EFFECT OF SOME ORGANIC MANURES AND AGROCHEMICAL AMENDMENTS ON QUALITY AND Yield OF FLAX AND SOYBEAN CROPS UNDER FIELD CONDITIONS

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ABSTRACT

Two field experiments were carried out at Sakha Experimental Station, Kafr El-Sheikh Governorate during the two successive seasons, winter ,1999 and summer ,2000 to assess the effects of soil surface application of sewage sludge (3 & 5% SS), poultry manure (1 & 2 % PM), processed town refuse (1 & 2 % PTR), mixture of (1:1) sewage sludge and poultry manures (1, 2 & 3%) and recommended rates of NPK-mineral fertilizers (RRF) without (alone) or with gypsum, 5Mg fed^{-1} or sulphur, 400 Kg fed^{-1} as soil conditioners on the biological yield and quality of flax and their residual effects on the following soybean crop. Added biosolid and agrochemicals were incorporated into the soil (0-15 cm) before planting.

The obtained data revealed that the addition of organic manures with or without soil conditioners significantly increased the seed, straw and oil yields of flax crop. Application of 2% PM without gypsum or sulphur recorded the high straw yield of flax and surpassed the control by 53% and RRF by 34%. In addition, essential and non essential elements were increased in flax straw and seed with addition of biosolids with or without agrochemicals .Appreciable amounts of NPK was higher in flax seed than straw. Concentration of Cd, Ni and Pb of straw were higher than the normal ranges and less than the toxic limits for these plants.

The residual effects due to types and rates of pre-incorporated biosolids and agrochemicals on the biomass of soybean was highly significant. The highest seed yield of soybean provided by $(SS + PM)_3$ were 2.31; 2.39 and 2.42 Mg fed^{-1} for the alone, gypsum and sulphur treatments, respectively. Also, the highest straw and oil yields of soybean were detected after soil residual pre-treatment under : $(SS + PM)_3$; SS_5 ;PM_2 and PM_2; PM_2 ; SS_5 for the alone, gypsum and sulphur treatments, respectively. The contents of N,P,K,Cu,Mn,Zn,Cd,Pb and Ni were highly significantly increased as affected by types and rates of residual biosolids and/or agrochemicals leading to nutrionally rich and safe biomass.

Key words : Soil characteristic, organic wastes , biosolids , sewage sludge, poultry manure, processed town refuse, agrochemicals, flax, soybean, trace elements, heavy metals, macronutrients, organic manure.

INTRODUCTION

Egyptian soils are usually deficient in organic matter (less than 2%), nitrogen and micronutrients (Abdel-Ghaffar, 1982). Also, intensive using of chemical fertilizers in the conventional agriculture led to increasing the pollution of soil, water and food as well as the input costs. Now days, the growers tended to use the natural sources of fertilizers and conditioners via using the organic manures and biofertilizer. Land application of sulphur to soil has an important role not only for chemical amelioration of alkaline soil, but also as fertilizer (Lorenz and Maynard, 1980). Legume crops need high requirements of sulphur to sustain their quality (Mengel and Kirkby, 1987). Moreover, it plays several important roles in soils such as reducing soil pH, providing $SO^{=}_4$ to plants, and increasing availability of some nutrients (Hilal *et al.*, 1990).

Raven and Loeppert (1997) evaluated the trace elements and heavy metals composition of a wide variety of fertilizers and soil amendments and found that the trace elements and heavy metals concentrations generally decreased in the following order: rock phosphate > sewage sludge > phosphorus fertilizers > organic amendments and liming materials > K fertilizers > N fertilizers. El-Gazzar (1997) found that inorganic and different organic N sources significantly increased flax seed yield over the control. He reported that 60 kg fed^{-1} urea-N gave the highest dry matter weight followed by pigeon and poultry manures. Arisha and Abd El-Bary (2000) found that application of sulphur had no significant effect, neither on growth or yield of pea and spinach; while sewage sludge application significantly increased growth and yield of both crops. Mashaly *et al.* (1993) found that the contents of NPK were increased in bean shoots and grains with increasing rate of sewage sludge addition. However the concentration of Mn, Zn, Cu, Ni, Pb, Co, Hg and Cr were not significantly increased.

The present study aimed to asses: (a) the potential effects of different levels and types of biosolids, e.g., sewage sludges (SS); poultry manures (PM) and processed town refuse (PTR) single or in combined additions (SS + PM) with or without agrochemical conditioners, e.g., sulphur and gypsum on biomass yield quality (seed, straw, yield components and quality such as elemental contents of N,P,K,Cu, Mn,Zn, Cd, Pb and Ni) of flax crop and (b) their residual effects on yield and quality of soybean crop.

MATERIALS AND METHODS

Field experiments :

Two successive field experiments were assessed at the Experimental Farm of Sakha Agricultural Research Center. After harvesting the preceeding wheat crop, representative composite surface soil samples (0-30 cm) were collected, air dried and passed through a 2 mm sieve. Thoroughly mixed samples were analyzed for their soil characteristics and N,P,K contents (Table 1) according to Page (1982). Available Cu, Mn, Zn, Cd, Pb and Ni were extracted by DTPA according to Lindsay and Norvell, (1978) in soil and organic manures. Also, total content of above elements in soil and organic manures were digested using aqua regia (Cottenie et al., 1982). Both total and available of tested elements were measured using atomic absorption spectrophotometericalley (Perkin Elimer, 3300).The texture of experimental soil was clay (sand 21.5,silt 31.6 and clay 46.9%) with water table depth of 110 cm.

The two experiments were carried out in the same area as the first crop was flax (winter, 1999) and after harvesting, the same experimental plots were cultivated with soybean (summer, 2000) in a split plot design with four replicate. The main three plots were devoted to the agrochemicals treatments, i.e., none, gypsum (5 Mg fed^{-1}) and sulphur(400 kg fed^{-1}) and the sub-plots were eleven, which can be summarized as follows:

Incorporated materials					
No.	Treatment		No.	Treatment	
1	Control *	C	6	Processed town refuse, 1%	PTR_1
2	Sewage sludge, 3%	SS_3	7	Processed town refuse, 2%	PTR_2
3	Sewage sludge, 5%	SS_5	8	(Sewage sludge + poultry manure,1:1), 1%	$(SS+PM)_1$
4	Poultry manure, 1%	PM_1	9	(Sewage sludge + poultry manure,1:1), 2%	$(SS+PM)_2$
5	Poultry manure, 2%	PM_2	10	(Sewage sludge + poultry manure,1:1), 3%	$(SS+PM)_3$
			11	ecommended rates of mineral fertilizers **	RRF

* No amendments ** N_{60} $P_{15.5}$ fed^{-1} for flax N_{30} $P_{15.5}$ fed^{-1} for Soybean

Sources and forms of used organic manures and agrochemical amendments:

Air dried composite subsamples of anaerobically digested SS, i.e., biosolid, were collected from accumulated deposits at the municipal sewage treatment plant at Kafr El-Sheikh after the secondary treatments. Subsamples of PM were obtained from the experimental college (Agric. Kafr El-Sheikh) farm. Both SS and PM dried materials were spreader on clean plastic sheets under sunlight for one week while being covered with plastic sheets to enhance photosensitization. Subsamples of PTR amendment were obtained from Al-Mansoura composting Factory. The

obtained organic amendments were air dried, pulverized and passed through a 2 mm sieve and then analyzed for their initial chemical characteristics (Table 1). Urea (46.5% N) and superphosphate (15.5% P_2O_5) were used as nitrogen and phosphorus fertilizers. All the experimental plots received 20% of P (during cultivation) and N (at sowing) as starter regard to RRF. The rest 80% of the recommended P were also added during cultivation for the RRF treatments, i.e., conventional farming.

