J. Plant Production, Mansoura Univ., Vol. 5 (12): 2105- 2128, 2014

EFFECT OF REMEDIAL AND AMENDMENTS USES ON SOME BOTANICAL CHARACTRISTICS AND YIELD OF PEA AND sunflower PLANTS *Pisum sativum L*. and *Helianthus annus L*.

El-Emary , F. A.A[-1].and N.I.A. Talha[-2]

1. Dept. of Agric. Botany, Fac. of Agric., Assiut, Al-Azhar Univ. Egypt.

2. Soils, Water and Environ. Res. Inst.Sakha Agric., Res. Station, Egypt.

ABSTRACT

Two field experiments were carried out at Sakha Experimental Station, Kafr El-Sheikh Governorate during the two growing seasons, of 2012 and 2013 The effects of sewage sludge (SS), poultry manure (PM), processed town refuse (PTR), mixture of SS and PM, recommended rates of NPK, mineral fertilizers (RMF) without or with gypsum, or sulphur, on the certain Botanical characteristics and yield of pea plants were studied. In addition, the residual effects on the yield and its components of sunflower plants were investigated. Remedial and amendments were incorporated into the plowing soil (0-15 cm) before planting pea plants.

The obtained data can be summarized as follows:

1-D.W and Seed index were markedly increased by increasing the biosolids application rate. The application of SS_5 (without) agrochemicals, PM_2 with gypsum and PM_2 with sulphur produced the highest Dry weight.

2-Concentration of plastid pigments in the pea leaves were increased due to the application of **(**SS_5**)** and sulphur **.** Addition of remedial with or without agrochemicals increased, N, P, K, Cu, Mn, Zn. Heavy metals, Cd, Pb and Ni contents of straw were also increased compared with the control but less than the toxic limits for these plants.

3-SS_5, without; $(SS+PM)_3$ and with gypsum and PM2 with sulphur increased seed yield if compared to control. The application of SS_5 without agrochemicals, PM_2 with gypsum and PM_2 with sulphur produced the highest straw yield.

The residual effects due to remedial and amendments treatments showed that:-

4-Plant height; D.W were increased due to pre-incorporated $(SS+PM)_3$. Similarly, stem and head diameter recorded, highest values by PM_2 gypsum and sulphur in a descending order.

5-Plastid pigments Macro, Micro and Heavy metals, were also increased. The highest values plastid pigments were obtained in sulphur-sewage sludge pre-treated soils at the high levels. At the same time N, P and K content of different sunflower plants organs were higher in SS_5, (SS+PM)3 and PM2 respectively, in soil than those obtained in low rate of organic manure treatments.

6-The highest seed oil yield was obtained due to (PM_2 and SS_3) without application.

It could be concluded that remedial and amendments, i.e, SS_5, (without); PM2(with gypsum) and PM2 (with sulphur) have a significant influence on Botanical characteristics and yield of pea plants. Their residual effects extends to best botanical characteristics and yield of sunflower plants under the experimental condition.

Keywords*:* Botanical characteristic, remedial, amendments, pea, sunflower.

INTRODUCTION

How do you get best Botanical characteristics, highest yield and quality by using available materials under our Egyptian condition**?** There is no doubt the mineral fertilizers are essential in most cropping systems, if maximum yields are to be realized. It caused adverse effects on public health and the environment from the absence of waste management programmes in rural and urban areas.

Now days, the growers tended to use the natural sources of fertilizers and conditioners *via* using the sewage sludge and poultry manures as well as amendments; gypsum and sulphur, (Lorenz and_Maynard, 1980; Mengel and Kirkby, 1987; Hilal *et al,* 1990 and Raven and Loeppert, 1997)

Land application of sulphur to soil has an important role not only for chemical amelioration of alkaline soil, but also as fertilizer. Moreover, it plays several important roles in soils such as reducing soil pH, providing $SO_4^=$ to plants, and increasing availability of some nutrients._Recently, municipal sewage sludge has become more attractive for agriculture utilization because this material is characteristically high in the major plant nutrients N and P. However, this material may also contain high concentrations of heavy metals including Cd, Zn, Cu and other metals. There are few potentially toxic metals most likely to occur in sewage sludge and therefore, would be of our interest in protecting the food chain in agriculture systems; in particular Cd, Cu, Ni, Pb and Zn to a lesser extent As, Co, Mn and Mo (Alina *et al.,* 1995).

Legumes are also capable of symbiotic nitrogen fixation enriching the soil condition suitable for both mix and alternate cropping (Bromfiled,2001), a true multifunctional crop that may be used as green forage, forage dry matter, forage meal, silage, haylage, immature grain, straw and green manure (Mikic *et al.,* (2011). 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

Sunflower (*Helianthus annus. L*.) belonging to the family Asteraceae, is a major oil seed, used four important annual crops in the world for edible oil. Seeds of Sunflower contain 24-49% oil (Saleh *et al.,*2008). Omar and Abou Bakr (1991) studied the effect of three organic residues, e.g. fresh garbage, fresh compost and matured compost with or without NPK fertilizers on growth, yield and yield components, seed oil content and oil quality of sunflower cv. Mayak, The tested parameters were significantly increased due to application of different mineral fertilizers and/or organic materials added. .Application of NPK fertilizers through all sources was found by many authors to enhance yield quantitively and qualitatively of field crops Allievei *et al.,* 1993; Preer *et al.,* 1995; Baca *et al.,* 1995; Mahmoud *et al.,* 2001; Saleh *et al.,*2004; and Mohamed 2012.

The present study aimed to study the following:-

(**a**)The potential effects of different levels and types of remedial uses, e.g., sewage sludges (SS); poultry manures (PM) and processed town refuse (PTR) single or in combined additions (SS + PM) with or without some amendments conditioners, e.g., sulphur and gypsum on the botanical characteristics of pea plants (Morphological , physiological and yield)

(**b**)The residual effects of the treatment used on Botanical characteristics and yield of sunflower plants.

MATERIALS AND METHODS

Field experiments :

Two successive field experiments were assessed at the Experimental Farm of Sakha Agricultural Research Center. After harvesting the proceeding 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 lements 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 pea (Winter, 2012) and after harvesting, the same experimental plots were cultivated with sunflower (summer, 2013) 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 (own 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%	PMi	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	recommended rates of mineral fertilizers **	RMF

*** No amendments ** $N_{70}P_{15.5}$ $fed.^{-1}$ for pea $N_{45}P_{15.5}$ fed^{-1} for sunflower**

Sources and forms of remedial to (organic manures) and (agrochemical) amendment USES:

Air dried composite subsamples of anaerobically digested SS, i.e., remedial uses, 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 RMF. The rest 80% of the recommended P were also added during cultivation for the RMF treatments, i.e., conventional farming.

Table (1):Some characteristics of the tested soil, remedial and amendment uses.

