Minufiya J. Agric. Res. Vol. 34 No. 6:2243-2260 (2009) "http:// agri.menofia.edu.eg/megla.html"

EFFECT OF ORGANIC AND INORGANIC SOIL AMENDEMENTS COMBINED WITH MINERAL FERTILIZERS ON THE FERTILITY OF CALCAREOUS SOIL AND ITS PRODUCTIVITY

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(Received: Sep. 29, 2009)

ABSTRACT: ***A field experiment was carried out during two successive growing seasons (winter 2007/2008 with wheat and summer 2008 with soybean) to study the effect of some soil amendments on soil fertility and productivity. A split- split plot design with three replicates was used. The main plots were devoted to application rates of compost, (0 and 20 m^3/fed^{-1}). The subplots were devoted to sulphur application at rates of 0, 350 and 700 kg fed^{-1}. The sub-subplots were assigned for mineral fertilizers, NP at rates of 50, 75 and 100 % from the recommended dose (100kg N/fed). The results showed that the yield of wheat and soybean, weight of 1000 wheat grain and 100 seed of soybean were influenced significantly by application of different soil amendments. The highest mean values of wheat and soybean yields were achieved upon treating the soil with application of 20 m^3 compost/fed + 700 kg sulphur/fed + 100% NP mineral fertilizer from the recommended dose (RD). Where the values were 2.23 ton/fed, 4.82 ton/fed and 0.89 ton/fed, 1.42 ton/fed for grain and straw of wheat and for seeds and straw of soybean, respectively. Also, results indicated a pronounced increases in contents of N, P and K in grains and straw of wheat and soybean treated with mineral nitrogen combined with compost and sulphur. The combined treatments of 20 m^3 compost/fed + 50% RD of NP + 700 kg sulphur/fed and 20 m^3 compost/fed + 75% RD of NP of mineral fertilizer + 700 kg sulphur/fed, were the most effective for increasing the contents of N, P and K in yields of wheat and soybean, respectively. A noticeable increase in the availability of K, P, Fe, Mn and Zn nutrient contents in soil was detected as results of the applied materials. The most effective interaction on increasing nutrients availability was obtained at 20 m^3 compost/fed +700 kg sulphur/fed+ mineral NP fertilizer at rate of 75% from the recommended dose after soybean harvesting.***

Key Words: ***Wheat, Soybean, NP mineral fertilizer, N-organic fertilizer, compost, sulphur.***

INTRODUCTION

Egyptian soils are known to be rather poor in organic matter. Thus, the application of organic manures to soils improving their physical, chemical and biological properties. The chemical improvement of these soils lead to increasing the other factors, such as increasing microbial activity. This depends mainly on soil type, soil reaction, temperature and moisture

content, source of organic matter and microbial activity (Abd El-Latif and Abd El-Fatah, 1985). Rehan *et al* (2004) and Hoda *et al* (2009)

Attention has been paid to the application of elemental sulphur to soil in sufficient quantities to correct soil alkalinity. Elemental sulphur is oxidized by microorganism in soil to sulphuric acid which reduce soil pH, improves soil structure and increase the availability of certain plant macro and micronutrients; notably P, iron, manganese and zinc (Mostafa *et al*., 1990).

In Egypt, farmers consume a large amount of chemical fertilizers aiming to increase the yield without any care of the hazard effect on the environment. Whereas, available of N in soil will be changed depending on the amount of N mineralized or immobilized during the decomposition of organic residues.

Wheat is very strategically important crop in Egypt. The mean production of wheat in Egypt in the valley and Delta soils is about 2.5 ton/fed., hence the national production of wheat is 8.3 million ton in 2007, while the national consumption of wheat is about 10.5 million tons in 2007(Yearly statistic book).

Soybean is a promise crop to solve the deficit of protein and oil. It considered on available source for height energy, high protein and other nutrients to human and livestock, some of the most exciting research taking place today involves the use of soybean in preventing cancer, reducing the risk of coronary heart diseases and controlling glucose levels in diabetic patients. Adding soybean as a part of our diet could improve our health (Aly, 1998). Soybean is one of legumes that have special organic and economic significance because of their ability to fix N_2 symbiotically in many cropping system. It fixes average rates of 60 kg N_2 /ha, (Keyser and Fudi, 1992; and El-Hadad *et al*., 1998).

In this respect, N mobility is very completed and influenced by climate and soil factors. Even the total nitrogen content of soil is high and ranges between 0.01 to 0.2% (depending on the organic matter content) only about 5% of total is inorganic N (NH_4^+ and NO_3^-) that available to plants (Amberger, 1989).

Most of nitrogen in agricultural soil is organically bound, while the N uptake by plants and also the N losses from the soil-plant system into the environment is inorganic N (Appel and Mengel 1998).