Table (1): Some characteristics of the tested soil and biosolids.

Tested characteristics	Soil+	SS	PM	PTR
pH (1: 2.5) soil : water.	7.98	6.25	7.11	7.69
EC_e* at 25°C, dSm^{-1}	3.30	3.15**	4.31**	7.30**
SP (saturation percent) ,%	78.10	182.88	158.76	121.86
TN (total nitrogen) , %	0.07	2.06	3.05	0.99
TOC, ***%	0.72	28.26	32.33	27.79
OM (organic matter) %	1.24	48.60	55.60	47.80
C/N ratio	10.23	13.73	10.59	27.96
Soluble cations* meq/L				
Ca^{++}	10.05	15.80	6.36	29.68
Mg^{++}	3.69	11.24	20.16	41.72
Na^{+}	19.90	4.20	6.59	1.97
K^{+}	0.83	0.58	10.10	1.58
Soluble anions* meq/L^{-1}				
CO_3^{--}	0.00	0.00	0.00	0.00
HCO_3^{-}	9.90	8.50	5.10	11.50
Cl^{-}	19.10	6.10	30.12	60.30
SO_4^{--}	5.15	17.22	7.89	3.16
Available, mg kg^{-1}				
N	28.50	771.20	1071.00	210.00
P	7.77	55:65	120.32	101.52
K	392.50	220.00	537.20	140.50

DTPA and Total , mg kg^{-1}	DTPA	Total	DTPA	Total	DTPA	Total	DTPA	Total
Zn	0.38	72.0	37.14	343.20	6.40	54.20	32.50	291.00
Mn	7.80	427.2	43.50	395.80	3.69	35.60	34.04	290.80
Cu	1.42	52.6	26.24	175.80	4.9	38.00	9.94	127.00
Pb	0.52	70.2	18.22	251.80	8.89	81.20	10.84	190.20
Cd	0.02	1.2	0.36	4.40	0.31	3.40	0.45	3.00
Ni	0.02	3.7	1.12	70.20	0.27	22.80	0.66	49.60

*In paste extract for soil and extract 1:5 for biosold ** before leaching and photosensitization ***Total organic carbon Total carbonate % 3.8 : CEC (cation exchange capacity) cmole kg^{-1} 33.2; SAR 7.6

Agriculture practices:

Seeds of flax, 60 kg fed^{-1}, (*Linum usitatissimum* L.), cv. sakha 1, were drilled into soil on November, 25th, 1999 and harvested in May, 15th, 2000. The experimental plot area was 3 x 4 m^2 and consisted of 12 rows with 10 cm spacing. Added biosolid and agrochemicals were incorporated into the soil (0-15 cm) before planting. The rest 80% of mineral N, i.e., 48 kg fed^{-1} urea-N was added in two equal doses. The first dose was added 30 days after sowing before the first irrigation, and the second 8 days later. At harvesting, 20 guarded plants from each plot

were hand pulled at random to assess the mean heights, as well as yield and yield components of each plots.

Forty-five kg fed^{-1} of soybean grains (*Glycine max L., cv. Crowford*) pre- inoculation with a mixture of three infective and effective *Bradyrhizobium japonicum(* E38, E41, and 3417), were grown on the same soil plots of the harvested flax crop by sowing(in June,11^{th} 2000)on hills, 3-4 seeds/hill, with 20 cm spacing and 60 cm wide ridges. After 21 days of germination, plants were thinned to two plants per hill and 24 kg fed^{-1} of urea-N was added. Soybean plants were harvested on October, 5^{th}, 2000 and the mean of following assessments of yield and yield components were determined.

Yield and its analyses:

Collected flax and soybean plants were washed with tap and distilled water, oven dried at 70°C for 12 hours, weighed, and ground in a stainless steel mill. To assess protein in both straw and seed materials, (0.5 g) were digested according to Chapman and Pratt, (1961). The obtained digestion solution were used to find out: The total concentrations of N, P and K (g kg^{-1}) after Page (1982). Cu, Mn, Zn, Cd, Pb and Ni (mg Kg^{-1}) were determined by atomic absorption spectrophotometers as mentioned above. The oil yield and percentage in flax or soybean seeds were determined according to AOAC, (1980). The statistical analysis was done by using computer program.

RESULTS AND DISCUSSION

1. Flax as affected by tested organic manures and agrochemical conditioners:

1.1. yield and yield components:

Data presented in Table (2) showed highly significant differences in yield and yield components of flax crop which were higher in soils received organic manures used as single or co-organic waste substrates than these obtained from control. Assessed parameters also showed the same trend with applied RRF but the increase was significantly less than with organically treated soils. The increase magnitude of yield and yield components of flax crop with organic manures was significantly affected by the types and rates of incorporated organic wastes even at the same levels.

Mixtures of co-bioremediated organic manures led to an increase in the yield and yield components of flax crop than that obtained by individual incorporated organic manure at any level. The yield and yield components of flax crop obtained with both organic manures and agrochemicals were more pronounced as they dramatically increased

over the none received agrochemicals in the increasing order : sulphur > gypsum > none of both (Table 2). Application of PM_2 without agrochemicals addition (none) recorded the high values and surpassed the control and RRF of straw by 53% and 34%, respectively.

Table (2): Yield and yield components of flax crop as affected by the types and rates of applied organic manures and agrochemical amendments.

