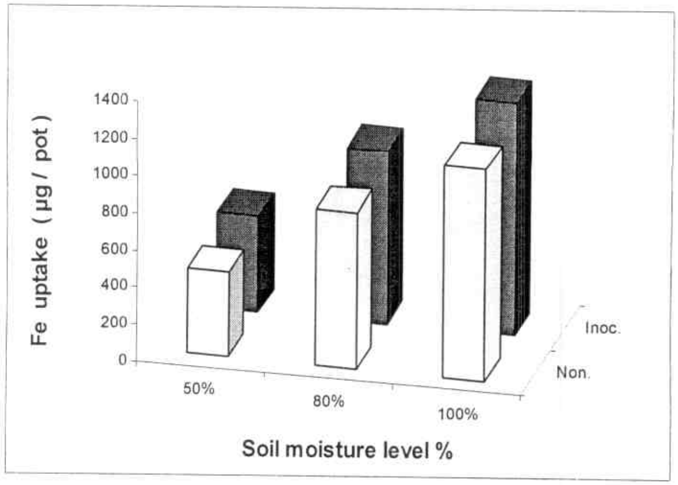

Fig. (39) : The effect of interaction between soil moisture levels and bio-fertilizers on iron uptake (µg / pot) by wheat plants at 45 days

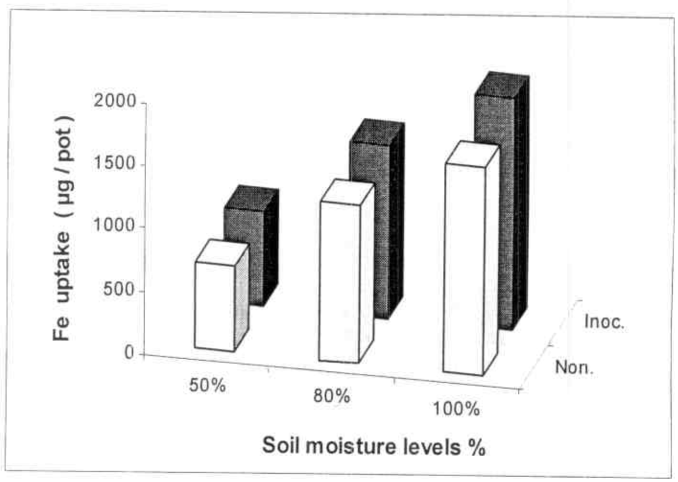

Fig. (40) : The effect of interaction between soil moisture levels and bio-fertilizers on iron uptake (µg / pot) by wheat plants at 70 days

0.5 (CM_1) and 2% (CM_2), respectively. When compost manure was applied, the above-mentioned values reached to 425 and 688 μg Zn/pot at rates of 0.5 ($Comp_1$) and 2% ($Comp_2$), respectively. Meanwhile increasing the rate of N applied conditioners significantly increased values of Zn-uptake.

Increasing growth periods to 70 days significantly increased values of Zn-uptake and reached to 212, 510, 687, 967, 1705, 616 and 987 μg Zn/pot for control, N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively. The effect of nitrogen could be ascribed to that nitrogen affects growth of plant and consequently deeper penetration of roots in soil causing higher nutrients uptake. Similar results were cope with **Awad *et al.*,(1996) ,El-Masry (2001), El-Shafie-Fatma (2001) and Ismail *et al.*, (2006).**

The positive effect of organic manures in increasing Zn-uptake might be due to that the release of organic acids during the decomposition of organic manures increases micronutrients availability to the growing plants via their abilities to chelate Fe, Mn, Zn and Cu. Similar results were obtained by **Allam (1999), El-Shafie,Fatma and El-Shikha (2003), Bakry *et al.*, (2005), Dahdoh *et al.*, (2005) and Taha *et al.*, (2006).**

The superiority of chicken manure to compost could be ascribed to its higher content of such nutrients. Also, the easily continuous biodegradation of chicken manure throughout the growth period, providing such elements in easily absorbable form. On the other side, improving the soil structure with chicken manure application encourages micronutrients availability to the growing plants. These results are in accordance with those obtained by **El-Koumey (1999) and El-Shafie-Fatma and El-Shikha (2003).**

Data of **Table (8-a)** which illustrated by **Fig. (42)** show the effect of soil moisture levels on Zn-uptake by wheat plants. This effect was significant. Meanwhile decreasing soil moisture levels or subjecting the wheat plants to moisture stress significantly decreased values of Zn-uptake by wheat at both growth periods 45 and 70 days of sowing.

Table (8-a):Effect of soil moisture stress on zinc uptake by wheat plants(µg/pot) as affected by soil conditioners and biofertilizers.

Soil conditioners		Control		N1		N2		CM1		CM2		Comp1		Comp2		Mean
M.L (F.C.)	Bio.	Non.	Inoc.	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc.	Non.	Inoc	
100%	45days	151	191	438	537	617	738	963	1027	1567	1693	554	662	956	1040	798
	70days	280	347	694	847	864	1037	1297	1433	2284	2513	828	975	1395	1509	1165
80%	45days	101	124	269	337	440	505	611	686	1078	1166	414	459	657	716	540
	70days	188	236	459	557	617	739	906	1001	1615	1737	570	658	930	1007	801
%50	45days	43	59	105	140	297	339	364	418	643	709	201	232	357	400	308
	70days	90	132	227	278	392	472	560	603	1007	1075	308	358	518	565	470
Mean	45days	111		304		489		679		1143		425		688		
	70days	212		510		687		967		1705		616		987		

L.S.D. at 0.05 for moistrue level at 45 days = 10.4 *L.S.D. at 0.05 for moistrue level at 70 days= 15.16*
L.S.D.at 0.05 for soil conditioners at 45 days = 15.89 *L.S.D. at 0.05 for soil conditioners at 70 days = 23.16*
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 45 days = 38.92
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 70 days = 56.73

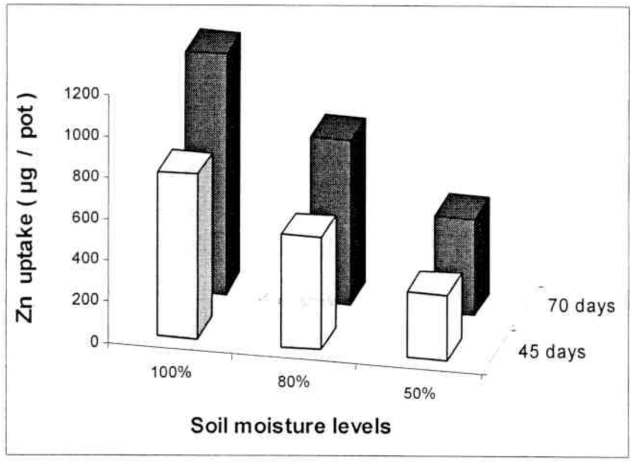

Fig. (41) : Effect of soil moisture levels on zinc uptake (µg / pot) by wheat plants.

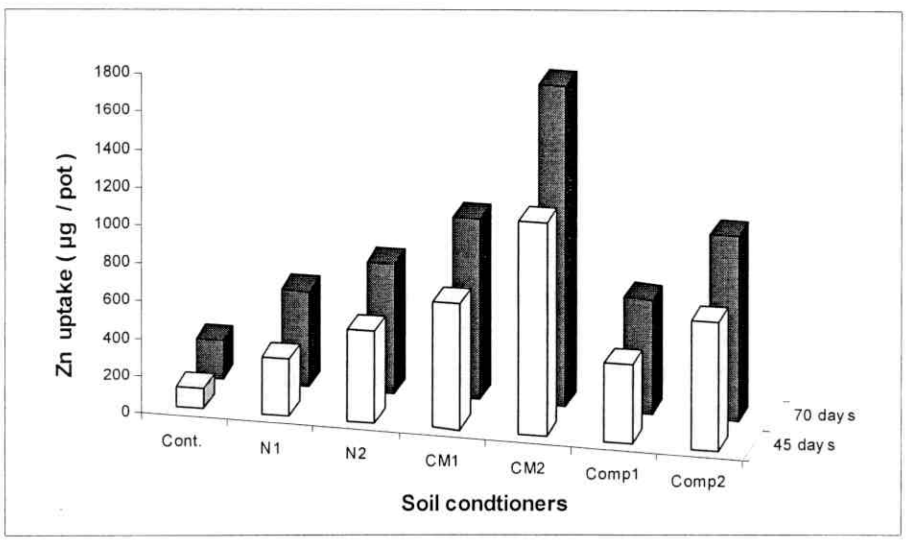

Fig. (42) : Effect of soil conditioners on zinc uptake (µg / pot) by wheat plants.

At 45 days values of Zn-uptake were decreased from 798 μg Zn/pot. at 100% of field capacity to 540 then to 308 μg Zn/pot when plants subjected to moisture stress of 80 and 50% of field capacity, respectively. The similar trend was obtained at 70 days growth, however the higher values of Zn-uptake were achieved.