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								
$CO_3^{=}$	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			
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	8i: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 biosolid ** 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 pea 35 kg fed^{-1},(*Pisum sativum L*.), cv. Progress No 9, (from Agriculture Research Center) were drilled into soil on December, 5^{lh}, 2012 and harvested in May, 5th, 2013. The experimental plot area was 15 m^2 (3 x 5) m and consisted of 5 rows with 60 cm spacing. Added biosolid and agrochemicals were incorporated into the soil (0-15 cm) before planting. Seeds inoculation` with infective and effective of strain *Rhizobium leguminosarum* biovar. The rest 80% of mineral N, i.e., 56 kg fed^{-1} urea-N

was added in four equal doses. The first dose was added 18 days after sowing before the first irrigation, while the other three splits, where added each 15 days. After 75 days of plant growths, plants collected; from each plot were hand pulled at random to assess the mean heights, as well as botanical chracrisitis and yield components of each plots.

Five kg fed^{-1} of sunflower seeds (*Helianthus annus L*.), cv. Giza 1 were grown on the same soil plots of the harvested pea crop by sowing in the last week of May during 2013 on hills, 3-4 seeds/hill, with 30 cm spacing and 50 cm wide ridges. After 21 days of germination (2-4 leaf stage), plants were thinned to one plants per hill and 48 kg fed^{-1} of urea-N was added. The first fraction, 24 kg N.was dressed after thing and the second, 24 kg N. was two weeks later. sunflower plants were harvested in the last week of Sep.2013 and the mean of following assessments of botanical characteristics and yield components were determined.

Botanical characteristics and yield components :-

At harvest a sample of five plants from every plot were chosen at random to measure the following characters:-

A-**Morphlogical** characteristics of pea and sunflower i.e, dry weight (D.W) (g)/ plant,Seed index weight 100(g) and Plant height(cm), Stem diameter(cm), Head diameter(cm),D.W stem(g)/plant and D.W leaves(g)/plant were recorded

B**-Physiologicai** characteristics of pea and sunflower, plastid pigments(chl.a, chl.b, total chl and carotenoids mg /g F.w leaves) according to Inskeep, and Bloom (1985): as well as Macro, Micro and heavy metal (N, P, K, Cu, Mn, Zn, Cd, Pb and Ni content in plant organs according to Snell and Snell (1977) were estimated.

c**- Yield and its components** of pea and sunflower including Seed yield (g) / plant**,** Seed yield (mg) $fed^{-1}$and Straw yield (kg) fed^{-1}, Seed yield(g)/plant**,** 100 Seed weight (g)**,** Seed yield (kg) $fed^{-1,}$ Oil yield (kg) fed^{-1} and Oil % in seeds were evaluated**.**

Collected pea and sunflower plants were washed with tap and distilled water, oven dried at 70°C for 24 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 sunflower seeds were determined according to AOAC (1980). The statistical analysis was done by using computer program. Data were tested by analysis of variance Duncans Multiple range test used to comparisons a many treatments means (Duncan, 1955). All statistical analysis were performed using analysis of variance technique by means of IRRISTAT Computer soft ware package.

RESULTS AND DISCUSSION

Effect of remedial and amendments uses on some botanical characteristics to pea plants

Morphological characteristics:

Data presented in Table (2) showed highly significant differences in morphological characteristics to pea plants 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 RMF but the increase was significantly less than with organically treated soils. The addition of biosolids and/or agrochemicals significantly increased D. W (g) / plant and Seed index Weight 100(g).. D. W (g) / plant and Seed index Weight 100(g) were markedly increased by increasing the biosolids application rate.

Data in Table (2) showed that the morphological with SS_5, without added agrochemicals, $(SS+PM)_3$ with gypsum and PM2 with sulphur was increased compared with the control. The application of SS_5 without agrochemicals, PM_2 with gypsum and PM_2 with sulphur produced the highest straw yield. The values were 15, 18 and 23.75 D. W (g) / plant , respectively.

The obtained results are in agreement with the findings of El-Saady (1991); Fatma Osman (1998) and Negm *et al.* (1998). They reported that application of sewage sludge at different rates, progressively and significantly increased the straw dry; seeds yield and fresh and dry yield of pea crop. Gendy *et al.* (1996) showed that soybean nodules, number and their dry weight responsed significantly to both gypsum and phosphate application alone or together. as well as positive effects on green pod yield and harvest index.

Physiological charactristics:

plasted pigments content:

Data in Table (3) show that, values of. total chl. ranged between 4.40 to 7.35, 4.49 to 7.64 and 4.96 to 7.63 (mg /g F.w for none, gypsum and sulphur treatments, respectively. In general, incorporated SS_5 and SS_3 without any agrochemicals, with gypsum or sulphur gave the Plastid pigments leave plants (Table 3). The above results are in harmony with those of El-Hindi *et al.* (2000) and Mohamed and Kandeel (1998). Table (3) also shows that highly significant interaction effect between agrochemicals (AC) and organic manures (B), i.e., (AC x B) on Plastid pigments in all treatments. With regard to the effect of biosolids, data emphasize that mixing SS_5 and SS_3 led to a significant increase with regard to the tested parameters over the control treatments. This might be due to the synergetic effect between SS5 and PM2 which has more contents of both total and active N and P (Table 4).

Macronutrients content:

Data listed in Table (4) revealed that, the N, P and K contents of pea plants organs were markedly increased due to the application of the different types and rates of organic manures and RMF as compared to the control. The contents of N, P and K of PEA seed were higher than straw.

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Also, data in Table (4) show that the N and P contents of PEA seed and straw were higher under application of RMF 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., 47.05; 47.50and47.78 and 4.85;5.15 and5.05 and11.00; 11.58 and 11.38 increased N, P and K contents of seed, respectively. 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 PEA seed and straw than those applied individually at the same rates which may be due to their synergetic or co-metabolizing effects.

Clearly the beneficial effects of sulphur by Mohamed and Kandeel (1998) of pea and sulphur and sewage sludge application on growth, productivity, the content of macro-nutrients, and heavy metals in the edible parts of spinach and pea as well as in the soil at the end of the experiments. The results indicated that application of sulphur had no significant effect, neither on growth or yield in both crops Arisha and Abd El-Bary (2000) add to Mashaly *et al.,* (1993) in bean shoots and grains.

Micronutrients content:

Results recorded in Tables (5 and 6) show that, Cu, Mn, Zn, Cd, Pb and Ni contents of different PEA organs were higher for application of organic manures to soil than those obtained with RMF.

Addition of gypsum to soil led to higher contents of micronutrients (Zn and Mn) of different PEA 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 pea organs (seed and straw) with sulphur treated soil were higher than those obtained with gypsum treated soil compared with the none agrochemicals treated soils.

Results in Tables (5 and 6) 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 microelements 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.

The abovementioned data Tables (5 and 6) show clearly the beneficial effects of gypsum and sulphur on quality of the different PEA 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 Grazabaky *et al.,* (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.