Treat.	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Straw yield ,Mg fed^{-1}			Seed yield , kg fed^{-1}			Weight 1000 seed , g		
Control	1.90 g	2.10 f	2.30 e	482 f	655 f	660 e	7.67 g	8.74 e	9.00 c
SS_3	2.52 d	2.58 d	2.69 b	800 e	82 0 e	865 c	9.20 b	9.25 cd	9.31 ab
SS_5	2.57 c	2.65 c	2.77 c	900 b	945 a	960 ab	9.38 ab	9.41 b	9.51 ab
PM_1	2.56 d	2.60 cd	2.70 cd	760 d	865 bc	895 bc	8.67 c	8.76 e	9.17 b
PM_2	2.91 a	2.92 a	2.96 a	800 e	880 bc	1000 a	9.16 b	9.34 c	9.45 ab
PTR_1	2.81 b	2.83 ab	2.85 b	820 de	835 cd	847 d	9.40 ab	9.73 ab	9.81 ab
PTR_2	2.82 b	2.85 ab	2.87 b	840 d	850 c	860 c	10.2 1 a	10.28 a	10.55 a
$(SS+PM)_1$	2.34 e	2.56 d	2.90 a	910 ab	920 b	940 b	8.32 e	9.21 cd	9..25 ab
$(SS+PM)_2$	2.49 de	2.72 b	2.93 a	917 a	935 ab	980 ab	8.57 d	9.23 cd	9.27 ab
$(SS+PM)_3$	2.80 bc	2.86 ab	2.94 a	920 a	940 a	1020 a	9.10 bc	9.33 c	9.42 ab
RRF	2.17 f	2.24 e	244 d	875 c	881 bc	885 bc	8.19 f	9.01 d	9.15 b
F test (c)	**	**	**	*	*	*	<1	<1	<1
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	NS	NS	NS
LSD 5%	0.296	0.296	0.296	78.87	78.87	78.87			
LSD 1%	0.394	0.394	0.394	105.94	105.94	105.94			
	Plant height,cm			Oil yield , kg fed^{-1}			Protein , %		
Control	80 e	89 e	95 e	192.30g	253.62 e	267.36 e	22.85 d	24.25 bc	26.85 cde
SS_3	99 bc	104 c	107 de	301.04 e	333.35 c	346.02 c	23.13 d	24.69 bc	27.07 cde
SS_5	102 b	112 a	117 ab	330.39 b	353.05 ab	354.05 bc	24.74 d	26.25 ab	28.31 c-f
PM_1	101 bc	10 3 c	107 cd	291.61 f	317.02 de	335.18 cd	24.10 cd	24.75 bc	26.78 f
PM_2	109 a	111 ab	115 b	308.72 cd	320.41 d	361.70 b	27.32 abc	28.06 c	29.89 ef
PTR_1	93 d	96 d	100 de	306.60 d	328.12 cd	339.05 bc	23.13 abc	26.00 bc	27.99 def
PTR_2	99 bc	101 cd	106 cd	341.72 a	344.94 b	354.66 b c	25.14 ab	27.43 abc	28.64 def
$(SS+PM)_1$	99 bc	103 c	106 cd	305.70 de	358.88 cd	363.78 cd	23.77 cd	29.07 a	31.74 bc
$(SS+PM)_2$	105 ab	108 b	111 c	333.42 b	361.71 b	391.82 bcd	24.56 bcd	30.29 a	34.77 a
$(SS+PM)_3$	110 a	114 a	121 a	341.21 a	365.47 a	394.55 a	29.43 a	31.13 a	32.13 b
RRF	98 cd	101 cd	113 bc	327.20 bc	338.95 bc	349.59 bcd	27.27 abc	27.77 abc	27.94 bcd
F test (c)	**	**	**	**	**	**	*	*	*
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	5.882	5.882	5.882	31.421	31.421	31.421	3.56	3.56	3.56
LSD 1%	7.877	7.877	7.877	41.99	41.99	41.99	4.78	4.78	4.78

SS: Sewage sludge, PM: Poultry manure, PTR: Processed town refuse. , G: gypsum, S: sulphur, RRF: Recommended rates of mineral fertilizers. NS not significant * significant , ** high significant

The overall values of flax seed yield ranged between 482 and 920 kg fed^{-1} without agrochemicals; 655 and 940 kg fed^{-1} with gypsum and

660 and 1020 kg fed^{-1} with sulphur. The obtained results are in agreement with the findings of El-Gazzar (1997) and El-Hindi *et al.* (2000) who found that straw and seed yields of flax differed with the types of applied organic manures.

Data in Table (2) show that, values of oil yield ranged between 192 to 341, 253 to 365 and 267 to 395 kg fed^{-1} for none, gypsum and sulphur treatments, respectively. In general, incorporated PM_2 and $(SS + PM)_3$ without any agrochemicals ,with gypsum or sulphur gave the tallest plants (Table 2). The above results are in harmony with those of El-Hindi *et al.* (2000). Table (2) also shows that highly significant interaction effect between agrochemicals (AC) and organic manures (B), i.e., (AC x B) on plant heights in all treatments. With regard to the effect of biosolids, data emphasize that mixing SS with PM led to a significant increase with regard to the tested parameters over the control treatments. This might be due to the synergetic effect between PM and SS as PM has more contents of both total and active N&P (Table 1).

1.2. Macronutrients content of flax:

Data listed in Table (3) revealed that, the N, P and K contents of flax crop organs were markedly increased due to the application of the different types and rates of organic manures and RRF as compared to the control. The contents of N,P and K of flax seed were higher than straw.

Also, data in Table 3 show that the N and P contents of flax seed and straw were higher under application of RRF than those obtained with low rates of organic manures, i.e., (PM_1; PTR_1) and $(SS + PM)_1$. However, applied or co-applied higher rates of biosolids, i.e., SS_3; SS_5; PTR_2 and $(SS + PM)_3$ increased N and P contents of biomass than applied of RRF. Different biosolid treatments led to higher K-concentrations in flax organs than RRF. Data show that mixing gypsum or sulpur with any of the proposed treatments led to higher contents of assessed elements with marked effect of added sulphur than gypsum. Co-application of organic manures at any level, increased the N, P and K contents of flax seed and straw than those applied individually at the same rates which may be due to their synergetic or co-metabolizing effects.

Also, Table (3) shows clearly the beneficial effects of applied gypsum and sulphur on seed and straw quality as they increased the nutrients contents over the control. These results agreed with those of El-Gazzar (1997); Abd Allah (1998) and Saber (2000).

Table (3): N,P and K contents, (g kg^{-1} dry weight) of flax as affected by the types and rates of applied organic manures and agrochemicals.

Treatments	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Seed-N			Seed-P			Seed-K		
C	36.55 d	37.40 c	39.45 f	5.50 g	5.68 f	6.25 e	7.10 f	7.67 cde	8.20 abc
SS_3	36.78 d	39.50 bc	42.10 c-f	5.80 f	6.93 e	7.18 d	9.20 b	9.30 ab	9.77 ab
SS_5	37.00 d	43.20 ab	45.30 cde	7.80 b	8.00 b	8.25 b	9.60 a	9.88 a	9.98 a
PM_1	38.55 d	38.90 c	40.23 def	7.05 bc	7.15 d	7.30 cd	8.60 bc	8.90 bcd	8.95 abc
PM_2	43.70 abc	44.60 bc	44.95 cd e	7.95 a	8.60 a	9.52 a	9.40 ab	9.60a	9.85 ab
PTR_1	40.40 abc	41.60 bc	42.38 def	6.63 d	6.90 e	6.95 d	8.18 c	8.20 cde	8.30 bcd
PTR_2	42.03 abc	43.87 abc	44.03 def	6.93 cd	6.98 bc	7.55 c	8.65 bc	8.85 b-e	8.97 abc
$(SS+PM)_1$	38.03 cd	46.45 a	47.58 bc	6.45 e	6.90 e	7.50 c	7.48 e	7.80 e	8.13 abc
$(SS+PM)_2$	39.30 bcd	49.70 a	49.80 b	6.60 d	7.30 cd	7.85 bc	8.15 b	8.33 bcd	8.45 bc
$(SS+PM)_3$	47.08 a	49.80 a	55.63 a	7.20 c	7.53 c	7.95 bc	8.48 ab	9.20 ab	9.40 abc
RRF	43.63 abc	44.43 abc	44.70 bcd	7.13 c	7.25 d	7.35 cd	7.63 c	7.82 de	8.23 abc
F test (c)	*	*	*	NS	NS	NS	NS	NS	NS
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	NS	NS	NS	**	**	**
LSD 5%	5.69	5.69	5.69				1.43	1.43	1.43
LSD 1%	7.64	7.64	7.64				1.92	1.92	1.92
	Straw-N			Straw-P			Straw-K		
C	5.90 c	6.57 bc	6.68 e	0.50 e	0.53 f	0.63 e	4.30 e	6.18 de	6.50 cd
SS_3	6.60 bc	6.73 bc	7.03 de	0.53 d	0.58 e	0.68 d	5.90 bcd	7.35 bcd	7.75 b
SS_5	6.80 bc	7.83 ab	7.90 cde	0.63 cd	0.68 d	0.75 c	6.70 abc	7.50 bcd	8.33 ab
PM_1	7.00 bc	7.20 bc	7.63 a-d	0.55 d	0.58 e	0.73 cd	5.60 cd	7.18 b	7.80 b
PM_2	7.10 bc	7.65 b	7.98 ab	0.65 cd	0.75 c	0.78 c	6.60 abc	8.53 a	8.80a
PTR_1	6.30 c	6.83 bc	6.90 b-e	0.60 cd	0.65 de	0.70 cd	6.10 bc	6.20 de	6.55 cd
PTR_2	6.73 bc	6.88 bc	7.85 abc	0.90 a	1.00 a	1.10 a	6.23 bc	6.25 de	6.85 cd
$(SS+PM)_1$	7.23 bc	7.38 b	8.18 bc	0.50 d	0.65 de	0.73 cd	6.25 abc	6.70 cde	6.88 cd
$(SS+PM)_2$	8.03 ab	8..33 ab	8.40 bcd	0.63 cd	0.70 d	0.78 c	7.40 ab	7.75 bc	8.20 ab
$(SS+PM)_3$	8.23 ab	9.03 a	9.10 a	0.68 c	0.83 b	0.87 b	7.63 a	7.95 b	8.50 ab
RRF	8.88 a	8.98 a	9.08 a	0.82 b	0.85 b	0.88 b	6.27 abc	6.38 de	6.48 cd
F test (c)	NS	NS	NS	NS	NS	NS	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	NS	NS	NS	NS	NS	NS	**	**	**
LSD 5%							1.17	1.17	1.17
LSD 1%							1.56	1.56	1.56