At 70 days, values of Zn-uptake had been decreased from 1165 μg Zn/pot at 100% of field capacity to 801 and 470 μg Zn/pot with subjecting the plants to 80 and 50% of field capacity, respectively. The negative effect of water deficit might be attributed to lack of water absorbed and inhibition of photosynthetic efficiency under in-sufficient water conditions. Similar results were obtained by **Sharma** ***et al.,(*****1984), Mc Cutchan and Shacker (1992) and Abdel- Nasser and El-Shazly (2000).**

Concerning the interaction effect between moisture level and soil conditioners on Zn-uptake, data of **Table (8-b)** which illustrated by **Figs.(43&44)** show a significant effect. Meanwhile application of soil conditioners, especially organic manures increased soil conserved moisture over control or mineral nitrogen treatments. Also, the decomposition of organic manures produced macronutrients along with micronutrients, which become available to the plants and thus increase the plant uptake.

It can be noticed that application of soil conditioners in the form of organic manure significantly increased values of Zn-uptake at both periods of growth as compared with control and mineral nitrogen, respectively. Moreover, chicken manure achieved the highest values of Zn-uptake as compared to the other treatments.

At 45 days of growth, values of Zn-uptake increased from 171μg Zn/pot for control to 488, 678, 995, 1630, 623 and 998 μg Zn/pot at 100 of field capacity for N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively. These values at 80% of field capacity were; 112, 303, 473, 649, 1122, 437 and 686 μg Zn/pot, while at 50% of field capacity, these values were; 51, 123, 318, 391, 676, 217and 378 μg Zn/pot for the above-mentioned treatments, respectively.

Increasing growth periods up to 70 days show similar trend, but higher values of Zn-uptake were obtained. At 70 days and 100% of field capacity, values of Zn-uptake increased from 314 μg Zn/pot for control to 771, 950, 1365, 2398, 901 and 1452 μg Zn/pot. for N_1, N_2, CM_1, CM_2, $Comp_1$and $Comp_2$, respectively. These values at 80% of field capacity increased from 212 μg Zn/pot for control to 508, 678, 954, 1676, 614 and 968 μg Zn/pot, while they were increased at 50% of field capacity from 111 μg Zn/pot to 252, 432, 581, 1041, 333 and 541 μg Zn/pot for N_1, N_2,CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively.

It is clearly shown from the data tabulated in **Table (8-b) t**hat, application of chicken manure at the highest rate of application 2% produced higher values of Zn-uptake at 50% of field capacity and both periods of growth as compared to the control or application of mineral nitrogen at 100% of field capacity or application of compost at 80% of field capacity especially at 70 days of growth, These results might be attributed to the effect on improvement of soil physical properties which is reflected on water behaviour and maximizing water content of soil beside decreasing nutrients losses. The superiority of chicken manure was most probably due to its superior properties as a conditioning agent and because it has an extra advantage of being a good source of plant nutrients. Similar results were obtained by **Zeidan and El-Kramany (2001), Abdel Aal *et al.,* (2003)** and **El-Shouny (2006).**

The interaction effect between biofertilizer and soil conditioners on Zn-uptake by wheat as presented in **Table (8-c)** and illustrated by **Figs. (45&46)** was significant. Meanwhile, the mutual effect of soil conditioners accompanied with biofertilizer significantly increased values of Zn-uptake at both periods of growth as compared with application of soil conditioner alone.

At 45 days and without inoculation, values of Zn-uptake were 98, 271, 451, 646, 1096, 400 and 656 μg Zn/pot for control, N_1, N_2, CM_1, CM_2, $Comp_1$and $Comp_2$, respectively. Inoculation of wheat grains before sowing increased values of Zn-uptake to reach 125, 338, 528, 711, 1189, 451 and 719 μg Zn/pot.

At 70 days of growth, higher values of Zn-uptake were recorded as compared with those obtained at 45 days and this might be due to the necessity of such nutrient in building metabolites and most of bio-plant processes. Values of Zn-uptake were increased at 70 days from

Table (8-b):The effect of interaction between moisture level(M.L.)and soil conditioners on zinc uptake (μg/pot) by wheat plants.

Soil conditioners M.L. (F.C.)		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
100%	45days	171	488	678	995	1630	623	998
	70days	314	771	950	1365	2398	901	1452
80%	45days	112	303	473	649	1122	437	686
	70days	212	508	678	954	1676	614	968
50%	45days	51	123	318	391	676	217	378
	70days	111	252	432	581	1041	333	541

L.S.D. at 0.05 for 45 days = 27.52
L.S.D. at 0.05 for 70 days = 40.11

Table (8-c):The effect of interaction between biofertilizers and soil conditioners on zinc uptake (μg/pot)by wheat plants .

Soil conditioners Biofertilizers		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
Non inoculation	45days	98	271	451	646	1096	400	656
	70days	186	460	924	921	1635	569	948
Inoculation	45days	125	338	528	711	1189	451	719
	70days	238	561	749	1012	1775	664	1027

L.S.D. at 0.05 for 45 days = 22.47
L.S.D. at 0.05 for 70 days = 32.75

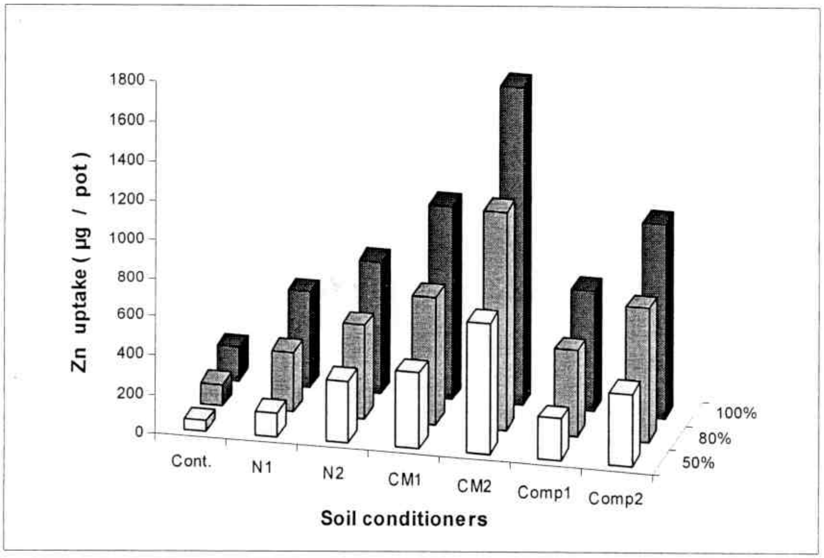

Fig. (43) : The effect of interaction between moisture levels and soil conditioners on zinc uptake (µg / pot) by wheat plants at 45 days .

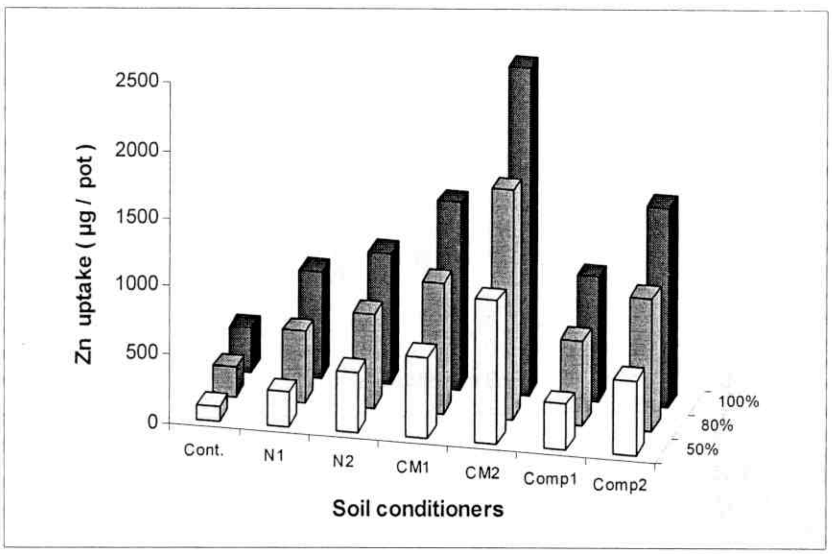

Fig. (44) : The effect of interaction between moisture levels and soil conditioners on zinc uptake (µg / pot) by wheat plants at 70 days .

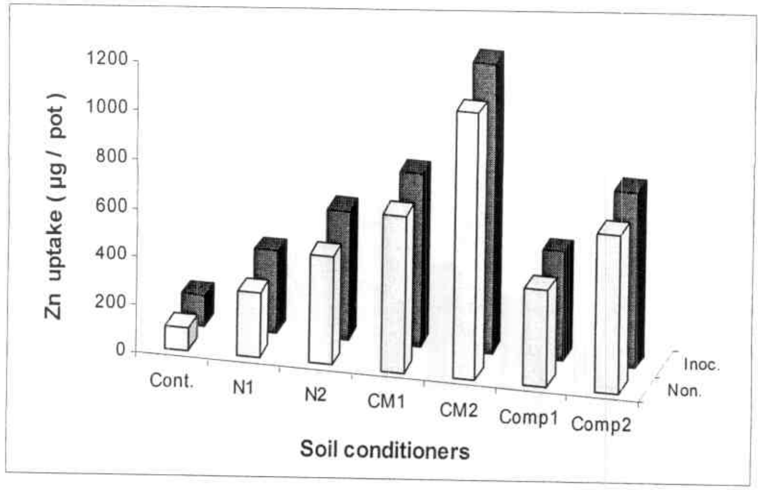

Fig. (45) : The effect of interaction between biofertilizers and soil conditioners on zinc uptake (µg / pot) by wheat plants at 45 days .