The aim of this study is to investigate the effect of some soil amendments on productivity of wheat and soybean and their quality as well as availability of some micronutrients in the studied soil.

MATERIALS AND METHODS

A field experiment was conducted during two successive season (winter season 2007/2008 with wheat and summer season 2008 with soybean) at El-Nahda village, Nahda sector, south east of Alexandria Governorate, to study the effect of some soil amendments such as compost and elemental sulphur

on soil fertility and its productivity for wheat and soybean. The variety of wheat and soybean was Giza 168 (Triticum aestivum) and Giza 21 (Glycin max L.), respectively.

A split- split plot design with three replicates was used. The main plots were devoted to application rates of compost, (0 and 20 cm^3/fed^{-1}). While the subplots were allocated to sulphur application at rates of 0, 350 and 700 kg fed^{-1}. The sub-subplots were assigned for mineral fertilizers, NP at rates of 50, 75 and 100 % from the recommended dose (100kg N/fed and 22.5kg P_2O_5 /fed). Nitrogen was applied in the form of ammonium nitrate (33.5% N) and P was applied in the form of calcium superphosphate (15% P_2O_5). Nitrogen was applied in equal two doses, the first dose was applied before the first irrigation and the remainder dose was applied before the second irrigation. Also, calcium superphosphate (15% P_2O_5) was added for specific treatments before sowing. The other mineral elements (K) were performed as the same as normally recommended in the area. Compost was made from rice straw mixed with farmyard manure and inculated for maturity and its chemical analysis are presented in Table (2). Soil samples were taken before planting and after harvesting during the two growing seasons from the surface layer (0-30 cm) to physical and chemical analysis according to Richards (1954) and Jackson (1967) and the data are shown in Table (1).

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

Characteristic	Soil depth 0-30 cm	Characteristic	Soil depth 0-30 cm
Particlesize distribution %		Soil paste extract:	
Sand	27.0	EC(dS/m)	6.7
Silt	33.0	Soluble ionsa(meq/l)	
Clay	40.0	Ca^{++}	7.8
Texture class	Clayey	Mg^{++}	15.9
Bulk density (gm/cm^3)	1.35	Na^{+}	50.0
Total porosity (v/v)	58.60	K^{+}	0.6
Field capacity (v/v)	24.81	$CO_3^{=}$	-
Wilting point%(v/v)	9.20	HCO_3^{-}	2.1
Available water %(v/v)	15.20	Cl^{-}	50.0
Infiltration rate (cm/h)	0.5	$SO_4^{=}$	22.2
Sat.Hydraulic cond.(cm/h)	0.4	pH(1:2.5soil water susp.)	8.3
Available N(µg/kg)	8.6	Organic matter%	0.31
P (µg/kg soil)	8.3	$CaCO_3$%	41.22
K (µg/kg soil)	326	SAR	27.50
Fe (µg/kg soil)	2.59	ESP	21.60
Mn (µg/kg soil)	2.15		
Zn (µg/kg soil)	1.16		

Some micronutrients were measured in soil according to Patterburgski(1968) for N, P and K, Knudesen et al. (1982) for Fe, Olsen and Sommers (1982) Fe and Page (1982) for Zn. Table (2) showed some chemical analysis of the compost used.

Table (2): Some chemical analysis of the compost manure Used :

Contents	Value
Moisture %	13.5
pH	7.81
EC (dS/m)	3.6
Organic carbon%	24.14
Total N %	1.73
Total P %	0.93
Total K %	1.41
Total Fe (mg/kg soil)	520
Total Mn (mg/kg soil)	463
Total Zn (mg/kg soil)	158
C/N ratio	13.95

Wheat was planted in 22nd of Nov., while soybean was planted in mid July, they harvested after 120 and 100 days for wheat and soybean, respectively. The plants of wheat and soybean were removed and separated into grain or seeds and straw to measure the following: grain (ton/fed) and straw (kg/fed) yields, 100-grain weight for wheat and 100 seed weight for soybean (g). Crud protein concentration (%) was calculated from total nitrogen percentage in grain yield multiplied by 6.22 for soybean and 5.57 for wheat according to A.O.A.C. (1980). Oil yield of soybean was determined by using soxlket apparatus according to A. O. A. C (1980).

Plant materials were oven dried at 70C for 24 hours and ground at a fine powder and kept for determination of nitrogen, phosphorus, potassium, zinc, iron and manganese.

The dried plants were digested using the mixture of H_2SO_4 and HCl acids for different analysis i.e. N, P and K according to Jackson (1967). Available nitrogen in soil was extracted by K_2SO_4 (1%) and determined by macro Kjeldahl method. All data statistically analyzed according to the method described by Gomez and Gomez (1984). The available N, P, K, Fe, Zn, were determined as described by Black *et. al* (1965) and Jackson (1967).