SS: Sewage sludge, PM: Poultry manure, PTR: Processed town refuse, C: Control, G: gypsum, S: sulphur, RRF: Recommended ratesof mineral fertilizer. NS not significant * significant , ** high significant

1.3. Micronutrients and heavy metals content of flax:

Results recorded in Tables (4&5) show that, Cu, Mn, Zn, Cd, Pb and Ni contents of different flax organs were higher for application of organic manures to soil than those obtained with RRF. Addition of gypsum to soil led to higher contents of micronutrients (Zn and Mn) of

different flax organs than those obtained with sulphur treated soil, i.e. gypsum > sulphur > none. Also, data show that Cu, Cd, Ni and Pb elements of different flax organs (seed and straw) with sulphur treated soil were higher than those obtained with gypsum treated soil compared with the none agrochemicals treated soils.

Table (4): Cu,Mn and Zn contents, (mg kg^{-1} dry weight) of flax as affected by types and rates of applied organic manure and agrochemical amendments.

Treatments	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Seed-Cu			Seed-Mn			Seed-Zn		
C	12.0 g	14.0 f	16.0 f	12 g	15 g	13 e	24 f	34 de	32 h
SS_3	26.0 b	27.0 b	29.0 b	20 b	26 b	22 b	40 b	48 b	38 f
SS_5	32.0 a	34.0 a	36.0 a	24 a	28 a	25 ab	50 a	52 b	50 b
PM_1	20.5 cd	21.0 cd	24.0 c	22 b	24 c	23 b	48 ab	58 a	52 b
PM_2	23.0 c	27.0 b	29.0 b	26 a	30 a	28 a	51 a	60 a	55 a
PTR_1	14.0 f	16.0 e	18.0 e	17 d	23 c	18 cd	34 d	40 c	38 f
PTR_2	18.0 e	20.0 cd	28.0 bc	18 c	27 ab	19 c	40 b	46 b	42 e
$(SS+PM)_1$	16.7 ef	18.0 d	20.0 de	12 g	16 f	13 d	36 cd	46 b	42 e
$(SS+PM)_2$	18.0 e	19.0 d	22.0 d	16 e	19 e	18 cd	38 c	48 b	46 d
$(SS+PM)_3$	20.0 d	21.0 cd	26.0 c	17 d	20 d	19 c	40 b	58 a	48 c
RRF	18.0 e	19.0 d	20.0 de	14 f	16 f	15 d	28 e	38 d	36 g
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	2.441	2.441	2.441	0.781	0.781	0.781	2.647	2.647	2.647
LSD 1%	3.249	3.249	3.249	1.042	1.042	1.042	3.536	3.536	3.536
	Straw-CU			Straw-Mn			Straw-Zn		
C	4.0 h	5.0 g	5.50 g	10 g	15 e	14 e	10 f	14 e	12 e
SS_3	6.0 f	7.0 e	8.0 e	18 c	20 d	19 b	15 c	18 d	16 c
SS_5	8.0 d	10.0 c	11.0 b	22 b	30 a	26 a	20 a	22 c	21 a
PM_1	9.0 c	10.0 c	11.0 b	20 b	22 c	21 b	12 d	24 b	18 b
PM_2	11.0 a	12.0 a	14.0 a	26 a	28 a	27 a	15 c	26 a	21 a
PTR_1	4.0 e	6.0 f	8.0 e	11 g	22 c	16 d	12 d	22 c	14 d
PTR_2	6.0 f	8.0 d	10.0 c	17 c	26 b	20 c	18 b	26 a	21 a
$(SS+PM)_1$	6.0 f	7.0 e	8.0 e	12 f	16 e	15 e	11 e	14 e	13 de
$(SS+PM)_2$	7.6 e	8.0 d	9.0 d	13 e	18 e	16 d	13 d	18 d	16 c
$(SS+PM)_3$	10.0 b	11.0 b	12..9 ab	16 d	20 d	18 cd	18 b	24 b	18 b
RRF	5.00 g	5.5 fg	6.0 f	12 f	19 d	16 d	13 d	14 e	13 de
F test (c)	<1	<1	<1	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	0.847	0.847	0.847	1.174	1.174	1.174	0.802	0.802	0.802
LSD 1%	1.162	1.162	1.162	1.578	1.578	1.578	1.070	1.070	1.070

SS: Sewage sludge, PM: Poultry manure, PTR: Processed town refuse, C: Control, G: gypsum, S: sulphur, RRF: Recommended rates of mineral fertilizer. NS not significant * significant , ** high significant

Results in Tables (4&5) indicate also that, values of Zn, Mn and Cu of different organs showed the following decreasing orders in seed and straw: Zn ≥ Mn ≥ Cu.The magnitude values of Cd, Ni and Pb of different flax organs exhibited the following decreasing order: straw > seed. Mixtures (1: 1) of organic manures added at any level, led to a decrease in the mircoelements and heavy metals content of different organs than those obtained by the same rates of the added individual organic manures, which may be due to the dilution effect of added materials.

Table (5): Cu, Ni and Pb contents, (mg kg^{-1} dry weight) of flax as affected by types and rates of applied organic manure and agrochemical amendments.