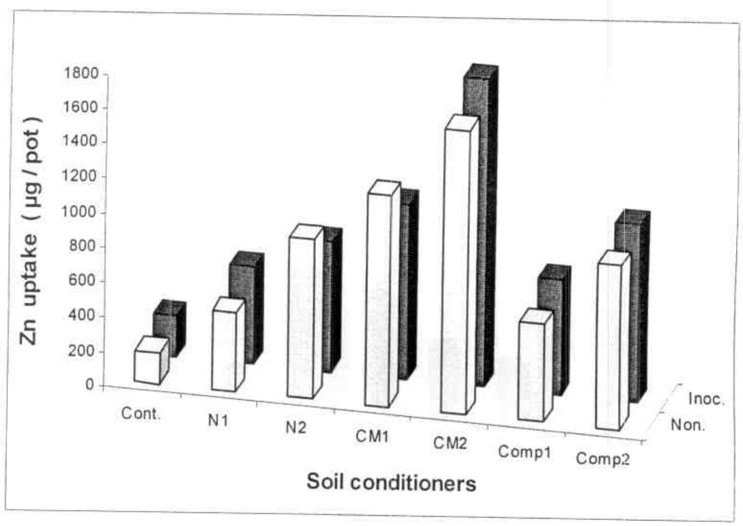

Fig. (46) : The effect of interaction between biofertilizers and soil conditioners on zinc uptake (µg / pot) by wheat plants at 70 days .

186, 460, 429, 921, 1635, 569 and 948 with inoculation to 238, 561, 749, 1012, 1775, 664 and 1027 µg Zn/pot with inoculation of wheat for control, N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively. Meanwhile, biofertilization encourages the plant growth, root penetration and consequently increased uptake of nutrients by plants. The enhanced effect of biofertilizers on Zn-uptake might be due to that free- living bacteria change root morphology, increase root growth and hence uptake of micronutrients Fe, Zn and Mn were increased. Also, biofertilizers increased nutrient availability through altering the root surface characteristics involved in nutrient uptake. Similar results were obtained by **Malik and Bilal (1988), Carletti *et al.*, (1996), El-Mancy (1998), Krol (1999) and El-Shafie-Fatma (2001).**

The significant interaction effect between moisture levels and biofertilizer on Zn-uptake as presented in **Table (8-d)** and illustrated by **Figs.(47&48)** indicate that biofertilization minimized moisture deficit and increased values of Zn-uptake at both periods of growth (45 and 70 days). Without inoculation and at 45 days of growth, values of Zn-uptake decreased as plants subjected to water stress, where they were decreased from 754 at 100% of field capacity to 510 and 287 µg Zn/pot when moisture levels decreased to 80 and 50% of field capacity, respectively. However, these values were increased with inoculation of wheat to reach 841, 571 and 328 µg Zn/pot for 100, 80 and 50% of field capacity, respectively.

At 70 days, the values of Zn-uptake increased from 1092, 755 and 443 µg Zn/pot without inoculation to 1237, 848 and 497 µg Zn/pot with inoculation for 100, 80 and 50% of field capacity, respectively. It is quite obvious that inoculation of wheat plants at 50% of soil moisture stress produced higher values of Zn-uptake than half those obtained at 80% of field capacity at both periods of growth. That means biofertilization of wheat plants minimized effect of moisture deficit by changes root morphology and increasing root growth and hence enhanced nutrients uptake. Similar results were obtained by **Saber (1993), El-Komy *et al.*, (1998) and El-Shafie-Fatma (2001).**

Table (8-d):The effect of interaction between moisture level and biofertilizers on zinc uptake (µg/pot) by wheat plants.

Soil moistrue % of (F.C.) *Biofertilizers*		*100%*	*80%*	*50%*
Non inoculation	*45days*	**754**	**510**	**287**
	70days	**1092**	**755**	**443**
Inoculation	*45days*	**841**	**571**	**328**
	70days	**1237**	**848**	**497**

L.S.D. at 0.05 for 45 days = 14.71
L.S.D. at 0.05 for 70 days = 21.44

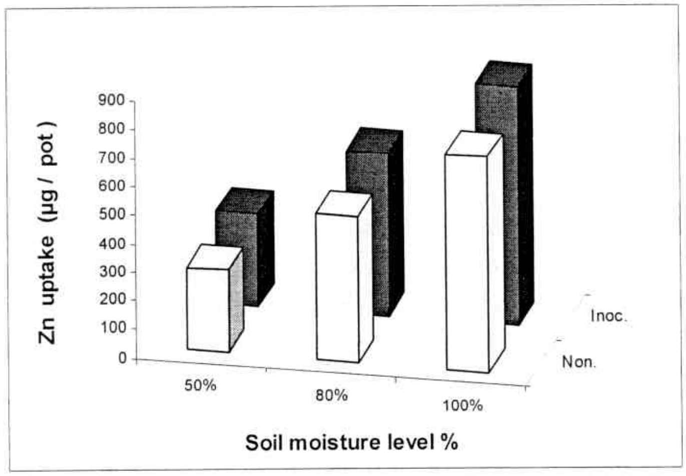

Fig. (47) : The effect of interaction between soil moisture levels and bio-fertilizers on zinc uptake (µg / pot) by wheat plants at 45 days

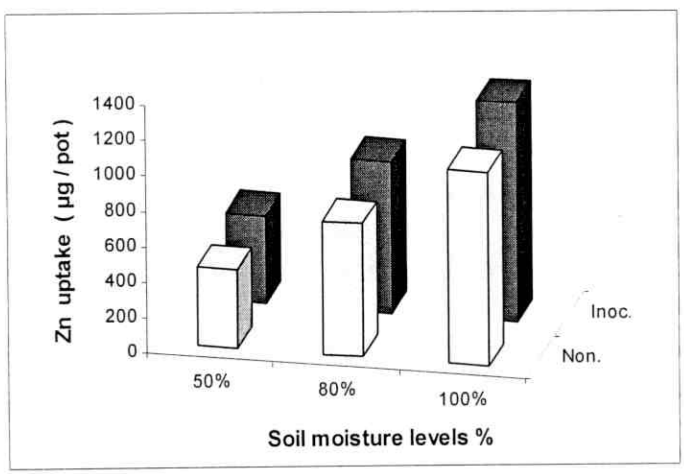

Fig. (48) : The effect of interaction between soil moisture levels and bio-fertilizers on zinc uptake (µg / pot) by wheat plants at 70 days

4.7: Manganese uptake by wheat plants as influenced by Soil conditioners and biofertilization under different soil moisture levels.

The obtained results as outlined in **Table (9-a)** and illustrated by **Fig. (49)** indicate that application of soil conditioners either in mineral or in organic forms significantly increased Mn-uptake by wheat plants as compared with control treatment.

The values averaged overall soil moisture levels at 45 days from sowing were increased from 45μg Mn/pot to 158 and 354 μg Mn/pot when mineral nitrogen was applied at rates 30 (N_1) and 90 (N_2) kg N/fed., respectively. These values were significantly and continuously increased with application of organic manures (chicken manure or compost ones), however chicken manure was superior to other conditioners treatment where values of 517 and 844 μg Mn/pot were obtained at rates of 0.5 (CM_1) and 2% (CM_2), respectively. The obtained values when compost manure was applied at 0.5 ($Comp_1$) and 2% ($Comp_2$) were; 304 and 504 μg Mn/pot, respectively.

At 70 days of growth, the above-mentioned values continued to increase with conditioners application. Values of Mn-uptake averaged overall soil moisture levels significantly increased from 100 to 290, 551, 783, 1286, 469 and 754 μg Mn/pot for control, N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively.

Also,data represented in **Table(9-a)** and **Fig.(50)** exhibit that, values of Mn-uptake averaged overall conditioners treatment were significantly decreased by subjecting wheat plants to moisture stress.

At 45 days of growth, values of Mn-uptake decreased from 590 μg Mn/pot at 100% of field capacity to 377 μg Mn/pot at 80% of field capacity and continued to decrease to reach 201μg Mn/pot at 50% of field capacity. Similar trend was observed at 70 days of growth, but higher values were achieved. Decreasing soil moisture levels from 100% of field capacity to 80 then 50% of field capacity decreased values of Mn-uptake from 919 to 585 then to 310 μg Mn/pot, respectively.