RESULTS AND DISCUSSION

1-Effect of soil amendments on wheat and soybean production:

1- The yields

Data presented in Table (3) illustrated the response of wheat and soybean yields to different treatments of soil amendments. Data showede a significant increase in the yields of wheat and soybean due to the application of different soil amendments. Application of 20 m^3 compost/fed. + 700 kg S/fed

produced the highest mean values of wheat grain (2.24 ton/fed.) and seed yield of soybean (0.85 ton /fed.) in the presence of NP. The corresponding relative increase in the yields of wheat and soybean over the control were 15.46 and 10.38 %, respectively. Regarding the sulphur application, the obtained results illustrated that there are significant increase in the grain and seed yields of wheat and soybean. The mean values of grain yield of wheat were 1.94, 2.08 and 2.16 ton/fed., for control, 350 and 700 kg sulphur/fed. without addition of compost, respectively. While the corresponding values for seed yield of soybean were 0.64, 0.67 and 0.68 ton/fed. in the same order. This true was observed at NP application. Thus, the application of sulphur at rate of 700 kg/fed., increased wheat grain yield by 11.34 and 3.84 % compared to control and 350 kg sulphur/fed., respectively. While, the increases in seed yield of soybean were 4.68 and 1.49 % over control and 350 kg sulphur/fed., respectively. Concerning the interaction effect, data indicated that the highest mean values of wheat grain and soybean seed yield achieved from the combination between application of 20 m^3 compost/fed +700 kg sulphur/fed +75% mineral fertilizers from the recommended doses. These results may be attributed to the composition of the applied compost itself, as well as the benefical effect of sulphur and mineral nitrogen, which their combination resulted in improving the physical and chemical properties of soil, such as decreasing soil pH, and increasing both macro -, micro nutrients availabilities in soil besides improving nutrient uptake and the elemental status in plant. Similar results were obtained by El-Fayoumy *et al.* (2000), Omer (2003), Wafa *et al*.(2004), Riffat (2004) and Atia (2005).

2- 1000 grain weight of wheat and 100seed weight of soybean:

It is obvious in Table (3) that the 1000 grain weight of wheat and 100seed weight of soybean were influenced significantly by alternative soil amendments treatments. Application of 20 m^3 compost/fed + 700 Kg S/fed in the presence of NP gave the highest 1000 grain weight (55.69 g) compared to untreated soil (48.45 g). While, 100 seed weight of soybean were 16.60 g for control and 18.58 g for 20 m^3 compost/fed + 700 kg S/fed. The increase as a percentage over control due to application of 20 m^3 compost/fed + 700 kg S/fed were 1494 and 27.26 % for wheat and soybean, respectively. Furthermore, 1000-grain of wheat and 100 seed weight of soybean significantly affected by sulphur application only, being 700 kg/fed. surpassed the other levels in increasing the 1000-grain weight of wheat and 100 seed weight of soybean. The corresponding relative increases for 1000-grain weight of wheat were 2.55 and 1.78 % over the control and 350kg S/fed., respectively. While the relative increase of 100seed weight of soybean, were 15.27 and 9.42 % over the control and 350 kg sulphur/fed, respectively.

Table (3)

Table (3 a)

Regarding the effect of mineral fertilizer levels, data in Table (3) showed a significant increase in 1000-grain weight of wheat and 100 seed weight of soybean due to application of NP fertilizers. The values of 1000-grain weight of wheat were 55.31, 55.76 and 55.94 g for NP rates of 50, 75 and 100% from the recommended doses when compost was added at rate of 20 m^3/fed, respectively. The corresponding values of 100-seed weight of soybean were 18.30, 18.50 and 18.94 g in the same order.

The application of NP fertilizers at rates of 100% from the recommended dose resulted in increasing 1000-grain weight of wheat by 15.05 % over than the same rate without compost and S, while this increase of 100-seed weight of soybean was 27.11 % than the stated treatments, respectively. It can be concluded that the interaction between application of 20 m^3 compost/fed, 700 kg sulphur/fed.+ NP fertilizers at rate of 100% from the recommended dose achieved the highest values of 1000-grain and 100-seed weight for wheat and soybean, respectively. These results are in agreement with those obtained by, Wafaa *et al.(2*004), Sadik *et al*., (2004), and Abd el Ghani and Bakry(2005).

3-protein content:

Data of total protein in wheat grain and soybean seeds as affected by different application of compost, sulphur and mineral fertilizers are presented in Table (3). The obtained results showed that increasing application rates of compost, sulphur and mineral fertilizers increased total protein in grain and seeds of wheat and soybean. The mean values of protein content in wheat grain and soybean seeds were 6.90 and 6.63 % for control plants, respectively. The application of 20 m^3 compost/fed. + 700 kg S/fed, increased relatively the protein content (mean values) by 60.72 % for wheat grains and 109.65 % in seeds of soybean, respectively comparing with control treatment.