Treatments	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Seed-Cd			Seed-Pb			Seed-Ni		
C	0.06 e	0.07 f	0.09 e	0.20 h	0.42 g	0.52 g	0.15 f	0.22 f	0.28 f
SS_3	0.08 d	0.11 c	0.14 bc	1.34 b	1.46 c	1.64 bc	0.22 d	0.28 de	0.35 e
SS_5	0.12 b	0.16 ab	0.18 ab	1.72 a	1.76 a	1.92 a	0.37 a	0.40 b	0.45 c
PM_1	0.08 c	0.10 b	0.12 cd	0.34 g	0.54 f	0.64 f	0.25 c	0.31 d	0.36 e
PM_2	0.09 d	0.13 bc	0.16 b	0.42 f	0.64 de	0.70 e	0.35 ab	0.40 b	0.48 b
PTR_1	0.12 b	0.16 ab	0.18 ab	1.10 cd	1.66 ab	1.78 b	0.25 c	0.42 ab	0.47 bc
PTR_2	0.16 a	0.18 a	0.20 a	1.26 c	1.76 a	1.94 a	0.32 b	0.50 a	0.58 a
$(SS+PM)_1$	0.08 d	0.10 c	0.12 cd	0.46 ef	0.60 e	0.65 de	0.22 d	0.24 e	0.29 f
$(SS+PM)_2$	0.10 c	0.11 c	0.13 c	0.49 e	0.66 de	0.70 e	0.26 c	0.32 d	0.36 e
$(SS+PM)_3$	0.11 c	0.15 b	0.16 b	0.66 d	0.72 d	0.82 d	0.35 ab	0.38 c	0.42 d
RRF	0.07 d	0.08 d	0.10 d	0.29 gh	0.40 b	0.64 f	0.18 e	0.28 de	0.46 c
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	0.018	0.018	0.018	0.67	0.67	0.67	0.028	0.028	0.028
LSD 1%	0.024	0.024	0.024	0.089	0.089	0.089	0.037	0.037	0.037
	Straw-Cd			Straw-Pb			Straw-Ni		
C	4.00 g	5.00 g	5.10 g	3.00 g	3.20 h	3.40 h	2.30 g	2.40 g	3.60 fg
SS_3	6.00 d	6.90 d	7.90 cd	3.80 ef	3.90 g	5.20 e	3.25 ef	3.50 e	3.90 de
SS_5	8.00 b	10.00 a	12.00 a	4.80 c	5.20 e	6.20 c	4.60 b	4.90 bc	5.20 ab
PM_1	4.90 e	5..90 d	8.00 c	3.20 ef	3.60 g	5.20 e	3.20 cd	3.40 e	3.80 e
PM_2	6.90 c	7..90 c	9.00 bc	3.90 b	5.20 g	6.00 d	4.00 d	4.20 c	4.30 cd
PTR_1	5.00 c	5..51 f	6.00 f	4.23 d	5.40 c	6.20 c	4.40 c	5.30 b	5.40 ab
PTR_2	6.00 d	6.70 de	8.00 c	5.20 a	7.60 c	9.20 a	5.00 a	5.50 a	5.63 a
$(SS+PM)_1$	6.05 d	6.19 e	7.10 d	3.60 d	4.20 f	4.80 f	2.70 f	3.80 d	4.00 d
$(SS+PM)_2$	6.90 c	7.30 cd	8.00 c	4.80 c	5.00 d	6.23 c	3.20 ef	4.15 cd	4.40 c
$(SS+PM)_3$	9.00 a	9.30 b	9.50 b	4.90 b	6.20 b	7.20 b	4.25 cd	4.36 c	4.80 b
RRF	4.19 f	6.00 ef	6.90 e	3.40 e	3.80 c	4.50 g	3.20 ef	3.40 f	3.75 ef
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	0.367	0.367	0.367	0.325	0.325	0.325	0.351	0.351	0.351
LSD 1%	0.489	0.489	0.489	0.441	0.441	0.441	0.466	0.466	0.466

SS: Sewage sludge, PM: Poultry manure, PTR: Processed town refuse, C: Control, G: gypsum, S: sulphur, RRF: Recommended rates of mineral fertilizer. * significant , ** high significant

The above mentioned data (Tables 4&5) show clearly the beneficial effects of gypsum and sulphur on quality of the different flax organs as they increased nutrients content with regard to control. Generally under the conditions of investigation although the combined organic manures with gypsum and sulphur were more pronounced in increasing the concentrations of studied heavy metals, which were still low and less than the recorded detrimental limits found in plants as given by Kabate Pendias and Pendias (1992) and Gray (1992). These results indicate the importance of studying heavy metals (Cd, Ni and Pb) specially, bioaccumulation and cycling in the environment for management of agricultural soils and crops.

2.The residual effects of applied organic manures and agrochemical amendments on soybean:

2.1. Yield and yield components:

Data listed in Table (6) showed highly significant differences in yield and yield components of soybean crop, which cultivated after flax. They were higher in soil treated with organic manures than those obtained from control. The above mentioned assessed parameters also showed the same trend with applied RRF. The yield and yield components of soybean crop obtained with residual of both organic manures and gypsum or sulphur were dramatically increased over the none received agrochemicals.

The analytical results in Table (6) indicated that the highest values of seed yield were recorded with soils pre-treated with biosolids and agrochemicals compared to the untreated soils (control). Under application of gypsum or sulphur as conditioners with or without co-incorporated organic manures there was an increase in soybean seed yield due to the improving effect on soil environment. On the other hand, the highest yield of oil was obtained from treatments amended with sulphur-sewage sludge at any level. Meanwhile the lowest values were recorded in the treatments without agrochemical and organic manures. These obtained results were in agreement with these of many investigators, such as El-Essawi and Fatma Sherief (1981); Talha (1997) and Saber (2000).

The results in (Table 6) show that residual organic manures at the different types and rates with or without agrochemicals gave the highest straw yield compared to control. The residual effect of organic manures and agrochemicals amendments was accompanied with significant increases in seeds protein content over the control. The highest values were obtained in sulphur-sewage sludge pre-treated soils at the high

levels. Meanwhile, the lowest data were obtained in soil without treatments. Similar results were obtained by Talha (1997).

Table (6): Yield and yield components of soybean as affected by residual effect of organic manures and agrochemical amendments.