Table (9-a):Effect of soil moisture stress on manganese uptake by wheat plants(μg/pot) as affected by soil conditioners and biofertilizers.

Soil conditioners		Control		N1		N2		CM1		CM2		Comp1		Comp2		Mean
M.L (F.C.)	Bio.	Non.	Inoc.	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc.	Non.	Inoc	
100%	45days	59	88	213	287	496	603	750	821	1188	1306	430	500	713	810	590
	70days	127	187	388	509	789	947	1110	1272	1805	2023	656	768	1089	1199	919
80%	45days	36	55	131	182	317	373	455	530	777	862	279	320	456	501	377
	70days	79	119	250	328	470	587	704	784	1189	1301	422	501	681	767	585
%50	45days	13	21	54	79	150	182	249	297	445	488	135	159	250	296	201
	70days	34	53	114	149	231	285	391	434	680	719	211	254	369	418	310
Mean	45days	45		158		354		517		844		304		504		
	70days	100		290		551		783		1286		469		754		

L.S.D. at 0.05 for moistrue level at 45 days =9.87 *L.S.D. at 0.05 for moistrue level at 70 days=316.2*
L.S.D.at 0.05 for soil conditioners at 45 days = 15.1 *L.S.D. at 0.05 for soil conditioners at 70 days =24.78*
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 45 days =36.94
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 70 days = 60.69

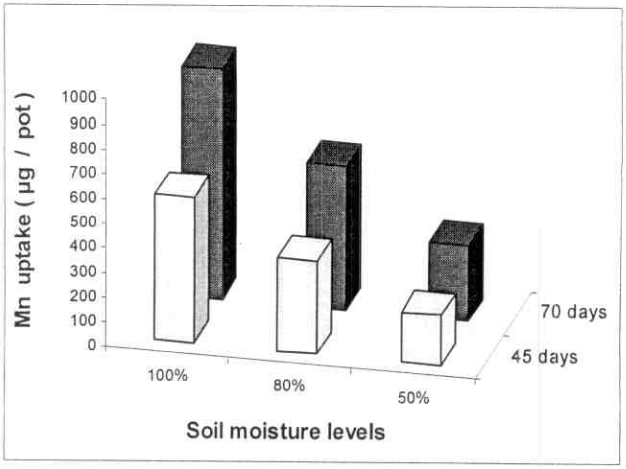

Fig. (49) : Effect of soil moisture levels on manganese uptake (µg / pot) by wheat plants.

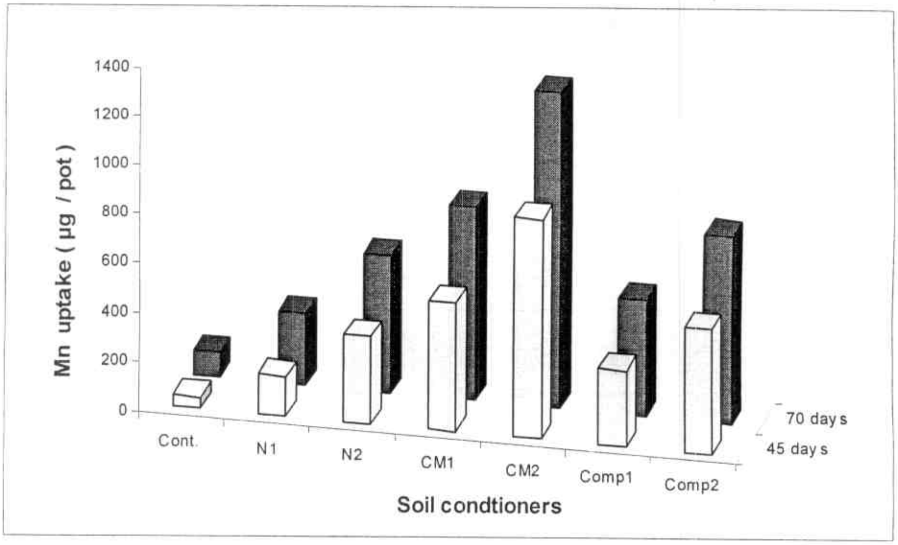

Fig. (50) : Effect of soil conditioners on manganese uptake (µg / pot) by wheat plants.

The superiority of chicken manure in increasing Mn-uptake could be ascribed to its higher content of Mn as shown in **Table (2)**. The obtained results came along with those reported by **Awad *et al.*,(1996)** and **El-Shafie-Fatma (2001)** for nitrogen effect and **El-Shafie-Fatma and El-Shikha (2003)** for organic manure effect and **Abdel- Nasser and El-Shazly (2000) and Munir *et al.*, (2000)** for moisture effect.

The interaction effect between soil moisture levels and soil conditioners on Mn-uptake was significant as presented in **Table (9-b)** and **Figs. (51&52)**. Meanwhile, the application of soil conditioners minimized the effect of soil moisture deficit and increased microbial population, activity and plant roots growth and hence increased micronutrients uptake.

At 45 days of growth, application of conditioners increased values of Mn-uptake from 73 μg Mn/pot for control treatment to 250, 549, 785, 1247, 465 and 762 μg Mn/pot at 100% of field capacity and from 45(control) to 157, 345, 492, 819, 299 and 479 μg Mn/pot at 80% of field capacity and from 17 (control) to 67, 166, 273, 466, 147 and 273 μg Mn/pot at 50% of field capacity for N_1, N_2, CM_1, CM_2, $Comp_1$, $Comp_2$, respectively .

Similar trend was obtained at 70 days of growth, however higher values of Mn-uptake were achieved. It is shown from the obtained results that subjecting wheat plants to moisture stress significantly and continuously decreased values of Mn-uptake by wheat plants. Data also, indicated that application of chicken manure at 80% of field capacity and at both rates of applications [CM_1(0.5%) and CM_2(2%)] achieved higher values than those obtained by the other treatments at 100% of field capacity.Meanwhile,the application of manure, especially chicken manure conserved more available water beside its higher content of Mn and consequently higher values of Mn were taking by plants. Similar results were obtained by **Sharma *et al.*, (1984) and El-Sharawy *et al.*, (2003).**

The interaction effect between biofertilizers and soil conditioners on Mn-uptake by wheat plants was significant as indicated in **Table (9-c)** which illustrated by **Figs.(53&54)**. That means biofertilization of wheat grains before sowing in combination with soil conditioners achieved the highest values of Mn-uptake as compared with the non-inoculation treatments.

Values of Mn-uptake at 45 days of growth were increased from 37, 133, 321, 485, 803, 281 and 473 μg Mn/pot for control, N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$ without biofertilization, respectively to 55, 183, 386, 549, 886, 326 and 536 μg Mn/pot for the above-mentioned treatments in case of inoculation, respectively.

Similar trend was obtained at 70 days of growth, however higher values of Mn-uptake were achieved. Without inoculation, values of 80, 251, 497, 735, 1225, 430 and 713 μg Mn/pot were recorded for control, N_1, N_2, CM_1, CM_2, $Comp_1$ and $Comp_2$, respectively. When wheat grains inoculated with nitrogen fixers and PDB (Phosphorus Dissolving Bacteria) before sowing, the abovementioned values increased to reach 120, 329, 606, 830, 1348, 508 and 795 μg Mn/pot for the same treatments, respectively.

It is clearly shown that organic manures exhibit more values of Mn-uptake as compared with control or mineral nitrogen at both rates of application. Moreover, chicken manure was significant and superior to the other treatments. These results came along with those obtained by **El-Mancy (1998), Awad *et al.*,(1996), El-Shafie,Fatma (2001) and El-Shafie,Fatma and El-Shikha (2003).**

Concerning the interaction effect between soil moisture levels and biofertilizers on Mn-uptake by wheat, data presented in **Table (9-d)** which illustrated by **Figs.(55&56)** indicated that the effect was significant. Meanwhile, inoculation of wheat grains before sowing minimized the effect of moisture deficit and this might be due to biofertilizers that stimulate root growth and change root morphology and hence enhance uptake of nutrients by plant roots.

Table (9-b):The effect of interaction between moisture level(M.L.)and soil conditioners on manganese uptake (µg/pot) by wheat plants.

Soil conditioners M.L. (F.C.)		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
100%	45days	73	250	549	785	1247	465	762
	70days	157	449	868	1191	1914	712	1144
80%	45days	45	157	345	492	819	299	479
	70days	99	289	528	744	1245	461	725
50%	45days	17	67	166	273	466	147	273
	70days	43	132	258	413	699	233	394

L.S.D. at 0.05 for 45 days =29.12
L.S.D. at 0.05 for 70 days = 42.92

Table (9-c):The effect of interaction between biofertilizers and soil conditioners on manganese uptake (µg/pot)by wheat plants.

Soil conditioners Biofertilizers		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
Non inoculation	45days	37	133	321	485	803	281	473
	70days	80	251	497	735	1225	430	713
Inoculation	45days	55	183	386	549	886	326	536
	70days	120	329	606	830	1348	508	795

L.S.D. at 0.05 for 45 days = 21.33
L.S.D. at 0.05 for 70 days = 35.04

Table (9-d):The effect of interaction between moisture level and biofertilizers on manganese (μg/pot) by wheat plants.