Data in Table (3) also showed that total protein content varied with different NP fertilizers treatments. It was found that the 100% NP fertilizers from the recommended dose produced the highest values of protein content in wheat grain and seeds of soybean, especially when compost was added at rate of 20 m^3/fed + 700 kg S/fed. Similar results were obtained by, Behera *et al* (2000), Melgar *et al.* (2002), and Atia 2005).

4-Oil yield in soybean:

Data presented in Table (3) showed the effect of different soil amendments on oil quantity in seeds of soybean. It is quite obvious that addition of 20 m^3 compost/fed., increased relatively the oil yield by 27.34 % compared to untreated treatments (mean values). Concerning the effect of sulphur on oil yield in seeds of soybean, data in Table (3) showed that sulphur application at rate of 350 and 700 kg/fed. without compost addition increased oil yield from 378.8 kg/fed (control) to 727.7 and 466.1 kg/fed (mean

values), respectively. The highest value of oil yield was obtained at 350 kg /fed sulphur without application of compost.

Data also, showed that increasing NP fertilizers levels from 50 to 100% from recommended dose slightly increased the oil content. The values of oil content increased gradually with increasing NP mineral fertilizer up to 100 % RD. The highest increases in oil yield due to 100% application from the recommended dose were obtained at 350 kg S/fed without addition of compost. These results are in good harmony with that found by Abou Hussien (1995), Bayoumi *et al*. (2003), Nasef (2004), Knany *et al*. (2004) and Atia (2005). Kimani et al. (2007), Muna et al. (2007), and Melgar et al. (2002).

5-N,P and K content

Data of nutrient contents of N, P and K in wheat and soybean as affected by applied compost, mineral nitrogen and P fertilizers, and sulphur rates amendments are given in Tables (4 and 5). Values indicated that there were marked increases in the contents of N, P and K of wheat and soybean by increasing mineral NP either alone or together with compost and sulphur application. Application of mineral nitrogen and phosphorus (NP) without compost and S at the rate of 100% RD increased the N, P and K contents in wheat grain by 4.47, 45.45 and 16.50 % over plants received mineral NP at the rate of 50% RD alone, respectively, vs. corresponding increases reached 100.00, 33.33 and 25.00 % for straw in wheat plants. Table (4) also revealed that compost and sulphur addition exert a more beneficial effect on N, P and K percentages as compared with no addition. The highest contents of N, P and K were achieved upon treating the soil with 20m^3/fed compost + 700 kg S/fed + 50% RD NP mineral fertilization. The percentage increased of NPK when compost and sulphur was applied at the rate of 20 m^3 compost /fed + 700 kg S/fed combined with 50 %RD of mineral NP were 94.77, 72.72 and 63.10 % for grain and 452.77, 161.11 and 90.62 % for straw over mineral NP with the rate of 50%RD alone, respectively.

These results indicated that the highest content of N, P and K in grain and straw of wheat grown on the sodic calcareous soils could be obtained at the rate of 20 m^3 compost/fed + 37.5 kg N/fed + 75 P_2O_5/fed +700 kg sulphur /fed. This was true, since a pronounced increase in the nutrients availability as a result of organic material, mineral fertilizers and sulphur application. These results are in agreement with that obtained by Aly(1998) and Hoda *et al* (2009) who obtained a significant increase in N, P and K content in maize and wheat as a result of combined effect of organic compost of farmyard manure and inorganic (NPK) fertilizers.

Data in Table (5) revealed that there were marked increases in the contents of N, P and K in soybean seeds and straw by increasing mineral NP application to calcareous soil either alone or together with compost and mineral sulphur application.

Table (4)

Table (5)

Application of NP mineral without compost or sulphur at the rate of 100% RD increased the N, P and K content in grain by 9.01, 38.46 and 15.78 % over plants received mineral NP at the rate of 50% RD alone, respectively, vs. corresponding increases reached 21.15, 36.36 and 25.00 % for straw in the same order. Table (5) also revealed that compost and sulphur addition exert a more beneficial effect in N, P and K percentages as compared with no addition. The percentage increase of NPK when compost and sulphur were applied at the rate of 20 m^3 compost/fed + 700 kg sulphur/fed combined with 75 % RD of mineral NP were 122.13, 253.84 and 71.57 % for seeds and 180.76, 209.09 and 82.14 % for straw of soybean, over application of mineral NP with the rate of 50%RD alone, respectively. So, the highest contents of N, P and K in seeds and straw of soybean plants were achieved upon treating the soil with 20 m^3/fed compost + 75% RD NP mineral fertilization. These results indicated that, under condition of this experiment, the highest contents of N, P and K in seeds and straw of soybean grown on sodic calcareous soils could be obtained at the rate of 20 m^3 compost /fed + 75 % RD of N + 75 % RD of P_2O_5 + 700 kg sulphur/fed. These results are in agreement with that obtained by Aly (1998), Abd El-Gani and Bakry (2006) and Hoda *et al* (2009). They attributed that to the improvement of soil properties, besides nitrogen released from organic matter (compost), the high content of K in compost used and its effect on conserving K from being lost by leaching and also attributed to organic compost fertilizer which improved the soil P supply power through direct and indirect effects. The direct effect includes the continous release of inorganic P in available form, while indirect effect in the role played by organic and inorganic acids as well as the other compounds of acidic effect, yielded upon mineralization of the organic fraction.