Treatments	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Seed yield Mg fed^{-1}			Oil, %			Oil yield kg fed^{-1}		
C	1.72 d	1.86 e	1.89 e	26.19 b	26.67 a	26.39 a	449.9 f	496.6 e	498.1 f
SS_3	2.19 b	2.24 cd	2.35 abc	26.00 bc	25.30 b	26.47 a	517.4 e	565.5 b	620.74 ab
SS_5	2.24 ab c	2.25 c	2.38 a	25.41 d	25.51 b	26.52 c	543.8 d	574.6 ab	631.2 a
PM_1	2.23 abc	2.36 ab	2.37 abc	25.62 cd	23.04 d	24.92 c	541.3 d	572.5 b	583.8 bc
PM_2	2.30 a	2.37 c	2.40 a	26.00 bc	23.13 f	24.94 c	586.8 a	588.9 a	593.9 b
PTR_1	2.16 bc	2.24 d	2.26 c	24.69 a	22.55 a	23.77 d	532.1 de	542.6 d	557.2 d
PTR_2	2.18 bc	2.29 bc	2.37 ab	23.56 f	25.15 b	24.74 c	558.9 c	576.6 ab	586.3 bc
$(SS+PM)_1$	2.25 ab	2.29 bc	2.31 bc	23.72 f	23.84 f	23.93 d	533.7 de	540.7 d	543.9 e
$(SS+PM)_2$	2.27 a	2.37 bc	2.39 abc	23.85 f	23.56 e	24.67 e	542.1 d	554.1 c	572.9 c
$(SS+PM)_3$	2.31 a	2.39 a	2.42 a	21.98 g	24.37 g	25.66 b	580.2 a	583.3 a	620.4 ab
RRF	2.14 c	2.19	2.20 d	26.59 a	26.52 a	26.51 a	569.2 bc	568.2 bc	583.2 bc
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	0.090	0.090	0.090	0.414	0.414	0.414	25.249	25.249	25.249
LSD 1%	0.120	0.120	0.120	0.560	0.560	0.560	33.931	33.931	33..931
	Straw yield Mg fed^{-1}			Weight of 100 seed , gm			Protein %		
C	2.43 c	2.55 e	2.90 d	15.03 c	15.29 b-e	15.53 d	31.88 f	33.13 g	34.06 e
SS_3	2.90 a	3.35 a	3.44 ab	16.27 abc	16.64 cde	16.93 cd	33.75 de	35.69ef	37.63 c
SS_5	2.92 a	3.42 a	3.49 a	16.60 bc	17.25 ab	17.49 ab	41.13 a	42.25 a	42.75 a
PM_1	2.53 bc	2.93 cd	3.40 ab	16.28 abc	17.06 abc	17.56 cd	32.91 e	35.69 ef	36.25 cd
PM_2	2.89 a	3.25 a	3.51 a	16.63 ab	16.99 abc	17.35 abc	33.00 ef	37.75 c	38.13 bc
PTR_1	2.61 b	2.87 d	2.95 cd	15.55 bc	16.00 a-d	16.30 cd	33.63 de	35.50 ef	36.75 de
PTR_2	2.86 a	2.95 cd	2.99 cd	15.69 bc	16.22 a-d	16.73 bcd	34.95 cd	36.38 d	37.32 c
$(SS+PM)_1$	2.64 b	2.89 cd	2.95 bcd	15.19 bc	15.53 e	15.85 d	35.58 c	36.19 d	37.00 cd
$(SS+PM)_2$	2.93 a	2.99 cd	3.05 bc	16.28 bc	16.51 de	16.76 bcd	36.00 b	37.56 c	38.75 bc
$(SS+PM)_3$	2.96 a	3.02 bc	3.09 b	17.16 a	17.44 a	18.62 a	38.00 b	38.88 b	39.50 b
RRF	2.85 a	2.91 cd	3.05 bc	16.09 abc	16.35 a-d	16.59 bcd	34.75 cd	34.94 f	35.00 de
F test (c)	**	**	**	NS	NS	NS	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	0.123	0.123	0.123	1.282	13.282	13.282	1.425	1.425	1.425
LSD 1%	0.165	0.165	0.165	1.720	1.720	1.720	1.407	1.907	1.907

SS: Sewage sludge, PM: Poultry manure, PTR: Processed town refuse, C: Control, G: gypsum, S: sulphur, RRF: Recommended rates of mineral fertilizer. NS not significant * significant , ** high significant

2.2. Macronutrients content of soybean:

Data demonstrated in Table (7) show that the N, P and K contents of soybean seed and straw after harvesting were highly significant as affected by types and rates of the residual organic manures and agrochemicals co-amendments as well as RRF.

Table (7): N, P and K contents(g kg^{-1} dry weight) in soybean crop as affected by residual effect of organic manures and agrochemical amendments.

Treatments	Added agrochemical								
	None	G	S	None	G	S	None	G	S
	Straw-N			Straw-P			Straw-K		
C	8.1 f	9.2 h	9.4 f	1.30 cd	1.40 ef	2.20 b	4.7 f	5.9 f	6.7 f
SS_3	8.5 f	10.6 b	12.0 d	1.45 c	1.60 e	1.90 d	8.0 c	8.2 cd	9.2 c
SS_5	8.7 f	11.4 ab	12.8 c	1.90 b	2.00 d	2.10 c	12.7 a	13.4 a	14.0 a
PM_1	9.4 f	10.1 d	10.8 e	1.6 cb	2.20 cd	2.25 b	5..9 e	7.9 d	8.8 cd
PM_2	11.4 a	11.5 c	12.9 c	1.8 b	2.30 bc	2.40 b	10.7 b	10.9 b	11.5 b
PTR_1	8.8 g	9.6 g	10.4 e	1.95 b	2.10 bc	2.40 d	6.2 de	6.9 e	7.9 e
PTR_2	10.4 d	11.2 a	13.2 b	2.40 a	2.50 b	2.70 b	8.6 c	8.8 c	9.6 c
$(SS+PM)_1$	9.6 e	9.9 f	11.5 c	1.40 cd	1.60 e	1.69 e	5.5 ef	6.6 fg	7.2 f
$(SS+PM)_2$	10.4 c	11.8 e	11.9 b	1.50 c	2.00 d	2.18 c	6.80 d	7.4 d	8.3 d
$(SS+PM)_3$	11.5 b	12.3 c	13.2 a	1.90 b	2.30 bc	2.40 b	7.1 cd	7.8 cd	9.6 c
RRF	9..9 de	10.0 f	10.9 d	2.60 a	2.70 a	2.80 a	6.7 d	6.8 e	7.0 e
F test (c)	**	**	**	NS	NS	NS	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	0.485	0.485	0.485	0.251	0.251	0.251	0.438	0.438	0.438
LSD 1%	0.657	0.657	0.657	0.341	0.341	0.341	0.581	0.581	0.581
	Seed-N			Seed-P			Seed-K		
C	51.0 f	53.0 g	54.5 d	5.40 e	5.90 fg	6.13 f	16.0 f	16.6 e	16.9 e
SS_3	54.0 de	57.1 efg	60.2 bc	6.20 g	6.90 d	6.70 e	16.7 e	18.5 d	20.5 b
SS_5	65.8 a	67.6 ab	69.4 ab	9.00 b	9.10 ab	9.20 b	21.0 ab	21.5 b	23.5 a
PM_1	52.8 e	57.1 e	58.1 d	8.40 c	8.60 b	8.90 e	18.4 cd	18.8	21.5 b
PM_2	55.5 cd	70.4 a	71.0 b	8.70 c	8.90 b	9.50 ab	19.4 c	cd	22.6 ab
PTR_1	53.8 e	56.8 de	58.8 d	7.50 e	7.70 c	9.20 b	17.6 d	19.6 c	22.4 ab
PTR_2	55.9 cd	58.2 d	59.7 d	9.40 a	9.50 ab	9.70 ab	21.9 a	21.6 b	23.6 a
$(SS+PM)_1$	56.6 c	57.9 c	59.2 d	6.10 g	6.60 e	6.80 f	16.7 e	22.4 ab	20.50 b
$(SS+PM)_2$	57.6 c	62.0 b	62.0 b	6.20 g	6.80 d	6.90 e	20.5 ab	17.7 de	22.5 ab
$(SS+PM)_3$	60.8 b	62.2 b	83.2 a	6.90 f	10.50 a	10.70 a	21.5 a	21.5 b	23.6 a
RRF	55.6 c	55.9 g	56.0 e	7.90 d	8.00 b	8.1 0 c	16.6 e	23.4 a	17.8 d
								16.7 e	
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	1.525	1.525	1.525	0.349	0.349	0.349	1.501	1.501	1.501
LSD 1%	2.047	2.047	2.047	0.464	0.464	0.464	2.000	2.000	2.000

SS: Sewage sludge, PM: Poultry manure, PTR: Processed town refuse, C: Control, G: gypsum, S: sulphur, RRF: Recommended rates of mineral fertilizer. NS not significant * significant , ** high significant

Data show that the N and P content of different soybean organs were higher in RRF-soil than those obtained in low rate of organic manure treatments. Meanwhile the opposite trend was shown with high rate added of organic treated soil. On the contrast, the potassium content

of different organs soybean was lower in RRF-soil than in organic treated soil. The NPK, contents of different soybean organs in sulphur treated soil was higher than those obtained with gypsum treated soil compared with none agrochemicals treated soil. These increases adopted the following decreasing order: Sulphur > gypsum > none.