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Heavy metals content:

The above mentioned data in Tables (5 and 6) show clearly the beneficial effects of gypsum and sulphur on quality of the different PEA 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 Grazabaky *et al.,* (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.

Yield characteristics:

The addition of biosolids and/or agrochemicals significantly increased seed and straw yield. Seed and straw yield are also affected by types and rates of biosolids. Seed yield of pea/Mg kg^{-1} was markedly increased by increasing the biosolids application rate.

Table (7):Yield characteristics of pea plants as affected by remedial and amendments

Treat.	Agrochemicals uses								
	None	G	S	None	G	S	None	G	S
	Seed yield (g) / plant			Seed yield (mg) fed^{-1}			Straw yield (kg) fed^{-1}		
Control	20.60e	24.14ef	25.63e	2.42f	2.64f	2.71g	1.56e	1.61e	1.80f
SS_3	26.57ab	26.33ab	28.81b	3.08ab	3.13ab	3.18d	1.79bc	1.86cd	1.93cd
SS_5	26.66ab	26.94ab	29.22a	3.15a	3.24a	3.33ab	1.93a	1.96bc	2.08bc
PM_1	25.10cd	25.11c-f	25.50c	2.95b	2.96c	3.00de	1.60d	1.64de	2.04c
PM_2	25.33c	26.61b	29.56a	2.98b	3.13ab	3.84a	1.73c	2.21a	2.85a
PTR_1	24.20d	24.47def	25.36de	2.61e	2.71e	2.85ef	1.58d	1.65de	1.80d
PTR_2	25.79c	26.07b	27.17e	2.63e	2.88d	2.92e	1.62d	1.69d	1.88d
$(SS+PM)_1$	24.14d	24.29def	24.46cd	2.77d	2.86d	2.88cd	1.59d	1.62e	1.74ef
$(SS+PM)_2$	24.91d	26.26b	26.72c	2.93bc	3.08b	3.09d	1.67c	1.74d	1.87d
$(SS+PM)_3$	27.18a	27.47a	27.77c	3.10ab	3.24a	3.25c	1.83b	1.84cd	2.06bc
RMF	25.34c	25.81c	25.72d	2.83c	2.89cd	2.98de	1.60d	1.65de	1.76e
F test (c)	ns	ns	ns	ns	ns	ns	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
ACxB	**	**	**	**	**	**	**	**	**
LSD 5%	2.170	2.170	2.17	0.254	0.254	0.254	0.157	0.157	0.157
LSD 1%	2.918	2.918	2.918	0.342	0.342	0.342	0.209	0.209	0.209

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

Data in Table (7) showed that the seed yield with SS_5, without added agrochemicals, $(SS+PM)_3$ with gypsum and PM2 with sulphur was increased if compared to control by 37; 19 and 16%, respectively. The application of SS_5 without agrochemicals, PM_2 with gypsum and PM_2 with sulphur produced the highest straw yield. The values were 1.93, 2.21 and 2.85 Mg fed^{-1}, respectively. These obtained results were in agreement with these of many investigators, such

as El-Saady (1991), Fatma Osman (1998); Mohamed and Kandeel (1998). and Negm *et al.* (1998) .

Residual effects of remedial and amendment uses on some botanical characteristics with sunflower plants

Morphological characteristics:

Morphological characteristic of sunflower plants, i.e., Plant height, Stem diameter and Head diameter are affected by types and rates of pre-incorporated, recommended fertilizers and agrochemicals. The obtained data in Table (**8**) showed that significant differences in morphological characteristic of sunflower was recorded, the highest values were obtained by PM_2 (269.50, 282.50 ' 290.00 ' 1.56, 1.62, 1.82, 22.00, 23.00 and 23.30) of the alone, gypsum and sulphur treatments, respectively.

Dry matter leaves and stems of sunflower plant were significantly increased by previous biosolids and agrochemical application (after pea crop) at any type or rate. The positive residual effects of both SS_5 and $(SS + PM)_3$ treatments were always higher than PM, PTR and control treatments. These results as a harmony with these obtained by Omar and Abou Bakr (1991); Mahmoud *et al.* (2001); Radwan (1991) and Mohamed, (2012).

Physiological characteristics:

Plasted pigments CONTENT:

The results in **Table**(**9**) show that residual organic manures at the different types and rates with or without agrochemicals gave the highest plastid pigments content in leaves of sunflower plants compared to control. The residual effect of organic manures and agrochemicals amendments was accompanied with significant increases in total chl. 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 Abdel-Sabour(1999) and Mohamed, (2012).

2-B.2. Macronutrients content:

Data demonstrated in Table (10) show that the N, P and K contents of sunflower plants 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 RMF.

Data show that the N, P and K content of different sunflower PLANTS organs were higher in SS_5, (SS+PM)3 and PM2 respectively, in 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 was lower in RMF-soil than in organic treated soil. The NPK, contents of different sunflower 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. Mahmoud *et al.,* (2001) on sunflower and Abd-Allah (1998) with sugar beet plant.

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Table (10):N, P and K contents, (g kg^{-1} dry weight) OF sunflower plants as affected by remedial and amendments.