Soil moistrue % of (F.C.) *Biofertilizers*		*100%*	*80%*	*50%*
Non inoculation	*45days*	**550**	**350**	**185**
	70days	**852**	**542**	**290**
Inoculation	*45days*	**631**	**403**	**218**
	70days	**987**	**627**	**330**

L.S.D. at 0.05 for 45 days = 13.96
L.S.D. at 0.05 for 70 days = 22.94

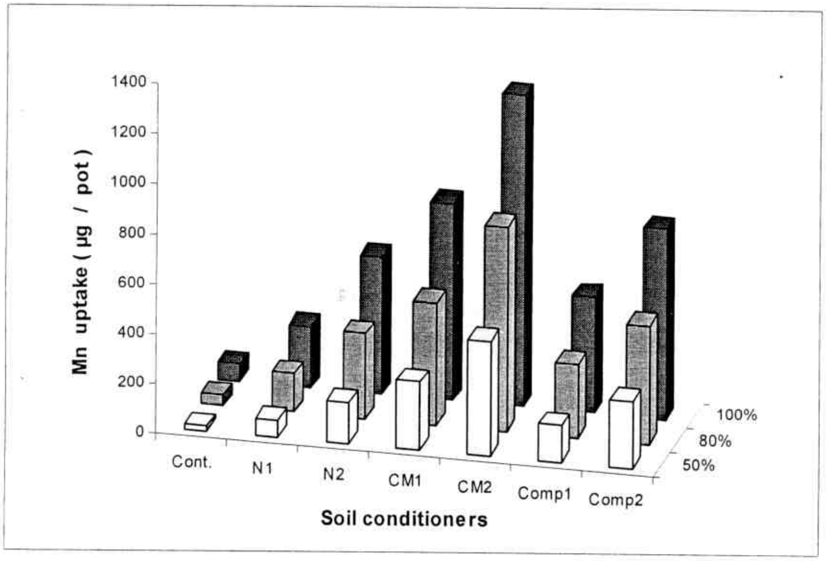

Fig. (51) : The effect of interaction between moisture levels and soil conditioners on manganese uptake (µg / pot) by wheat plants at 45 days .

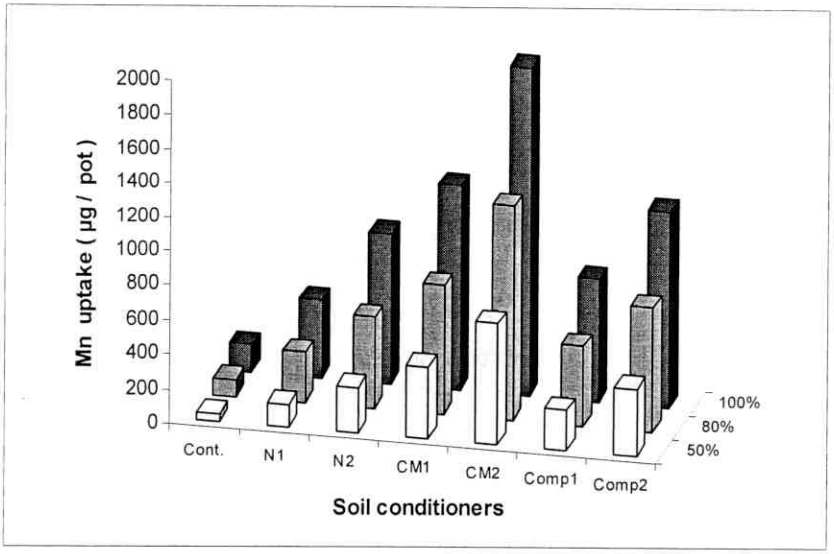

Fig. (52) : The effect of interaction between moisture levels and soil conditioners on manganese uptake (µg / pot) by wheat plants at 70 days .

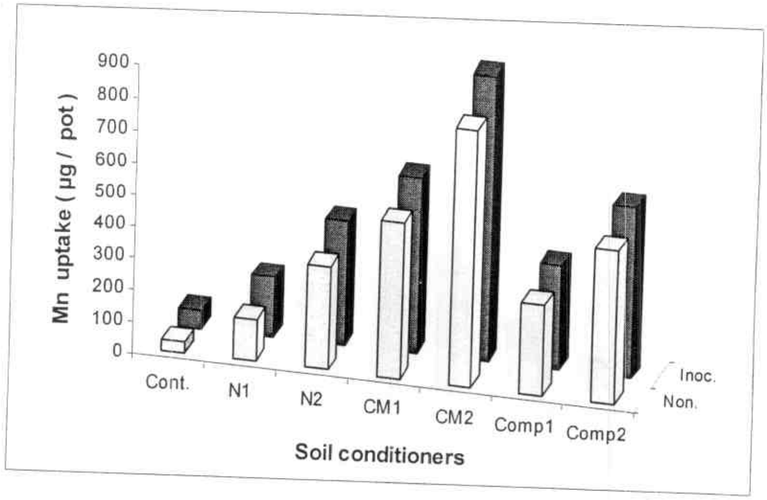

Fig. (53) : The effect of interaction between biofertilizers and soil conditioners on manganese uptake (µg / pot) by wheat plants at 45 days .

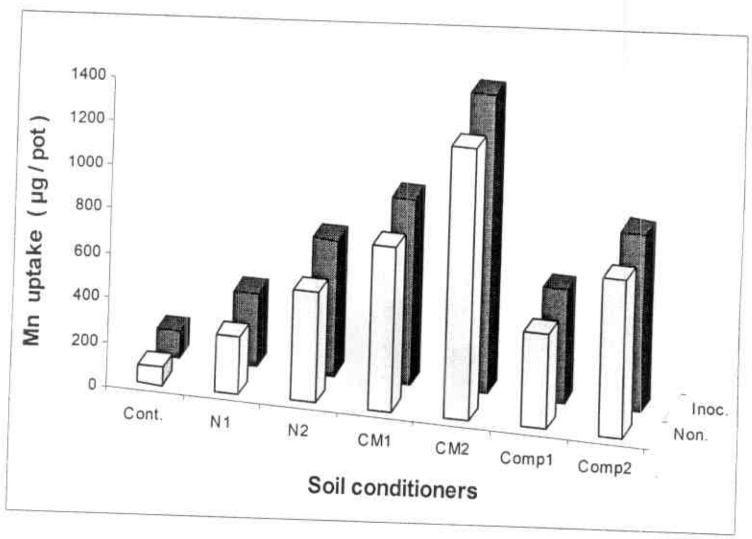

Fig. (54) : The effect of interaction between biofertilizers and soil conditioners on manganese uptake (µg / pot) by wheat plants at 70 days .

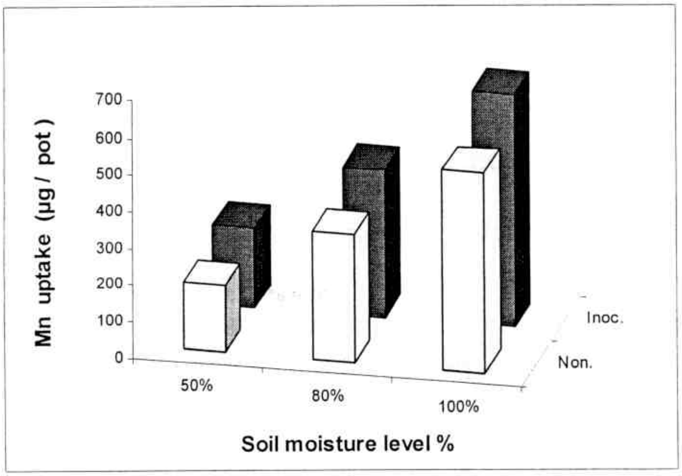

Fig. (55) : The effect of interaction between soil moisture levels and bio-fertilizers on manganese uptake (µg / pot) by wheat plants at 45 days

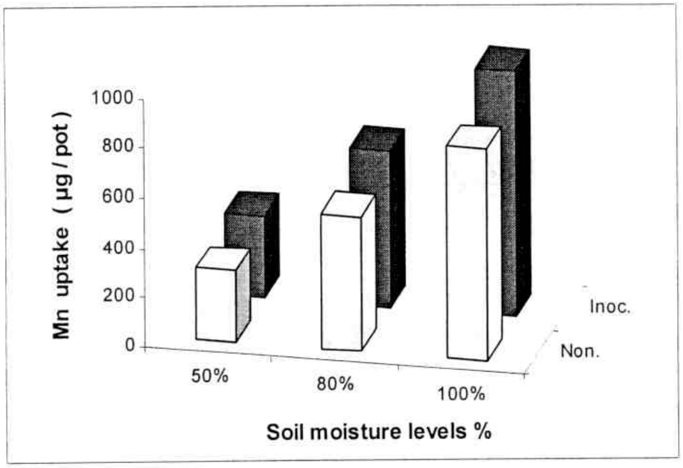

Fig. (56) : The effect of interaction between soil moisture levels and bio-fertilizers on manganese uptake (µg / pot) by wheat plants at 70 days

At 45 days of growth and without inoculation, values of Mn-uptake were; 550, 350 and 185 μg Mn/pot for 100%, 80 and 50% of field capacity. Inoculation of wheat grains before sowing increased these values to reach 631, 403 and 218 μg Mn/pot for the abovementioned moisture levels, respectively.