11. Effect of soil amendments on the availability of N. P,K,Fe,Zn and Mn in soil:

The data presented in Table (6) showed the availability of some macro and micronutrients after harvesting of wheat and soybean, it clearly from the data, that application of compost increased with different magnitudes the available nutrients contents (N, P, K, Fe, Mn and Zn) of surface soil after each of the growing seasons. The highest increase for different nutrients was obtained when compost applied combined with the highest rate of sulphur (700 kg/fed).

The favorable effect of the applied soil amendments on increasing the availability of nutrients in soil may be attributed to reducing the soil pH and increasing the released organic acids. It is clear that available K content showed a similar trend of those of P, Fe, Mn and Zn after wheat harvesting, but a noticeable decrease in its content was detected after soybean harvesting.

Table (6)

The most effective interaction on increasing the P, K, Fe, Zn and Mn concentration in soil was obtained at 20 m^3 compost + 700 kg sulphur/fed + mineral fertilizer at rate of 100% from the recommended dose after harvesting of wheat. While after soybean the best interaction was detected at 20 m^3 compost + 700 kg sulphur + adding NP mineral fertilizers at rate of 75% from the recommended dose. In all cases, the plots treated with compost at rate of 20m^3/fed in combination with sulphur at rate of 700 kg /fed and mineral fertilizers at rate of 75% from the recommended dose, i.e. (compost rate of 20 m^3/fed + 700 kg sulphur/fed and adding NP mineral fertilizer at rate of 75%) exhibited the highest values of available nutrients contents. These results are in agreement with those of El-Nashar (1985), Kaloosh *et al.* (1989), Mostafa *et al.* (1990), Keriem (1993), Behera *et al.* (2000), Mahmoud *et al*. (2001), Shata (2002), Abdel - Aziz *et al. (*1996) and El-Sayed *et al*. (2003). and El-Koumy (2007)

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تأثير مصلحات التربة العضوية غير العضوية المرتبطة مع الاسمدة المعدنية على خصوبة الأرض الجيرية وإنتاجيتها

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الملخص العربي

أجريت تجربة حقلية خلال موسمين متعاقبين(شتاء ٢٠٠٧/ ٢٠٠٨ على محصول القمح وصيف٢٠٠٨ على محصول فول الصويا) لدراسة تأثير بعض مصلحات التربة على خصوبة وإنتاجية التربة. استخدم التصميم الإحصائي لنظام القطع المنشقة مرتين في ثلاث مكررات، ووضعت في القطع الرئيسية معدلات من مكمور الكمبوست (صفر، ٢٠م٣/فدان) ووضع الكبريت المعدني بثلاث مستويات(صفر، ٣٥٠، ٧٠٠كجم/فدان) في القطعة المنشقة الأولى ووضعت الأسمدة المعدنية (نترات الامونيوم وسوبر فوسفات الكالسيوم(NP) بمعدلات ٥٠%، ٧٥%و١٠٠% من السماد الموصى به في القطع المنشقة الثانية *هقشه ة آ لوطعمتئ ذ لقيكو:*

١- أوضحت النتائج المتحصل عليها لمحصولي القمح وفول الصويا ووزن ١٠٠٠حبة من القمح و١٠٠ بذرة من فول الصويا تأثرها معنويا بالإضافات المختلفة للتربة. وأن أفضل القيم المتحصل عليها للقمح وفول الصويا عند معاملة التربة بمعدل ٢٠م٣ كمبوست/فدان + ٧٠٠كجم كبريت/فدان + ١٠٠% من السماد المعدني الموصى به. حيث كانت القيم المتحصل عليها٢.٢٣ طن/فدان، ٤.٨٢ طن/فدان و ٠.٨٩طن/فدان، ١.٤٢ طن/فدان لكل من الحبوب والقش لمحصولي القمح وفول الصويا على التوالي .