Treatments	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Seed-N			Seed-P			Seed-K		
Control	37.0 f	37.5 g	40.4 e	7.8 e	7.9 d	8.4 c	6.0 d	6.4 f	8.0 bc
SS3	39.0 de	43.5 c	44.8 ab	8.0 d	8.4 cd	8.7 c	6.5 bc	6.8 ef	8.2 ab
SS5	43.8 a	44.1 b	44.8 ab	8.6 ab	8.7 a	8.8 bc	6.6 b c	6.9 ef	8.6 a
PM1	37.3 f	38.0 g	41.4 d	8.4b	8.6 abc	8.7 bc	6.8 bc	6.9 ef	8.5 ab
PM2	40.3 a	46.9 a	49.7 a	8.6 ab	8.8 a	9.0 ab	7.4 a	7.6 ab	8.7 a
PTR1	38.1 f	40.6 e	45.3 d	8.0 cd	8.3 a-d	8.5 c	6.6 bc	7.0 de	8.2 ab
PTR2	38.6 f	43.4 bc	46.4 bc	8.3 bc	8.5 ab	8.6 c	7.6 a	7.4 cd	8.4 ab
(SS+PM)1	40.7 c	41.6 de	42.6 c	8.0 cd	8.2 bcd	8.6 bc	6.0 d	7.6 bc	7.8 c
(SS+PM)2	42.3 b	42.8 cde	43.8 bc	8.4 b	8.8 abc	9.0 ab	6.8 bc	8.0 ab	8.1 bc
(SS+PM)3	43.6a	45.2 ab	46.9 bc	8.8 a	9.2 a	9.2 a	7.0 b	8.2 a	8.4 ab
RMF	43.7 a	44.0 bc	44.5 bc	8.6 ab	8.8 a	9.0 ab	6.4 cd	6.6 ef	6.8 d
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	1.97	1.97	1.97	0.43	0.43	0.43	0.46	0.46	0.46
LSD 1%	2.68	2.68	2.68	0.58	0.58	0.58	0.62	0.62	0.62
	Leaves-N			Leaves-P			Leaves-K		
Control	16.0 e	17.6 e	18.1e	1.7 h	2.2 f	2.4 g	33.2 f	35.1 g	37.6 d
SS3	19.0 c	20.0 d	20.2 c	2.0 g	2.4 e	2.5 ef	35.9 b	45.1 c	42.5 fg
SS5	21.3 a	21.8 b	28.8 a	2.3 f	3.0 bc	3.1 d	36.2 b	43.6 a	55.3 a
PM1	14.2 e	16.6 b	21.0 f	2.4 ef	2.7 d	3.3 cd	35.2 de	38.2 d	41.2 g
PM2	18.7 c	19.5 a	24.2 d	2.9 bc	3.0 bc	3.3 cd	39.8 a	47.4 b	49.2abc
PTR1	16.2 c	19.6 cd	20.2 e	2.2 c	2.9 b	3.1 g	37.6 e	40.2 d	41.0 c
PTR2	19.9 b	20.7 c	23.0 c	2.5 cd	3.0 bc	3.4 fg	38.1 de	41.2 d	43.0 a
(SS+PM)1	17.4 d	18.5 d	19.9 d	2.6 c	2.8 cd	2.9 e	36.0 cd	37.3 f	39.3 efg
(SS+PM)2	17.6 d	19.1 b	21.6 d	2.8 bc	3.0 bc	3.1 d	33.9 cd	38.3 f	39.6 def
(SS+PM)3	19.6 c	19.9 b	21.9 c	3.4 b	4.3 a	5.2 a	37.9 b	39.9 e	42.2 def
RMF	17.1 d	18.0 e	18.5 d	3.5 a	3.6 b	3.7 b	40.0 c	41.0 de	41.5 b
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	0.599	0.599	0.599	0.26	0.26	0.26	1.11	1.11	1.11
LSD 1%	0.807	0.807	0.807	0.35	0.35	0.35	1.49	1.49	1.49

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

2-B.2. MIcronutrients content:

Data presented in Tables (11 and 12) show that the magnitude of Zn, Mn, Cu, Cd, Ni and Pb in different sunflower organs (seeds and straw) cultivated in soil RMF 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 sunflower organs were higher in organic treated soil than those obtained in RMF. With regard to agrochemical treated soils combined with the same organic manures and RMF, micronutrients and heavy metals of sunflower 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 (11 and 12) 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 sunflower 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 sunflower organs than those obtained by the same rate of the individual organic manures.
The above-mentioned data Tables (11and 12) show clearly the beneficial effects of gypsum and sulphur on different sunflower 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.

Table (11): Zn, Mn, and Fe contents, (mg kg^{-1} dry weight) of sunflower plants as affected by Remedial and amendments.

Treatments	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Seed-Zn			Seed-Mn			Seed-Fe		
Control	32.0 h	36.0 g	42.0 f	11.0 g	12.0 g	13.0 f	47.0 f	55.0 e	58.0 f
SS3	40.0 de	46.0 d	56.0 c	14.0 e	18.80 d	19.0 d	56.0 c	66.0 c	68.0 d
SS5	54.0 a	62.0 a	66.0 b	18.0 c	22.0 c	24.3 c	69.0 a	72.0 a	78.0 b
PM1	38.0 ef	48.0 c	50.0 d	12.0 f	15.50 e	20.0 d	63.0 b	64.0 c	68.0 c
PM2	52.0 ab	54.0 bc	57.5 c	14.0 e	18.8 d	24.0 c	68.0 ab	72.0 b	74.0 bc
PTR1	34.0 ef	38.0 fg	50.0 d	12.0 f	14.0 f	16.0 e	55.0 c	65.0 c	72.0 c
PTR2	39.0 cd	42.0 e	60.0 bc	16.0 d	18.0 d	24.0 c	68.0 ab	69.0 b	84.0 a
(SS+PM)1	35.5 g	39.0 f	56.0 c	16.0 d	18.0 d	20.0 d	53.0 d	64.0 c	66.0 d
(SS+PM)2	44.0 c	48.0 c	68.0 a	20.0 b	24.0 b	28.0 b	55.0 c	69.0 b	72.0 c
(SS+PM)3	46.0 b	56.0 b	70.0 a	26.0 a	26.0 a	30.0 a	64.0 b	72.0 a	74.0 bc
RMF	36.0 fg	40.05 ef	47.0 e	13.0 e	15.0 e	16.0 e	50.0 e	60.0 d	62.0 e
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	2.384	2.384	2.384	1.977	1.977	1.977	3.346	3.346	3.346
LSD 1%	3.208	3.208	3.208	2.623	2.623	2.623	4.475	4.475	4.475
	Leave-Zn			Leave-Mn			Leave-Fe		
Control	30.0 f	36.0 g	38.0 e	36.0 g	40.0 i	46.0 g	330 d	364 f	366 f
SS3	36.0 d	46.0 c	53.0 b	64.0 c	72.0 c	76.0 c	352 d	474 e	572 c
SS5	47.0 a	53.0 a	58.0 ab	76.0 a	84.0 a	90.0 a	414 c	524 cd	644 ab
PM1	35.0 d	37.0 e	40.0 d	39.0 f	46.0 h	66.0 d	366 d	458 e	496 de
PM2	43.0 b	48. 0 bc	50.0 bc	52.0 d	76.0 b	86.0 b	446 bc	498 d	512 de
PTR1	33.0 e	36.0 f	45.0 c	66.0 bc	68.0 d	86.3 b	416 c	561 bc	618 b
PTR2	40.0 c	45.0 cd	50.0 bc	69.0 b	84.0 a	92.0 a	482 b	655 a	676 a
(SS+PM)1	32.0 ef	38.0 de	40.0 d	42.0 e	56.0 e	58.0 e	338 d	462 b	503 e
(SS+PM)2	42.0 c	46.0 c	50.0 b	44.0 e	66.0 de	68.0 d	446 bc	500 cd	531 d
(SS+PM)3	48.0 a	50.0 b	60.0 a	52.0 d	74.0 b	76.0 c	572 a	586 b	664 a
RMF	33.0 e	38.0 e	40.0 d	39.0 f	48.0 g	52.0 f	426 c	578 b	636 ab
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	3.120	3.120	3.120	2.829	2.829	2.829	37.624	37.624	37.624
LSD 1%	4.213	4.213	4.213	3.799	3.799	3.799	50.551	50.551	50.551

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

2.B-4. Heavy metals content:

Results in Tables (11 and 12) 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 sunflower 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 sunflower organs than those obtained by the same rate of the individual organic manures.

The above-mentioned data Tables (11and12) show clearly the beneficial effects of gypsum and sulphur on different sunflower 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 Baca *et al.* (1995); Preer *et al.,* (1995) ; Abdel-Sabour *et al.,* (1999) and Tlustos *et al.* (2001) and Abari *et al.,* in sunflower plants and Jung and Logan (1992) in sudax [*Sorghum biocolo* (*L.*)] Moench.