Similar trend with higher values of Mn-uptake was recorded at 70 days of growth. Without inoculation, values of Mn-uptake at 70 days were; 852, 542 and 290 μg Mn/pot. These values were increased to reach 987, 627 and 330 μg Mn/pot for 100, 80 and 50% of field capacity.

It is quite obvious that the lowest values of Mn-uptake were recorded when wheat plants subjected to moisture stress at 50% of field capacity. On the other hand, biofertilization of wheat grains increases the capability of wheat roots to absorb more nutrients through altering the root surface characteristics involved in nutrients uptake. Similar results were obtained by **Hsiao (1973), Ruiz-Lozano** ***et al.*****, (1995), Carletti** ***et al.*****, (1996) and Munir** ***et al.*****, (2000).**

4.8:Total chlorophyll in wheat leaf as influenced by soil conditioners and biofertilizers under different soil moisture levels.

Values of total chlorophyll (a+b) content in leaf wheat plants at both growth of stages (45 and 70 days from sowing) are presented in **Tables (10a-10d)** and illustrated in **Figs. (57- 64)**. These values were significantly affected by soil conditioners, biofertilization, periods of growth and soil moisture levels.

At 45 days of sowing values of total chlorophyll content averaged overall soil moisture levels as presented in **Table (10 a)** and **Fig.(57)** were significantly increased with application of soil conditioners either in mineral form $(NH_4)_2 SO_4$ or in organic ones (chicken manure or organic compost) . Whereas , these values increased from 3.21 mg/g. F.W. for control treatment to 5.49 and 6.10 mg/g.F.W. with application of nitrogen in the form of $(NH_4)_2SO_4$ at rates of 30 and 90 kg N /fed. , respectively . When chicken manure was applied at rates of 0.5 and 2 % , the highest values of chlorophyll content were achieved where values of 5.53 and 7.19 mg/g.F.W. were recorded , respectively . However , when compost was applied, lower values than those obtained with $(NH_4)_2SO_4$ and chicken manure treatment was recorded but these values still higher than that at control.

At 70 days, similar trend was observed, however the highest values than those obtained at 45 days were achieved. Meanwhile, value of total chlorophyll was 4.31 mg/g.F.W.. for control treatment at 70 days from sowing . This value increased to reach 7.02 and 8.22 by application of 30 and 90 kg N/fed. in the form of $(NH_4)_2SO_4$, respectively. Moreover , these values reached to the highest ones; 7.78 and 10.07 mg/g.F.W. at rates of 0.5 and 2 % chicken manure , respectively . On the other hand , application of compost significantly increased values of total chlorophyll as compared with control treatment and reached to 5.92 and 7.65 mg/g.F.W.. at rates of 0.5 and 2 % , respectively .

It is evident that chicken manure treatment was superior in increasing total chlorophyll content to mineral fertilizer $(NH_4)_2SO_4$ that was superior to organic compost and control treatments.

The positive effect of nitrogen on increasing chlorophyll content may be due to the role of N on cell enlargement and delay the leaf senescence . Also, nitrogen is one of the most important components of cytoplasm, nucleic acids and chlorophyll, whereas forming porphyrines, which constitute base of chlorophyll which was one of the most nitrogenous compounds formed. Similar results were obtained **by Deveilen** and **Williams (1985), Zahran** and **Mosalem(1993), Moselhy(1995)** and **Abdul- Galil *et al.*, (1997) .**

The enhancing effect of organic manures on increasing chlorophyll content might be due to a possible increase in the availability of macro and micronutrients which produced from the decomposition of such manures .Similar results were obtained by **Barsoom (1991) , Barsoom *et al* . , (1991)** and **Mowafy (2002a)** . The superiority of CM treatment to compost and mineral nitrogen could be ascribed to its higher nutrients content especially N, P, K, Fe, Zn and Mn which constitute the base of chlorophyll or helps in its formation.

On the other side, the superiority of mineral conditioner in the form of $(NH_4)_2SO_4$ in chlorophyll content may be due to existence N in more soluble and available form more than those form existed in the compost.

Data of **Table (10a)** and illustrated by **Fig. (58)** showed that the values of total chlorophyll content in wheat leaf significantly affected by soil moisture content . Subjecting wheat plants to moisture stress (50 % of field capacity) significantly decreased values of total chlorophyll content. However, these values increased with increasing periods of growth until 70 days from sowing.

At 45 days from sowing, values of total chlorophyll content averaged overall treatments decreased from 6.90 mg/g.F.W. at 100 % of field capacity to 5.40 and 3.84 mg/g.F.W. with subjecting wheat plants to 80 and 50 % of field capacity, respectively .

At 70 days from sowing , higher values of chlorophyll content were obtained but exhibit the similar trend. The obtained values as presented in **Table (10 a)** and **Fig. (58)** decreased from 9.09 mg/g.F.W. at 100 % of field capacity to 7.47 and 5.28 mg/g.f.w. with subjecting wheat plants to soil moisture 80 and 50 % of field capacity.

The depressive effect of soil moisture may be attributed to the role of water as a substrate for all vital processes in plant tissue especially in chlorophyll formation. Also, with increasing soil moisture depletion, the plants had less ability to absorb water and the nutrients uptake decreased. These nutrients especially, N , Mg and Fe are responsible for chlorophyll formation. These results are in agreement with those obtained by **Basak** and **Dravid (1997), Abdel - Nasser and El - Shazly (2000) , Abdel - Nasser and Hussein (2001) and Rane *et al* ., (2001)**.

Data presented in **Table (10-b)** and illustrated by **Figs. (59 & 60)** represent values of total chlorophyll and their effects by the interaction between moisture levels and soil conditioners. This interaction effect was significant. That means application of conditioners maximized values of total chlorophyll content which were produced under different levels of soil moisture and at the both periods of growth.

Table (10-a):Effect of soil moisture stress on total chlorophyll(mg/g F.W.) of wheat plants as affected by soil conditioners and biofertilizers.

Soil conditioners		Control		N1		N2		CM1		CM2		Comp1		Comp2		Mean
M.L (F.C.)	Bio.	Non.	Inoc.	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc	Non.	Inoc.	Non.	Inoc	
100%	45days	4.22	4.34	6.85	6.93	7.43	8.23	6.82	7.21	9.14	9.33	5.67	5.86	7.23	7.34	6.90
	70days	5.23	5.73	8.66	9.16	9.63	10.64	9.23	9.94	12.12	12.43	7.28	8.25	9.44	9.52	9.09
80%	45days	3.12	3.23	5.19	5.49	5.84	6.54	5.63	5.60	7.23	7.43	4.19	4.61	5.67	5.81	5.40
	70days	4.33	4.56	6.67	7.49	8.09	8.80	7.86	8.38	10.31	10.39	5.71	6.23	7.87	7.96	7.47
%50	45days	2.13	2.19	3.56	4.89	4.17	4.42	3.78	4.15	4.90	5.12	2.90	3.41	4.06	4.11	3.84
	70days	2.77	3.27	4.85	5.26	5.76	6.38	5.39	5.86	7.47	7.69	3.85	4.2	5.46	5.65	5.28
Mean	45days	3.21		5.49		6.10		5.53		7.19		4.43		5.71		
	70days	4.31		7.02		8.22		7.78		10.07		5.92		7.65		

L.S.D. at 0.05 for moistrue level at 45 days =.0.203 *L.S.D. at 0.05 for moistrue level at 70 days = 0.061*
L.S.D.at 0.05 for soil conditioners at 45 days = 0.096 *L.S.D. at 0.05 for soil conditioners at 70 days = 0.093*
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 45 days = 0.235
L.S.D. at 0.05 for moistrue level X soil conditioners X biofertilizers at 70 days = 0.229

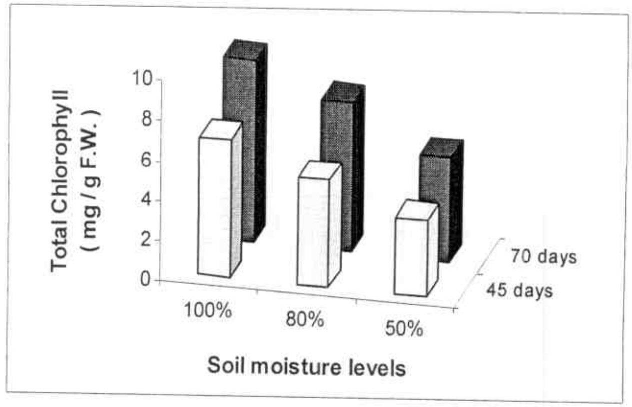

Fig. (57) : Effect of soil moisture levels on total chlorophyll content of wheat plants (mg / g F.W.).