٢- كذلك أوضحت النتائج زيادة واضحة فى عناصر النيتروجين والفوسفور والبوتاسيوم في محصول القمح وفول الصويا المضاف عند إضافة الكبريت والكمبوست. وأن أعلى قيمة من هذه العناصر تم الحصول عليها عند إضافة ٢٠م٣ كمبوست/فدان + ٥٠% من السماد المعدني الموصى به و٧٠٠ كجم كبريت للفدان بالنسبة لمحصول القمح و ٢٠م٣

كمبوست/فدان + ٧٥% من السماد المعدنى الموصى بـه و ٧٠٠ كجم كبريت للفدان لأعلى نسبة من النيتروجين والفوسفور والبوتاسيوم فى بذور وقش فول الصويا.

٣- لوحظ زيادة ملموسة فى صلاحية عناصر الفوسفور والبوتاسيوم والحديد والمنجنيز كنتيجة للإضافات. كان للتفاعل الأكثر فاعلية في زيادة صلاحية العناصر عند إضافة ٢٠م^{٣} كمبوست/فدان + ٧٠٠ كجم كبريت للفدان +٧٥% من السماد المعدني الموصى بها من النيتروجين والفوسفور المعدني وذلك عقب حصاد فول الصويا.

Table (3): Effect of soil amendments on the yield and yield components of wheat and soybean.

Compost rates (m^3/fed)	Sulphur treatments (kg/fed)	NP fertilizer level (% from the recommended)	After wheat harvesting				After soybean harvesting				Oil yield (kg/fed)
			Grain yield (ton/fed)	Straw yield (ton/fed)	1000 grain weight (g)	Protein (%)	Seed yield (ton/fed)	Straw yield (ton/fed)	100 seed weight (g)	Protein (%)	
Without addition	Control	50	1.91	3.23	48.31	6.98	0.63	0.75	14.10	6.42	369.9
		75	1.95	3.22	48.41	6.94	0.65	0.78	14.80	6.66	381.0
		100	1.96	3.23	48.62	6.99	0.64	0.79	14.90	6.81	386.5
	Mean		1.94	3.23	48.45	6.90	0.64	0.77	14.60	6.63	378.8
	350	50	2.01	3.45	48.41	7.01	0.65	0.82	15.31	7.32	690.0
		75	2.11	3.52	48.95	7.16	0.68	0.84	15.41	7.59	721.6
		100	2.13	3.67	49.11	7.25	0.68	0.86	15.43	7.74	759.5
	Mean		2.08	3.55	48.82	7.14	0.67	0.84	15.38	7.55	727.7
	700	50	2.14	3.74	49.46	7.52	0.67	0.88	16.75	9.17	452.1
		75	2.16	3.81	49.50	7.61	0.69	0.91	16.84	9.33	463.9
		100	2.15	3.92	50.11	7.68	0.70	0.93	16.91	9.61	482.2
	Mean		2.16	3.82	49.69	7.63	0.68	0.91	16.83	9.37	466.1
$20m^3$/fed	Control	50	2.19	4.11	53.15	8.14	0.71	0.94	17.10	11.80	466.5
		75	2.21	4.22	53.41	8.33	0.72	0.96	17.25	12.10	488.4
		100	2.22	4.31	54.14	8.51	0.74	0.98	17.36	12.44	492.4
	Mean		2.20	4.21	53.56	8.32	0.72	0.96	17.23	12.11	482.4
	350	50	2.21	4.53	54.65	9.64	0.73	1.01	17.50	12.65	490.8
		75	2.22	4.61	54.45	9.81	0.77	1.14	17.68	12.81	500.0
		100	2.23	4.64	55.01	9.94	0.78	1.21	17.93	13.61	506.2
	Mean		2.22	4.59	54.87	9.79	0.76	1.12	17.70	13.02	499.0
	700	50	2.24	4.72	55.31	10.51	0.81	1.31	18.30	13.90	525.3
		75	2.23	4.81	55.76	11.22	0.85	1.41	18.50	13.90	530.7
		100	2.23	4.82	55.94	11.55	0.89	1.42	18.94	14.16	535.4
	Mean		2.24	4.78	55.69	11.09	0.85	1.38	18.58	13.90	530.3
$LSD._{0.05}$	C x S		*	*	*	*	*	*	*	*	*
	C x NP		*	*	*	n.s	n.s	n.s	*	n.s	*
	S x NP		*	*	*	*	n.s	*	*	*	n.s
	C x S x NP		*	*	*	*	*	*	n.s	*	*

Table (3 a): Effect of different treatments on yield and yield components of wheat and soybean plants.