Mixed (1:1) organic manures added at any level, led to an increase in N, P and K contents in different soybean organs than those obtained by the same rates of added individuals organic wastes. Similar trends were obtained by Abd-Allah (1998) and Saber (2000), they found that the residual effects of different sources of organic manures combined with sulphur significantly increased the macronutrients content in maize grains compared with control.

2.3. Micronutrients and heavy metals content of soybean:

Data presented in Tables (8&9) show that the magnitude of Zn, Mn, Cu, Cd, Ni and Pb in different soybean organs (seeds and straw) cultivated in soil RRF received, as well as, those under residual organic manures treated plots were higher compared with their controls. In general, the micronutrients and heavy metals content of different soybean organs were higher in organic treated soil than those obtained in RRF. With regard to agrochemical treated soils combined with the same organic manures and RRF, micronutrients and heavy metals of soybean organs (seed and straw) in gypsum - treated soil were higher than those obtained in sulphur-treated soil compared with the none agrochemicals treated soils. These increases take the following decreasing order: gypsum > sulphur > none.

Results in Tables (8&9) indicate that, values of Mn, Zn and Cu in different organs had taken the decreasing orders: For Zn, Mn ,Cu Seed > straw . Also, data show that, the magnitude of Ni, Pb and Cd of different soybean organs were taking the decreasing order: Straw > seed.

Residual of mixed (1:1) organic manures at any level led to a decrease in the micronutrients and heavy metal contents of different soybean organs than those obtained by the same rate of the individual organic manures.

The above-mentioned data (Tables 8&9) show clearly the beneficial effects of gypsum and sulphur on different soybean organs quality as they increased nutrients content compared with control. Generally, under this investigation conditions, the combined of organic manures with gypsum and sulphur were more pronounced in increasing the amounts of heavy metals. But their concentrations were still low and

less than the recorded detrimental limits which found in plants as given by Kabate Pendias and Pendias (1992) and Gray (1992). These results were in agreement with those obtained by Abd-Allah, (1998); Saber, (2000) and Ragaa Zein and Zein (2000). It is well known that the residual effect of organic manures lost for long period during which the slow release of nutrients and modifying the soil agro-ecosystem are achieved (Lal, 1998).

Table (8): Cu ,Mn and Zn contents,(mg kg^{-1} dry weight) of soybean as affected by residual effect of organic manures and agrochemical amendments.

Treatments	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Seed-Cu			Seed-Mn			Seed-Zn		
C	25.0 h	30.0 g	29.0 g	28.0 h	40.0 h	30.0 h	26.0 h	40.0 g	36.0 f
SS_3	32.0 d	36.0 ef	34.0 d	40.0 f	44.0 f	41.0 g	38.0 e	58.0 c	48.0 cd
SS_5	38.0 b	48.0 a	45.0 a	42.0 e	48.0 e	43.0 e	65.0 a	82.0 a	69.0 a
PM_1	28.0 f	37.0 de	34.0 d	52.0 d	58.0 d	53.0 d	44.0 d	54.0 cd	52.0 bc
PM_2	38.0 b	42.0 b	40.0 c	60.0 c	65.0 c	62.0 c	48.0 c	58.0 c	50.0 c
PTR_1	28.0 f	41.0 b	42.0 b	62.0 b	82.0 b	72.0 b	50.0 c	56.0 cd	54.0 b
PTR_2	37.0 bc	48.0 a	46.0 a	66.0 a	90.0 a	82.0 a	66.0 b	76.0 b	68.0 a
$(SS+PM)_1$	27.0 g	32.0 g	30.0 fg	34.0 g	42.0 g	40.0 f	36.0 f	44.0 f	42.0 e
$(SS+PM)_2$	30.0 e	35.0 f	32.0 e	38.0 ef	52.0 e	48.0 e	38.0 e	48.0 ef	46.0 fg
$(SS+PM)_3$	40.8 a	45.0 ab	42.0 b	52.0 d	60.0 cd	54.0 d	42.0 de	52.0 d	50.0 c
RRF	31.9 d	38.0 cd	35.0 ef	34.0 g	58.0 d	50.0 d	34.0 g	52.0 d	44.0 d
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	1.725	1.725	1.725	2.259	2.259	2.259	2.021	2.021	2.021
LSD 1%	1.977	1.977	1.977	3.044	3.044	3.044	2.690	2.690	2.690
	Straw-Cu			Straw-Mn			Straw-Zn		
C	6.05 i	9.80 i	8.60 i	46.0 g	52.0 f	50.0 f	26.0 g	34.0 f	28.0 f
SS_3	8.30 h	16.28 c	8.90 h	56.0 ef	66.0 e	62.0 e	38.0 cd	40.0 de	39.0 d
SS_5	10.38 f	18.20 a	10.65 f	74.0 c	88.0 c	78.0 c	47.0 a	50.0 b	48.0 ab
PM_1	8.40 h	11.30 h	10.30 f	54.0 f	80.0 d	64.0 de	34.0 e	40.0 de	36.0 de
PM_2	13.40 c	14.10 f	12.50 d	72.0 cd	96.0 a	76.0 c	36.0 d	48.0 bc	44.0 b
PTR_1	12.30 e	16.20 d	15.20 b	62.0 e	88.0 c	63.0 e	36.0 d	42.5 cd	38.0 de
PTR_2	14.50 b	18.30 a	17.40 a	75.0 c	90.0 b	78.0 c	44.0 b	54.0 a	50.0 a
$(SS+PM)_1$	10.20 f	12.10 h	10.90 f	70.0 d	78.0 de	72.0 d	28.0 f	38.0 e	36.0 e
$(SS+PM)_2$	11.80 d	14.90 e	12.80 a	84.0 b	88.0 c	86.0 b	34.0 e	42.0 cd	38.0 de
$(SS+PM)_3$	16.90 a	18.80 ab	16.28 ab	90.0 a	98.0 a	94.0 a	38.0 cd	46.0 c	42.0 c
RRF	9.30 g	12.10 h	10.58 g	56.0 ef	64.0 e	62.0 e	30.0 ef	38.0 cd	34.0 ef
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	0.272	0.272	0.272	2.611	2.611	2.611	2.374	2.374	2.374
LSD 1%	0.365	0.365	0.365	3.555	3.555	3.555	3.182	3.182	3.182

SS: Sewage sludge, PM: Poultry manure, PTR: Processed town refuse, C: Control, G: gypsum, S: sulphur, RRF: Recommended rates of mineral fertilizer. NS not significant * significant , ** high significant

Table (9): Cu, Pb and Ni contents,(mg kg^{-1} dry weight) of soybean as affected by residual effect of organic manures and agrochemical amendments.