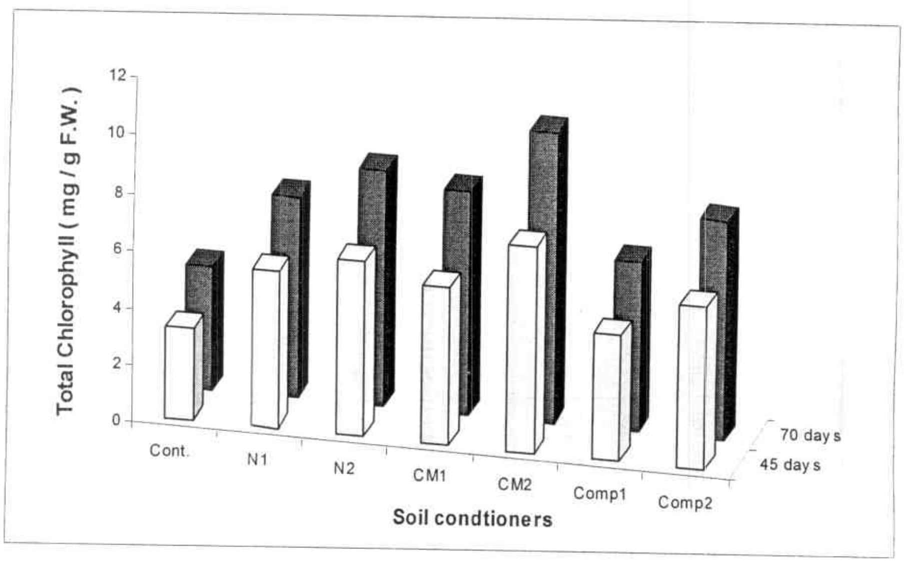

Fig. (58) : Effect of soil conditioners on total chlorophyll content of wheat plants (mg / g F.W.).

On the other hand, application of soil conditioners especially chicken manure minimized the negative effect of moisture deficit and produced higher values at both rates of application followed by mineral nitrogen, compost then control treatments.

At 45 days of growth and 100 % of field capacity, values of total chlorophyll content were; 4.28, 6.89 , 7.83 , 7.01 , 9.23 , 5.76 , and 7.29 mg/g.F.W.These values decreased to 3.18 , 5.34 , 6.19, 5.62 , 7.33 , 4.40 and 5.74 mg/g.F.W. at 80 % of field capacity , then decreased to reach 2.16 , 4.22 , 4.30 , 3.97 , 5.01 , 3.15 , and 4.08 mg/g.F.W. with subjecting wheat plants to moisture stress (50 % of field capacity) for control , N_1 , N_2 , CM_1 , CM_2 , $Comp_1$ and $Comp_2$ respectively .

At 70 days of growth, similar trend was observed, however, the higher values were achieved. Meanwhile, values of chlorophyll content were decreased from 5.48, 8.91, 10.14, 9.59 , 12.27 , 7.76 , and 9.48 mg/g.F.W. at 100 % of field capacity to reach the lowest ones at 50 % of field capacity where values of 3.02 , 5.06 , 6.07 , 5.63 , 7.58 , 4.03 and 5.56 mg/g.F.W. were achieved for control , N_1 , N_2 , CM_1 , CM_2 , $Comp_1$ and $Comp_2$, respectively.

Such results could be attributed to that organic manure especially, chicken manure enhancing plants to absorb more water and nutrient due to its higher nutrients and consequently increase photosynthesis activity.

These results coincided with those obtained by **Maamoun (1994)** and **Ibrahim (2007).**

Data of **Table (10-c)** and **Figs.(61&62)** show a significant interaction between biofertilizers and soil conditioners on total content of chlorophyll. Meanwhile, biofertilization enhanced the effect of soil conditioners, either mineral in the form of $(NH_4)_2SO_4$ or organic (chicken manure or compost) on chlorophyll content of wheat at both growth stages 45 and 70 days of sowing.

At 45 days of growth and without inoculation values of chlorophyll content were; 3.16 , 5.20 , 5.46 , 7.09 , 4.25 , and 5.66 mg/g.F.W. These values increased with inoculation to reach 3.25 ,

Table (10-b):The effect of interaction between moisture level(M.L.)and soil conditioners on total chlorophyll (mg/ g F.W.) of wheat plants.

Soil conditioners M.L. (F.C.)		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
100%	45days	4.28	6.89	7.83	7.01	9.23	5.76	7.29
	70days	5.48	8.91	10.14	9.59	12.27	7.76	9.48
80%	45days	3.18	5.34	6.19	5.62	7.33	4.40	5.74
	70days	4.45	7.08	8.45	8.12	10.35	5.97	7.91
50%	45days	2.16	4.22	4.30	3.97	5.01	3.15	4.08
	70days	3.02	5.06	6.07	5.63	7.58	4.03	5.56

L.S.D. at 0.05 for 45 days = 0.166
L.S.D. at 0.05 for 70 days = 0.162

Table (10-c):The effect of interaction between biofertilizers and soil conditioners on total chlorophyll (mg/g F.W) of wheat plants.

Soil conditioners Biofertilizers		Control	N1	N2	CM1	CM2	Comp.1	Comp.2
Non inoculation	45days	3.16	5.20	5.81	5.41	7.09	4.25	5.66
	70days	4.11	6.73	7.83	7.50	9.97	5.61	7.59
Inoculation	45days	3.25	5.77	6.39	5.65	7.29	4.62	5.75
	70days	4.52	7.30	8.61	8.06	10.17	6.23	7.72

L.S.D. at 0.05 for 45 days = 0.140
L.S.D. at 0.05 for 70 days = 0.132

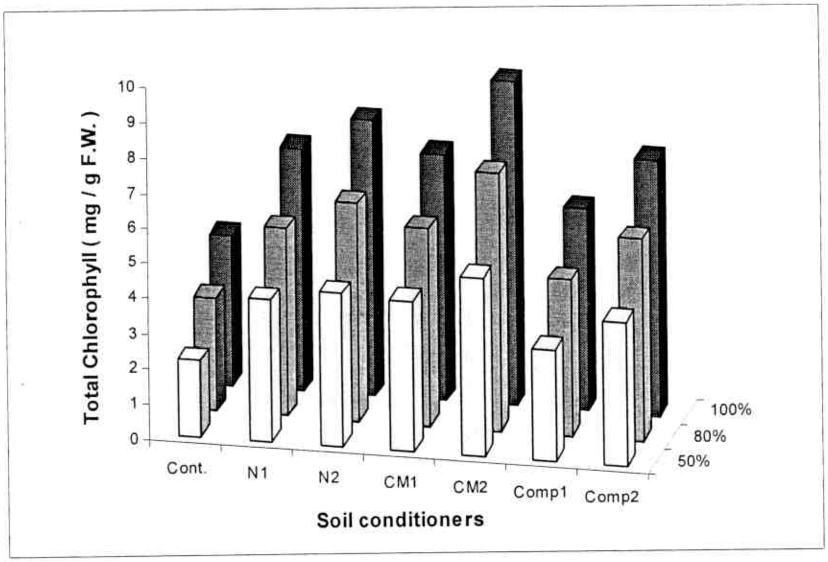

Fig. (59: The effect of interaction between moisture levels and soil conditioners on total chlorophyll content of wheat plants (mg / g F.W.) at 45 days .

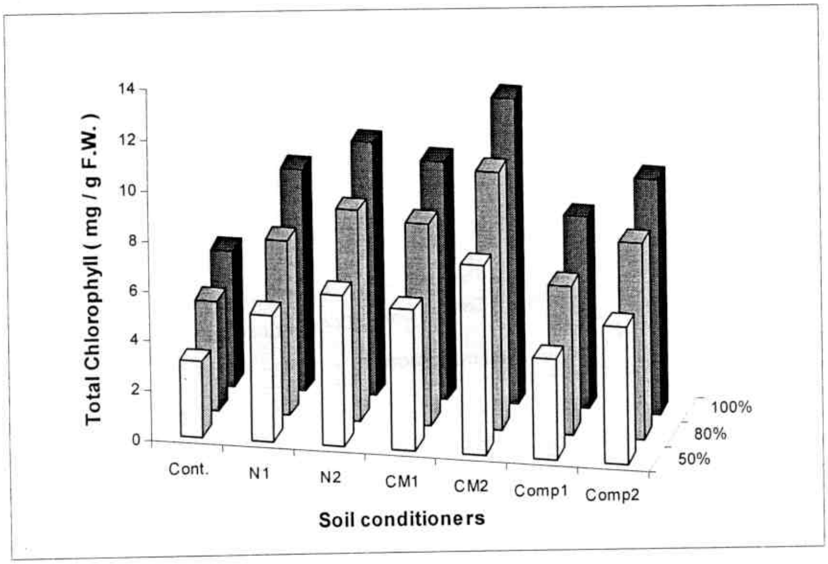

Fig. (60): The effect of interaction between moisture levels and soil conditioners on total chlorophyll content of wheat plants (mg / g F.W.) at 70 days .