Data showed also that appreciable amounts of macro and micronutrients were found at lower extents. On the other hand, the contents of heavy metals in leaves and stems were higher than the seeds and still less than the toxic limits for plants.

The differences in the residual effect of biosolids may be due to their nature and chemical composition as well as the degree and rates of decomposition. However, the obtained values of Fe, ZN, Cu, Mn, Ni, Cd and Pb concentrations lie within the normal levels

2-C-Yield characteristics:

Sunflower seed, Oil yield and Oil % are affected by types and rates of pre-incorporated, recommended fertilizers and agrochemicals. The obtained data showed that significant differences in seed yield of sunflower was recorded, the highest seed yield was obtained by PM_2 (2.56, 2.90 and 2.93 Mg fed^{-1}) of the alone, gypsum and sulphur treatments, respectively. The PM_2 treatment surpassed that of the control by 53%, PM_2 55% and PM_2 with sulphur surpassed that of the control by 35%.

The obtained data of seed oil percentage and contents were significantly affected by type and rate of pre-incorporated biosolids, recommended fertilizers and agrochemicals uses.

The highest seed oil yield (747.52 kg fed^{-1}) was obtained by application of PM_2 without agrochemicals, gypsum application 821.86 kg fed^{-1} was obtained by SS_5 and with added sulphur existed 932.32 kg fed^{-1} was obtained by PM_2. The highest percentage of oil 37.4; 33.8 and 35.1% were obtained by SS_3 for the alone, gypsum and sulphur treatments, respectively. It could be concluded that residual effect of both biosolids, recommended mineral fertilizes with or without agrochemicals exerts synergistic effect on oil yield obtained and oil %,similar resuls were obtained by Abari *et al.,* (2011) and Mohamed (2012).

The analytical results in Table (13) indicated that the highest values of seed yield/fed. were recorded with sulphur2.93 and gypsum 2.90 compared to the untreated soils (control) 2.56 kg fed^{-1}.

Under application of gypsum or sulphur as conditioners with or without co-incorporated organic manures there was an increase in sunflower 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 Omar and Abou Bakr (1991) ; Mahmoud *et al.,* (2001) ; Allievei *et al.,* (1993); Abdel-Sabour *et al.,* (1999); Abari *et al.,* (2011) and Mohamed (2012).

Significant differences in yield and yield components of sunflower plants, which cultivated after pea plants. 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 RMF. The yield and yield components of sunflower plants obtained with residual of both organic manures and gypsum or sulphur were dramatically increased over the none received agrochemicals**.**

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CONCLUSION

Remedial and amendments, i.e, SS_5, (without); PM2(with gypsum) and PM2 (with sulphur) have a significant influence on Botanical characteristics and yield of pea plants. Their residual effects extends to best botanical characteristics and yield of sunflower plants under experimental condition.

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

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اثر الاستخدامات ألعلاجيه و المحسنات علي بعض الخصائص النباتيه و المحصول لنباتات البسلة و دوار الشمس

فؤاد عبد الله احمد العمرى[١] وناصر إبراهيم علي طلحة[٢]

١- قسم النبات الزراعي ـ كلية الزراعة بأسيوط- جامعة الأزهر ـ مصر

٢- معهد بحوث الأراضى والمياه والبيئة ـ محطة بحوث سخا ـ مصر

أجريت هذه الدراسة تحت الظروف الحقلية لمحطه بحوث سخا بمحافظة كفرالشيخ فى موسمين متتاليين شتاء ٢٠١٢وصيف ٢٠١٣ بهدف دراسة تأثير الإضافة السطحية لمخلفات الصرف الصحى Sewage sludge (SS) ، سماد الدواجن Poultry manure (PM) ، وسماد قمامة المدن المصنعة Processed town refuse (PTR) والخلط بين حمأة المجارى وسماد الدواجن (SS + PM) بالإضافة لمعاملة الكنترول والسماد المعدنى الموصى (RMF) به لكل محصول. كل المعاملات أضيفت مع أو بدون الجبس والكبريت الزراعى وذلك على الخصائص النباتيه(المورفولوجيه- الفسيولوجيه) و المحصول لنباتات البسله مع دراسة الأثر المتبقى للإضافات السابقة على الخصائص النباتيه و المحصول لنباتات دوار الشمس.علما بانه قد تمت تلك الاضافات كلها قبل الزراعة للمحصول الاول.

ويمكن تلخيص النتائج كالآتى:

١. عند إضافة الأسمدة العضوية منفردة أو مع المحسنات الزراعية و المعالجات تاثرت معنويا كل الخصائص المورفولوجيه لنباتات البسله. وان مقدار الزياده في تلك الخصائص يزداد بزياده معدل الاضافه من المحسنات و المعالجات و بخاصه مع اضافه SS5 بدون Agroch و٣(SS +PM)مع الجبس و كذلك PM٢ مع الكبريت مقارنه بالكنترول. بينما اعطت النتائج اعلي القيم مع دليل البذورعند استخدام المعامله PM٢ مع الجبس.

٢. تحسنت الخصائص الفسيولوجيه حيث ازداد محتوي الاوراق من الصبغات النباتيه وبخاصه عند المعامله SS5 مع الكبريت و مع ان هناك زياده واضحه في مقدار العناصر الضرورية الكبري والصغري وكذلك العناصرالثقيلة في كل من البذور و القش نتيجة لإضافة الأسمدة العضوية منفردة أو مع المحسنات الزراعية الا ان تركيز كل من النتروجين والفوسفور والبوتاسيوم كان فى البذور أكثر من القش. في الوقت الذي كانت فيه تركيز العناصر الثقيلة فى القش أعلى لكنها كانت في الحدود الامنه و لم تصل إلى حد السمية.

٣. -اعطي محصول البذور ارقاما معنويه مع كل من SS_5 (بدون) و $_3$(SS+PM) مع الجبس وPM2 مع الكبريت.اما محصول القش فقد سجل زياده معنويه عند اضافهSS_5(بدون) و PM2 مع الجبس وكذلك PM2مع الكبريت.

٤. احدث التاثير المتبقي لكل من المعاملات تحسنا لكل الخصائص النباتيه لنباتات دوار الشمس وكان ذلك واضحا في الخصائص المورفولوجيه و هي(طول النبات- المادة الجافه للساق- المادة الجافه للاوراق)باستخدام $_3$(SS+PM).في حين اعطي كل من(قطر الساق-قطر القرص) زياده معنويه باستخدام المعامله PM2 حيث جائت اعلي هذه النتائج علي هذا الترتيب منفردا و مع الجبس و كذلك مع الكبريت مع تلك المعاملتين.