Treatments		Wheat (2007/2008)				Soybean (2008)				
		Grain yield ton/fed	Straw yield ton/fed	1000 grain weight (g)	Protein %	Seed yield ton/fed	Straw yield ton/fed	1000 grain weight (g)	Protein %	Oil yield %
Compost Rate (C)	Without	1.94	3.23	48.56	7.05	0.67	0.81	16.09	7.69	20.70
	20m^3 / fed	2.27	3.71	54.58	9.73	0.79	1.01	17.69	12.80	22.5
	F Test	*	*	*	*	*	*	*	*	*
Sulphur rate (S)	Without	1.95	3.18	49.13	7.29	0.68	0.84	15.56	8.87	19.42
	350 kg/fed	2.11	3.60	51.17	8.50	0.73	0.92	15.86	10.08	21.65
	7000 kg/fed	2.23	3.72	53.90	9.36	0.78	0.95	16.10	11.79	22.25
	F Test	*	*	*	*	*	*	*	*	*
L. S. D	0.05	0.23	0.28	2.03	0.69	0.20	0.02	0.25	0.83	0.94
	0.01	0.32	0.54	3.51	1.33	0.70	0.03	0.42	2.13	3.01
NP fertilizer from recommended dose	50 %	2.05	3.46	51.82	8.21	0.72	0.89	15.79	9.74	23.79
	75 %	2.11	3.48	52.56	8.34	0.73	0.90	15.85	10.31	24.18
	100 %	2.14	3.45	35.23	8.62	0.75	0.92	17.08	10.70	29.90
	F Test	*	*	*	*	*	*	*	*	*
L. S. D	0.05	0.03	0.014	0.23	0.28	0.008	0.012	0.038	0.004	0.23
	0.01	0.06	0.210	0.90	0.39	0.210	0.032	0.067	0.016	0.62
Interaction	C x S	*	*	*	*	*	*	*	*	*
	C x NP	*	*	*	n.s	n.s	n.s	*	n.s	*
	S x NP	*	*	*	*	n.s	*	*	*	n.s
	C x S x NP	*	*	*	*	*	*	n.s	*	*

*** Significant at 0.05**

Table (4): Effect of compost, sulphur and mineral fertilizers rates on the content of NPK (%) in grain and straw of wheat

Compost rates	Sulphur rates (kg/fed)	NP fertilizer level(% from RD)	In Grain %				InStraw %			
			N	P	K	Mean	N	P	K	Mean
Without addition	Control	50	1.34	0.22	1.03	0.86	0.36	0.18	0.32	0.37
		75	1.37	0.28	1.18	0.96	0.61	0.21	0.36	0.31
		100	1.40	0.32	1.20	0.96	0.72	0.24	0.40	0.45
	mean		1.37	0.27	1.14	0.93	0.56	0.21	0.36	0.38
	350	50	1.46	0.24	1.20	0.97	1.09	0.22	0.39	0.57
		75	1.57	0.33	1.34	1.08	1.04	0.26	0.41	0.57
		100	1.69	0.36	1.37	1.14	1.15	0.28	0.44	0.62
	mean		1.57	0.31	1.30	1.06	1.09	0.26	0.41	0.59
	700	50	1.63	0.27	1.46	1.12	1.23	0.29	0.41	0.64
		75	1.82	0.42	1.61	1.28	1.15	0.32	0.45	0.64
		100	2.00	0.44	1.65	1.36	1.25	0.34	0.46	0.68
	mean		1.82	0.38	1.57	1.26	1.21	0.32	0.44	0.65
$20m^3$/fed	Control	50	2.31	0.35	1.42	1.36	1.36	0.32	0.45	0.71
		75	2.14	0.44	1.29	1.29	1.25	0.28	0.47	0.67
		100	2.16	0.41	1.44	1.34	1.17	0.30	0.48	0.65
	mean		2.20	0.36	1.38	1.31	1.26	0.30	0.47	0.68
	350	50	2.47	0.41	1.61	1.50	1.63	0.37	0.49	0.83
		75	2.26	0.53	1.73	1.51	1.39	0.34	0.50	0.74
		100	2.14	0.46	1.63	1.41	1.26	0.36	0.47	0.70
	mean		2.29	0.47	1.66	1.47	1.24	0.36	0.49	0.70
	700	50	2.61	0.60	1.68	1.62	1.99	0.47	0.61	1.0
		75	2.41	0.59	1.66	1.56	1.53	0.46	0.55	0.87
		100	2.44	0.56	1.67	1.56	1.42	0.41	0.59	0.81
	mean		2.49	0.58	1.67	1.58	1.65	0.45	0.58	0.90

Table (5): Effect of compost, sulphur and mineral fertilizers rates on the content of NPK (%) in seed and straw of soybean plants