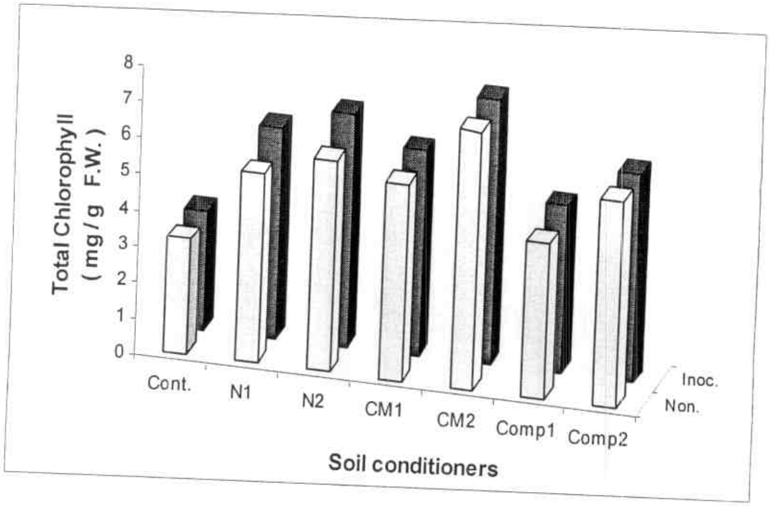

Fig. (61) : The effect of interaction between biofertilizers and soil conditioners on total chlorophyll content of wheat plants (mg / g F.W.) at 45 days .

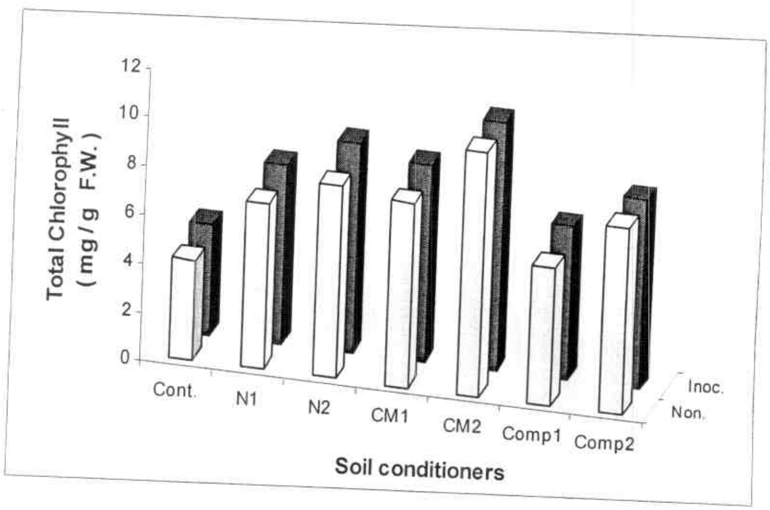

Fig. (62) : The effect of interaction between biofertilizers and soil conditioners on total chlorophyll content of wheat plants (mg / g F.W.) at 70 days .

5.77 , 6.39 , 5.65 , 7.29 , 4.62 , and 5.75 mg/g.F.W. for control , N_1 , N_2 , CM_1 , CM_2 , $Comp_1$ and $Comp_2$ respectively .

At 70 days of growth, values of chlorophyll content were increased from 4.11 , 6.73 , 7.83 , 7.50 , 9.97 , 5.61 and 7.59 mg/g.F.W. without inoculation to reach 4.52, 7.30, 8.61, 8.06, 10.17, 6.23 and 7.72 mg/g. F.W. for control , N_1 , N_2 , CM_1 , CM_2 , $Comp_1$ and $Comp_2$, respectively .

It is quite obvious from the obtained results that the highest values of chlorophyll content were achieved by application of chicken manure treatments accompanied by biofertilizers. Also, the values obtained by mineral conditioners in the form of $(NH_4)_2SO_4$ were superior to those obtained by compost treatment .

The enhancing effect of biofertilizers may be due to the effect of microorganisms on increasing cytokinin which plays an important role in building nitrogenous compounds and consequently chlorophyll. Also, nitrogen fixation bacteria play an important role in increasing the endogenous phytohormones (IAA , GAS and CKS) which plays an important role in formation the active root system , increasing the nutrient uptake and photosynthesis rate and accumulation within different parts .

These results are agree with those obtained **by El – Khawas (1981) Abd-Alla** ***et al.*****, (1994) Ahmed (1995), Ompal** and **Panwar (1997) , Mohsen** ***et al.*****, (2004)** and **Bakry** ***et al*** **., (2005)** who stated that inoculation of wheat with *Azospirillum* significantly increased photosynthetic pigment (chlorophyll a+b and carotenoide) in leaves after 50 or 110 days from sowing.

Table (10-d) which illustrated by **Figs. (63&64)** shows a significant interaction effect between moisture level and biofertilizer on total chlorophyll content. Meanwhile, biofertilizers minimized soil moisture stress on chlorophyll content i.e. increased values of chlorophyll content at lower level of moisture as compared with uninoculation treatment at both growth stages (45 and 70 days).

Table (10-d): The effect of interaction between moisture level and biofertilizers on total chlorophyll (mg/g F.W) of wheat plants.

Soil moistrue % of (F.C.) / Biofertilizers		100%	80%	50%
Non inoculation	45days	6.77	5.27	3.64
	70days	8.80	7.26	5.08
Inoculation	45days	7.04	5.53	4.04
	70days	9.38	7.68	5.47

L.S.D. at 0.05 for 45 days = 0.089
L.S.D. at 0.05 for 70 days = 0.087

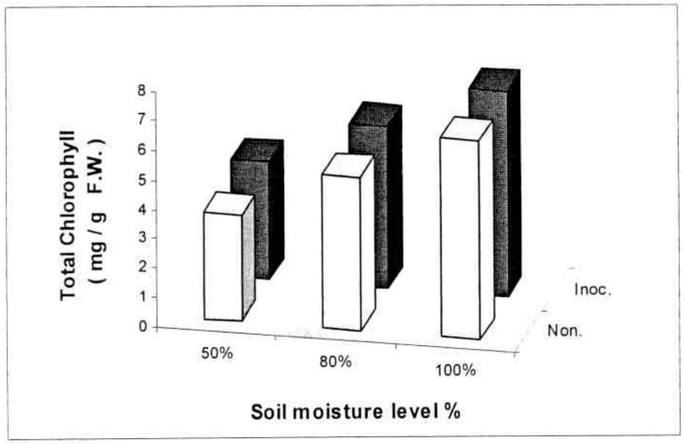

Fig. (63) : The effect of interaction between soil moisture levels and biofertilizers on total chlorophyll content of wheat plants (mg / g F.W.) at 45 days

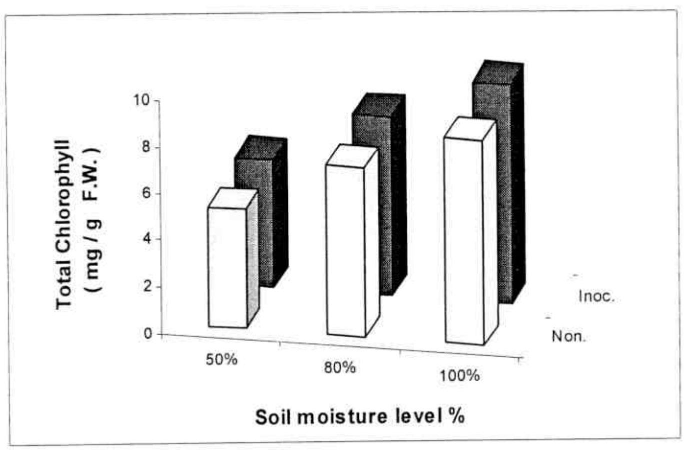

Fig. (64) : The effect of interaction between soil moisture levels and biofertilizers on total chlorophyll content of wheat (mg / g F.W.) plants at 45 days .

Without inoculation and at 45 days , values of chlorophyll content were 6.77 , 5.27 , and 3.64 mg/g.F.W. Inoculation of wheat grains before sowing increased the above-mentioned values to 7.04 , 5.53 and 4.04 mg/g.F.W. for 100 , 80 , and 50 % of field capacity , respectively .

Similar trend was obtained at 70 days of growth but higher values of chlorophyll content were achieved, whereas values of 8.80 , 7.26 , and 5.08 mg/g.F.W. were obtained without inoculation. These values were increased to reach 9.38 , 7.68 , and 5.47 mg/g.F.W. with biofertilization of wheat for 100 , 80 ; and 50 % of field capacity respectively.

Similar results were found by **Ahmed (1995)** , **Abdel-Nasser and El – Shazly (2000)** and **Bakry et al., (2005)** .