Treatments	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Seed-Cd			Seed-Pb			Seed-Ni		
C	0.16 i	0.26 g	0.22 g	0.34 f	0.60 f	0.50 f	0.24 i	0.68 i	0.66 g
SS_3	0.32 f	0.44 cd	0.38 e	0.63 c	0.75 d	0.67 cd	1.28 f	1.72 f	1.64 d
SS_5	0.58 a	0.68 a	0.60 b	0.73 b	0.79 cd	0.65 d	3.02 a	3.95 a	3.70 a
PM_1	0.24 g	0.27 f	0.26 i	0.46 e	0.63 e	0.56 e	1.72 d	1.90 d	1.88 d
PM_2	0.34 e	0.42 cd	0.38 e	0.55 d	0.86 bc	0.65 d	2.30 c	2.86 b	2.42 c
PTR_1	0.42 d	0.50 c	0.48 d	0.65 c	0.98 a	0.69 c	1.56 e	2.46 c	1.82 d
PTR_2	0.58 b	0.66 ab	0.65 a	0.89 a	1.00 a	0.94 a	2.44 b	2.80 b	2.74 b
$(SS+PM)_1$	0.22 g	0.40 d	0.38 e	0.45 e	0.71 de	0.52 f	0.72 h	1.50 g	1.20 e
$(SS+PM)_2$	0.36 e	0.54 bc	0.50 c	0.57 d	0.83 c	0.69 c	1.30 f	1.80 e	1.78 d
$(SS+PM)_3$	0.48 c	0.60 b	0.52 c	0.61 cd	0.91 b	0.85 b	1.34 f	1.92 d	1.80 d
RRF	0.31 f	0.42 e	0.34 e	0.64 c	0.68 de	0.65 d	0.66 g	0.98 g	0.88 f
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	0.018	0.018	0.018	0.031	0.031	0.031	0.031	0.031	0.031
LSD 1%	0.024	0.024	0.024	0.043	0.043	0.043	0.041	0.041	0.041
	Straw-Cd			Straw-Pb			Straw-Ni		
C	3.00 i	3.80 g	3.60 f	3.04 h	3.73 f	3.44 h	2.50 j	3.03 h	2.91 h
SS_3	5.20 b	5.60 b	5.40 b	3.57 g	3.98 e	3.90 g	3.16 h	3.39 f	3.05 g
SS_5	6.00 a	6.20 a	6.10 a	4.70 e	4.80 d	4.73 e	3.90 b	3.98 b	3.93 b
PM_1	4.60 c	5.00 c	4.80 cd	5.47 c	5.69 c	5.58 c	3.55 e	3.74 d	3.73 c
PM_2	5.20 b	5.40 b	5.30 c	6.46 b	6.87 b	6.51 b	3.64 d	3.99 b	3.92 b
PTR_1	3.40 e	4.00 f	3.90 e	4.70 e	5.33 cd	5.40 c	3.16 h	3.18 g	3.13 f
PTR_2	4.35 d	4.60 d	4.50 d	4.99 d	5.55 c	5.29 cd	3.28 g	3.75 d	3.35 e
$(SS+PM)_1$	4.40 c	4.60 d	4.50 d	4.37 f	4.88 d	4.72 e	3.4 1 f	3.84 c	3.4 4 e
$(SS+PM)_2$	5.20 b	5.40 b	5.30 c	4.57 cd	4.95 d	4.85 de	3.70c	3.80 c	3.77 c
$(SS+PM)_3$	5.40 b	5.60 b	5.50 b	7.07 a	7.24 a	7.18 a	4.19 a	4.91 a	4.47 a
RRF	3.20 g	3.90 f	3.80 e	4.12 g	4.75 f	4.53 f	2.67 i	3.51 e	3.67 d
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	0.139	0.139	0.139	0.04	0.04	0.04	0.04	0.04	0.04
LSD 1%	0.186	0.186	0.186	0.054	0.054	0.054	0.055	0.055	0.055

SS: Sewage sludge, PM: Poultry manure, PTR: Processed town refuse, C: Control, G: gypsum, S: sulphur, RRF: Recommended rates of mineral fertilizer. * significant , ** high significant

CONCLUSION

The organic manures in combination with agrochemical amendments have a significant influence on yield and yield components of flax crop .Their residual effects extends to the following soybean crop.

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الملخص العربي

تأثير المعاملة بالأسمدة العضوية و المحسنات الكيميائية الزراعية علي جودة ومحصول كلا من الكتان و فول الصويا تحت الظروف الحقلية

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أجريت هذه الدراسة تحت الظروف الحقلية بمحافظة كفر الشيخ في موسمين متتاليين صيف ١٩٩٩، وشتاء ٢٠٠٠ بهدف دراسة تأثير الإضافة السطحية لمخلفات الصرف الصحي بكفر الشيخ بعد المعالجة Sewage sludge (SS) بمعدل ٣ ، ٥% ، سماد الدواجن جمع من مزرعة كلية الزراعة بكفر الشيخ Poultry manure (PM) ، بمعدل ١، ٢ % و سماد

قمامة المدن المصنعة والذي احضر من مصنع السماد العضوي بالمنصورة Processed town refuse (PTR) بمعدل ١، ٢%والخلط بين حماة المجاري وسماد الدواجن (SS+PM) بنسبة (١: ١) بمعدل ١ ، ٢ ، ٣ %بالإضافة لمعاملة الكنترول و السماد المعدني الموصي (RRF) به لكل محصول. كل المعاملات أضيفت مع أو بدون الجبس بمعدل ٥ طن/للفدان والكبريت الزراعي بمعدل ٤٠٠كجم/للفدان وذلك علي إنتاجية ومكونات محصول الكتان مع دراسة الأثر المتبقي للإضافات السابقة علي إنتاجية ومكونات محصول فول الصويا. وتمت تلك الإضافات قبل زراعة الكتان.

ويمكن تلخيص النتائج كالآتي:

أدت إضافة الأسمدة العضوية منفردة أو مع المحسنات الزراعية إلى زيادة معنوية في إنتاجية كل من الحبوب والقش ومحصول الزيت للكتان.وأعطت المعاملة PM_2 بدون الجبس أو الكبريت أعلى قيمة في محصول القش بمعدل زيادة ٥٣ ، ٣٤ % مقارنة بالكنترول و آل RRF علي التوالي. وازداد محتوي القش والحبوب للكتان من العناصر الضرورية والثقيلة نتيجة لإضافة الأسمدة العضوية منفردة أو مع المحسنات الزراعية.و كان تركيز عناصر النيتروجين الفوسفور و البوتاسيوم في الحبوب أكثر من القش . وكان تركيز العناصر الثقيلة (الكادميوم ، النيكل ، الرصاص) أعلى في القش من الحدود العادية ولكن لم تصل إلى حد السمية.

أوضحت النتائج وجود زيادة معنوية نتيجة الأثر المتبقي لإضافة الأسمدة العضوية مع أو بدون المحسنات الزراعية على إنتاجية محصول فول الصويا (حبوب ، قش ، إنتاج الزيت) . وأعطت المعاملة$_3$(SS+PM) أعلى قيمة لمحصول الحبوب وهي ٢,٣١ ، ٢,٣٩ ، ٢,٤٢ طن/فدان بدون محسنات ، جبس و كبريت زراعي على الترتيب. وسجلت أعلى قيمة لمحصول القش و الزيت لفول الصويا كنتيجة للأثر المتبقي للمعاملات ($SS+PM_3$) وPM_2 بدون جبس وكبريت زراعي و SS_5 وPM_2 مع إضافة الجبس بينما كانت PM_2 , SS_5 مع الكبريت الزراعي على الترتيب.أزداد تركيز العناصر تحت الدراسة في الأجزاء المختلفة لفول الصويا معنويا نتيجة للأثر المتبقي للأسمدة العضوية مع أو بدون المحسنات الكيميائية وكانت في الحدود الآمنة ولم تصل إلى حد السمية.