Compost rates	Sulphur rates (kg/fed)	NP fertilizer level(% from RD)	In seed %				Straw %			
			N	P	K	Mean	N	P	K	Mean
Without addition	Control	50	1.22	0.13	0.95	0.89	0.52	0.11	0.28	0.31
		75	1.23	0.17	1.06	0.82	0.55	0.13	0.32	0.36
		100	1.33	0.18	1.10	1.05	0.63	0.15	0.35	0.35
	mean		1.26	0.16	1.04	0.82	0.56	0.13	0.32	0.34
	350	50	1.43	0.16	1.09	0.89	0.72	0.13	0.34	0.40
		75	1.65	0.19	1.21	2.13	0.91	0.15	0.35	0.53
		100	1.51	0.21	1.25	0.99	1.04	0.14	0.35	0.52
	mean		1.53	0.19	1.18	0.96	0.89	0.14	0.36	0.46
	700	50	1.48	0.18	1.32	0.99	1.17	0.17	0.36	0.57
		75	1.91	0.26	1.99	1.39	1.21	0.19	0.39	0.59
		100	1.66	0.28	1.60	1.18	1.24	0.21	0.38	0.61
	mean		1.68	0.24	1.64	1.19	1.20	0.19	0.38	0.59
20m^3/fed	Control	50	1.83	0.24	1.28	1.12	1.19	0.20	0.39	1.10
		75	2.24	0.35	1.26	1.28	1.39	0.26	0.40	0.68
		100	2.01	0.31	1.31	1.21	1.21	0.23	0.41	0.62
	mean		2.02	0.30	1.28	1.20	1.26	0.23	0.40	0.36
	350	50	2.10	0.36	1.66	1.37	1.26	0.24	0.42	0.64
		75	2.43	0.42	1.51	1.90	1.37	0.28	0.41	0.67
		100	2.25	0.38	1.49	1.37	1.32	0.24	0.40	0.65
	mean		2.16	0.39	1.55	1.37	1.32	0.25	0.41	0.66
	700	50	2.46	0.40	1.51	1.49	1.24	0.28	0.46	0.66
		75	2.71	0.46	1.63	1.56	1.46	0.34	0.51	0.77
		100	2.53	0.42	1.46	1.53	1.42	0.32	0.49	0.74
	mean		2.56	0.40	1.53	1.53	1.37	0.31	0.49	0.72

Table (6): Effect of compost, sulphur and mineral nitrogen fertilizer rates on the availability of some macro and micronutrients (mg/kg soil) after harvesting of wheat and soybean

Compost rates	Sulphur rates (kg/fed)	NP fertilizer level(% from RD)	Available (mg/kg soil)					
			N content	P Content	K Content	Fe Content	Mn Content	Zn Content
			After wheat harvesting					
Without addition	Control	50	20.52	6.40	440	3.25	2.76	1.13
		75	23.60	6.48	375	3.16	2.15	1.10
		100	25.71	6.33	4.25	3.72	2.46	1.09
	350	50	27.29	8.19	481	348	2.81	1.33
		75	30.15	7.25	547	3.56	2.99	1.25
		100	30.11	8.12	526	3.84	2.79	1.31
	700	50	30.46	11.26	492	3.88	2.96	1.50
		75	31.06	10.19	556	4.45	3.13	1.51
		100	32.79	12.64	319	4.16	3.45	1.57
$20m^3$/fed	Control	50	36.72	8.63	516	5.16	3.39	1.66
		75	38.81	9.23	579	4.90	3.45	1.63
		100	38.64	9.12	571	4.88	3.17	1.45
	350	50	38.66	14.35	456	4.92	3.52	1.67
		75	39.74	13.60	561	5.56	3.35	1.62
		100	39.82	13.79	589	4.49	3.62	1.63
	700	50	38.96	13.45	522	5.56	3.63	1.66
		75	40.21	16.70	545	5.60	3.67	1.63
		100	40.63	17.22	599	5.49	3.80	1.52
			After soybean harvesting					
Without addition	Control	50	20.65	7.60	466	2.84	2.16	1.24
		75	23.22	6.51	426	2.77	2.29	1.13
		100	25.81	6.11	470	2.81	2.33	1.21
	350	50	26.08	10.15	475	3.47	3.45	1.24
		75	26.12	11.16	418	3.60	3.19	1.35
		100	28.07	10.80	416	3.61	2.61	1.42
	700	50	28.06	12.50	426	3.79	3.71	1.49
		75	29.15	13.10	425	3.81	3.62	1.53
		100	31.42	13.66	429	3.88	2.88	1.61
$20m^3$/fed	Control	50	35.51	15.45	419	3.45	3.77	1.55
		75	36.17	17.00	406	3.40	3.89	1.64
		100	36.77	17.30	415	3.84	3.79	1.59
	350	50	36.95	19.51	418	5.80	4.39	1.71
		75	40.97	19.18	411	6.19	4.45	1.82
		100	41.79	19.30	417	6.10	4.66	1.93
	700	50	41.80	21.49	406	6.64	3.81	1.75
		75	43.75	21.18	403	6.29	3.73	1.81
		100	44.78	21.66	465	6.68	3.80	1.90