٥. كما احدث هذا التاثيرتفوقا واضحا في التقديرات الفسيولوجيه للاوراق مع ملاحظه انه في الوقت الذي ازدادت فيه قيم العناصر الضرورية الكبري والصغري وكذلك العناصرالثقيلة في الأعضاءالمختلفة لنباتات دوار الشمس (البذور و القش) و بخاصه مع المعاملات الاتيه:- SS_5 و $_3$(SS+PM) و كذلك المعامله PM2 علي التوالي.

٦. -ترتب علي كل ما سبق زياده في محصول الزيت وكذلك % للزيت مع كل المعاملات وبخاصه مع المعامله PM2 مع الكبريت و SS_5(بدون) .

و اخيرا توصي الدراسه بانه عند استخدام المعاملات SS5 (بدون) و PM2 مع الجبس و كذلكPM2 مع الكبريت قبل زراعه البسله فقد تحسنت كل الخصائص النباتيه والمحصول لنباتات البسله .واحدث التاثير المتبقي من تلك المعاملات مضاف اليها نباتات البسله زياده معنويه ملحوظه في كل الخصائص النباتيه المدروسه والمحصول لنباتات دوار الشمس تحت نفس ظروف الدراسه.

Table (8): Morphological characteristic of sunflower plants as affected by remedial and amendments

Treatments	Agrochemicals uses														
	None	G	S	None	G	S	None	G	S	None	G	S	None	G	S
	Plant height(cm)			Stem diameter(cm)			Head diameter(cm)			D.W stem(g)/plant			D.W leaves(g)/plant		
Control	230.00c	237.50d	240.75c	1.22e	1.30f	1.39df	16.70d	18.58c	19.00d	116.80e	142.16f	146.53de	35.80c	40.41d	42.36c
SS_3	236.50c	269.25abc	289.00ab	1.39bc	1.47cd	1.48cd	18.63cd	21.05ab	21.50abc	139.19cd	148.66f	153.80de	47.73ab	48.94bcd	56.37ab
SS_5	271.75ab	272.09abc	275.75ab	1.43b	1.54b	1.56ab	19.38bc	22.25a	22.40ab	166.48a	188.40e	197.33e	53.50ab	58.71ab	62.30ab
PM_1	237.25c	267.00abc	282.00ab	1.48ab	1.53bc	1.81a	20.8bc	21.75ab	22.28ab	183.49ab	191.10ab	211.95bc	42.33bc	42.72cd	48.92abc
PM_2	269.50ab	282.50abc	290.00a	1.56a	1.62a	1.82a	22.00a	23.00a	23.30a	187.90a	212.99ab	214.22a	44.03abc	53.16abc	53.66abc
PTR_1	252.50bc	263.00bc	274.00ab	1.30de	1.38de	1.41e	18.50bc	20.38c	20.63bcd	124.56de	181.47de	186.06c	43.66abc	44.72bcd	47.71bc
PTR_2	266.75ab	275.50ab	287.75ab	1.42c	1.43de	1.48cd	21.05ab	21.50ab	22.033ab	131.96de	196.03bc	199.71bc	44.47abc	49.61bcd	49.91abc
$(SS+PM)_1$	253.00bc	267.50abc	274.50ab	1.35c	1.42de	1.44d	20.38bc	20.50abc	21.50abc	129.50c	155.76c	166.74f	43.28ab	49.73abc	50.23abc
$(SS+PM)_2$	260.75ab	271.00abc	275.75ab	1.45bc	1.46cd	1.48cd	20.78bc	21.88ab	21.93abc	154.71b	169.62cd	184.82d	53.50ab	55.44ab	57.88ab
$(SS+PM)_3$	279.75a	284.50a	286.50ab	1.46bc	1.48bc	1.61bc	21.63ab	22.63a	23.25a	189.09a	207.07a	217.09a	55.20a	60.16a	63.22a
RMF	257.50abc	260.25c	263.00b	1.32d	1.34e	1.35e	18.95d	19.45bc	19.70cd	136.17cd	138.75f	141.38ef	54.00ab	54.07abc	54.26abc
F test (c)	**	**	**	NS	NS	NS	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
ACxB	**	**	**	**	**	**	**	**	**	**	**	**	<1	<1	<1
LSD 5%	21.718	21.718	21.718	0.084	0.084	0.084	2.073	2.073	2.073	16.152	16.152	16.152	10.6114	10.6114	10.6114
LSD 1%	29.334	29.334	29.334	0.113	0.113	0.113	2.753	2.753	12.753	22.029	22.029	22.029	14.2556	14.2556	14.2556

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

Table (9): Chl.a, chl.b, total chl. and carotenoids contents, (mg /g F.w leaves) of sunflower plants as affected by remedial and amendments

Treatments	Agrochemicals uses											
	None	G	S	None	G	S	None	G	S	None	G	S
	chl.a			chl.b			total chl.			carotenoids		
Control	1.90 cd	1.95e	1.99 d	1.00 de	1.03de	1.05e	2.90 d	2.98 d	3.04cd	1.08e	1.15f	1.21e
SS_3	3.15 a	3.19a	3.20 a	1.83b	1.90b	1.93ab	4.98ab	5.09 ab	5.13ab	1.68ab	1.70a	1.80 ab
SS_5	3.12ab	3.20a	3.22a	1.87a	1.92a	1.96 a	4.99a	5.12a	5.18a	1.69ab	1.75a	1.82a
PM_1	2.48bc	2.51c	2.54bc	1.25bc	1.28bc	1.29 cd	3.73 bc	3.79bc	3.83ab	1.39bc	1.40b	1.51c
PM_2	3.15 a	3.18a	3.21a	1.83b	1.91b	1.92 ab	4.98 ab	5.09ab	5.13a	1.66bc	1.68ab	1.71ab
PTR_1	2.85ab	2.89b	2.92b	1.35b	1.38b	1.39 bc	4.20b	4.27b	4.32 c	1.56ef	1.57bc	1.58bc
PTR_2	3.15a	3.18a	3.20 a	1.81a	1.90a	1.90ab	4.96ab	5.08ab	5.10ab	1.67cd	1.70a	1.78ab
$(SS+PM)_1$	1.91cd	1.95e	1.98 d	1.01 d	1.02d	1.06e	2.92 de	2.97cd	3.04cd	1.09d	1.15c	1.20 de
$(SS+PM)_2$	2.23 c	2.28d	2.32cd	1.12cd	1.14cd	1.15de	3.35cd	3.42bc	3.47abc	1.23de	1.30cd	1.36de
$(SS+PM)_3$	2.49bc	2.54c	2.56b	1.27c	1.29c	1.31c	3.76 cd	3.83abc	3.87bcd	1.41bc	1.45b	1.51cd
RMF	2.82 b	2.86b	2.92ab	1.34 b	1.38 b	1.40ab	4.18bc	4.24abc	4.32ab	1.57bc	1.58abc	1.59ab
F test (c)	**	**	**	NS	NS	NS	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**	**	**	**
ACxB	**	**	**	**	**	**	**	**	**	**	**	**
LSD 5%	0.17	0.18	0.19	0.09	0.09	0.10	0.02	0.01	0.01	0.10	0.11	0.12

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

Table (2):Morphological characteristics of pea plants as affected by remedial and amendments treatments

Treatments	Agrochemicals uses								
	None	G	S	None	G	S	None	G	S
	D. W (g) / plant			Seed index Weight 100(g)			Protein%		
Control	13.30bc	13.62bc	13.81c	25.37 f	25.46g	27.70e	24.16e	25.44ab	26.63bc
SS_3	13.38ab	14.47c	15.25b	28.95cd	29.83d	32.95b	24.94a	25.52d	26.46a
SS_5	15.00a	15.50bc	15.76bc	29.04c	31.53c	32.39b	26.32a	27.96bcd	28.72b-e
PM_1	13.60abc	13.73b	13.97c	26.12e	26.91f	31.65b	26.06cde	27.92ab	28.66b-e
PM_2	14.49abc	18.20a	23.75a	27.80e	28.84e	34.92a	27.05bcd	28.27a	30.00bcd
PTR_1	13.11abc	13.17c	14.87bc	28.07cd	29.51d	29.90d	24.85de	25.14d	25.83e
PTR_2	13.47c	13.55c	15.15bc	31.30ab	30.37cd	30.90c	26.24cde	26.24abc	26.91cde
$(SS+PM)_1$	12.93c	13.50c	13.60c	27.46d	30.49cd	31.16c	25.27abc	26.61cd	26.93de
$(SS+PM)_2$	13.86abc	13.89bc	13.98c	30.29b	31.33c	32.98b	26.94b-e	27.12a	27.65b-e
$(SS+PM)_3$	15.00ab	15.45bc	15.83bc	31.02ab	33.08a	33.81ab	27.55a-d	28.46a	29.02b-e
RMF	13.58abc	14.08bc	14.99bc	32.57a	32.70b	32.95b	29.47ab	29.69ab	29.86b
F test (c)	*	*	*	*	*	*	*	*	*
Bio (B)	**	**	**	**	**	**	**	**	**
ACxB	**	**	**	**	**	**	**	**	**
LSD 5%	2.630	2.630	2.630	2.001	2.114	2.114	2.501	2.501	2.501
LSD 1%	2.756	2.756	2.756	2.830	2.830	2.830	3.343	3.343	3.343

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

Table (3): Chl.a , chl.b, total chl. and carotenoids contents, (mg /g F.w leavs) OF PEA plants as affected by remedial and amendmens

Treatments	Agrochemicals uses											
	None	G	S	None	G	S	None	G	S	None	G	S
	chl.a			chl.b			total chl.			carotenoids		
Control	2.33f	2.38f	2.44f	2.07g	2.11g	2.15g	4.40g	4.49g	5.59g	1.01f	1.02f	1.03e
SS_3	3.78b	3.84b	3.86b	3.26b	3.26b	3.27b	7.04b	7.10b	7.13b	1.18b	1.21b	1.23b
SS_5	4.34a	4.29a	4.24a	3.31a	3.35a	3.39a	7.35a	7.64a	7.63a	1.37a	1.42a	1.47a
PM_1	3.20d	3.21d	3.22d	2.87d	2.85d	2.82d	6.07e	6.06e	6.04e	1.11d	1.11de	1.12e
PM_2	3.70b	3.73b	3.77b	3.10b	3.13b	3.16b	6.80b	6.86b	6.93b	1.13b	1.16b	1.18b
PTR_1	2.69e	2.80e	2.91e	2.31e	2.40e	2.49e	5.00f	5.20f	5.40f	1.07e	1.08ef	1.09f
PTR_2	2.69e	2.78f	2.78f	2.15f	2.27f	2.38f	4.84g	5.05g	5.16g	1.06e	1.08ef	1.09f
$(SS+PM)_1$	2.58e	2.64e	2.66e	2.24f	2.27f	2.30f	4.82f	4.91f	4.96f	1.05e	1.07ed	1.09d
$(SS+PM)_2$	3.11d	3.14d	3.17d	2.75e	2.76e	2.77e	5.85e	5.90e	5.94e	1.07d	1.09d	1.10d
$(SS+PM)_3$	3.77b	3.78b	3.79bc	3.25b	3.30ab	3.35a	7.02c	7.08c	7.14c	1.13c	1.13c	1.14d
RMF	3.66c	3.69c	3.71c	3.06c	3.13c	3.19c	6.72d	6.82d	6.90d	1.14c	1.16c	1.17c
F test (c)	**	**	**	NS	NS	NS	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**	**	**	**
ACxB	**	**	**	**	**	**	**	**	**	**	**	**
LSD 5%	**0.36**	**0.26**	**0.22**	**0.08**	**0.16**	**0.15**	**0.42**	**0.42**	**0.43**	**0.06**	**0.05**	**0.06**

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

NS not significant * significant, ** high significant

Table (4):N, P and K contents, (g kg^{-1} dry weight) of pea plants as affected by remedial and amendments

Treatments	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Seed-N			Seed-P			Seed-K		
Control	38.65 e	39.10 ab	40.40 ab	4.30 c	4.90 abc	4.75 ab	9.45 d	10.43 c	9.83 c
SS3	41.90 ab	45.72 cd	47.95 bc	4.80 abc	4.83 bc	5.00 a	10.40 bcd	11.18 c	10.60 abc
SS5	43.50 a	48.13 bcd	51.13 a	5.00 a	5.43 a	5.00 a	10.68 a	12.30 c	11.45 ab
PM1	41.70 de	45.28 abe	46.85 bc	4.40 bc	5.08 ab	4.60 ab	10.50 bcd	11.64 bc	11.15 abc
PM2	43.28 b-e	46.42 a	48.08 bc	4.80 abc	5.10 ab	4.85 ab	11.23 ab	13.08 a	11.65 ab
PTR1	40.98 cde	41.23 d	42.33 c	4.43 abc	4.65 bc	4.54 b	9.77 cd	10.70 c	10.30 bc
PTR2	42.25 cde	43.18 a-d	45.05 bc	4.90 ab	5.00 ab	4.95 ab	10.10 bcd	11.45 b c	10.6 0 bc
(SS+PM)1	40.10 b-e	41.98 d	43.80 c	4.48 abc	4.88 c	4.55 ab	10.50 abc	11.85 bc	10.85bc
(SS+PM)2	44.08 a-d	44.80 ab	47.22 bc	4.53 abc	4.98 bc	4.78 ab	11.25 ab	12.00 bc	11.59 bc
(SS+PM)3	43.23 a-d	45.73 a	48.23 bc	4.68 abc	5.00 bc	4.88 ab	11.45 ab	12.10 ab	11.78a
RMF	47.05 abc	47.50 ab	47.78 ab	4.85 abc	5.15 ab	5.05 a	11.00 ab	11.58 bc	11.38ab
F test (c)	*	*	*	*	*	*	ns	ns	ns
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	ns	ns	ns	**	**	**
LSD 5%	4.41	4.41	4.41	0.49	0.49	0.49	1.28	1.28	1.28
LSD 1%	5.88	5.88	5.88	0.65	0.65	0.65	1.73	1.73	1.73
	Straw -N			Straw-P			Straw-K		
Control	16.60 f	17.75	20.65 ef	1.10 d	1.33 d	1.33 e	5.90 e	6.78 f	8.48 d
SS3	17.23 b	17.60 c	22.10 f	1.35 bc	1.50 cd	1.40 d	7.80 cd	7.98 e	8.80 cd
SS5	17.63 a	20.00 c	26.20 a-d	1.38 ab	1.65 cd	1.45 cd	8.70 a	11.25 cde	11.70 a
PM1	17.30 ef	18.00 bc	18.48 c-f	1.20 ab	1.70 d	1.48 cd	8.05 cd	10.28b	10.50 ab
PM2	18.00 def	18.63 abc	19.05 c-f	1.35 a	1.90 cd	1.65 de	8.40 c	11.10a	11.75 a
PTR1	18.18 cde	18.63 abc	19.33 def	1.45 bc	1.58 bcd	1.50 c	7.40 cd	7.90 e	8.20 d
PTR2	19.03 bc	20.23 a	20.30 b-f	1.48 bc	1.63 a bc	1.58 b	7.80 cd	8.30 de	8.80 d
(SS+PM)1	19.70 cd	20.00 ab	20.43 abc	1.33 cd	1.48 bcd	1.38 d	8.10 cd	8.80 cde	9.60 bc
(SS+PM)2	20.03 bc	20.28 a	20.80 ab	1.43 bc	1.53abc	1.50 c	9.20 b	9.58 cd	10.00 b
(SS+PM)3	20.63 bc	20.60 a	21.83 a	1.58 a	1.88 a	1.68 b	9.60 b	10.05 bc	10.50 a b
RMF	18.30 def	19.03 abc	19.48 b-e	1.68 ab	1.88 a	1.78 a	7.15 d	7.98 e	8.30 d
F test (c)	ns	Ns	ns	< 1	< 1	*	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	2.11	2.11	2.11	0.29	0.29	0.29	0.92	0.92	0.92
LSD 1%	2.90	2.90	2.90	0.39	0.39	0.39	1.23	1.23	1.23

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

Table (6):Cd, Cu, Ni and Pb contents, (mg kg^{-1} dry weight) of pea plants as affected by Remedial and amendments.

Treatments	Added agrochemicals											
	None	G	S	None	G	S	None	G	S	None	G	S
	Seed-Cd			Seed-Cu			Seed-Ni			Seed-Pb		
Control	0.02 f	0.03 f	0.04 g	3.0 f	3.2 f	3.4 e	0.30 i	0.38 ef	0.42 f	0.17 g	0.19 e	0.22 f
SS3	0.04 d	0.10 bc	0.11 cd	3.4 ef	3.5 ef	3.6 e	0.42 f	0.44 ef	0.56 e	0.21 cd	0.24 bc	0.28 c
SS5	0.10 a	0.12 b	0.18 a	3.5 d	4.0 cd	4.3 e	0.50 d	0.56 ef	0.61 d	0.26 a	0.28 a	0.35 b
PM1	0.04 d	0.08 cd	0.09 e	3.2 f	3.3 f	3.4 e	0.46 ef	0.48 f	0.55 e	0.22 c	0.24 bc	0.26 d
PM2	0.06 cd	0.10 bc	0.12 c	3.4 ef	3.5 ef	4.3 f	0.56 d	0.58 de	0.60 d	0.25 a	0.28 a	0.30 b
PTR1	0.06 cd	0.08 cd	0.09 e	5.5 c	6.0 cd	8.0 c	0.64 b	0.66 cd	0.70 c	0.20 d	0.24 bc	0.26 d
PTR2	0.08 bc	0.10 bc	0.11 cd	6.0 b	8.0 b	9.0 b	0.66 a	0.67 bc	0.76 c	0.24 b	0.28 a	0.30 b
(SS+PM)1	0.06 cd	0.07 d	0.08 cd	3.5 e	3.8 d	5.0 de	0.38 g	0.54 f	0.78 b	0.18 f	0.20 cd	0.23 e
(SS+PM)2	0.08 bc	0.10 bc	0.11 cd	4.5 d	5.5 d	9.0 b	0.50 e	0.56 ef	0.82 b	0.22 c	0.24 bc	0.28 c
(SS+PM)3	0.10 a	0.13 a	0.14 b	8.0 a	9.0 a	10.0 a	0.62 c	1.20 a	1.26 a	0.24 b	0.28 a	0.30 b
RMF	0.03 e	0.04 e	0.05 f	3.5 e	4. 0 e	5.0 de	0.44 ef	0.50 b	0.52 c	0.18 f	0.20 cd	0.22 ef
F test (c)	**	**	**	*	*	*	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**	**	**	**
LSD 5%	0.022	0.022	0.022	1.989	1.989	1.989	0.039	0.039	0.039	0.033	0.033	0.033
LSD 1%	0.030	0.03	0.03	2.665	2.665	2.665	0.052	0.052	0.52	0.046	0.046	0.046
	Straw-Cd			Straw-Cu			Straw-Ni			Straw-Pb		
Control	2.00 e	3.95 f	4.00 g	14.0 e	16.0 de	19.0 bc	5.80 e	6.00 f	6.80 e	5.20 h	6.10 ef	7.00 g
SS3	4.00 c	4.90 e	8.00 e	18.0 de	20.0 bc	22.0 c	6.20 e	6.60 f	7.10 d	6.40 cd	8.20 c	10.55 b
SS5	5.95 b	8.95 bc	12.50 bc	22.0 bc	22.0 bc	24.0 c	6.60 e	6.80 e	7.60 bc	6.60 c	9.20 a	11.60 a
PM1	4.00 c	4.80 e	6.00 f	17.0 de	18.0 cd	20.0 d	7.00 c	7.40 d	8.20 c	5.60 b	7.20 d	10.60 b
PM2	6.00 b	6.90 cd	12.00 c	18.0 cd	20.0 cd	22.0 d	7.60 b	8.00 c	8.60 bc	7.00 ab	8.00 c	11.70 a
PTR1	4.00 c	6.00 d	12.00 c	22.0 bc	23.0 ab	24.0 b	7.00 bc	8.60 b	8.80 d	5.80 fg	6.60 ef	8.20 e
PTR2	6.00 b	8.00 c	14.00 b	24.0 a	25.0 a	26.0 b	8.60 a	9.00 a	10.00 a	6.80 b	7.00 d	8.60 d
(SS+PM)1	4.00 c	8.00 c	10.00 d	18.0 de	20.0 bc	22.0 c	7.00 d	7.60 c	8.00 bc	6.20 d	6.80 de	8.20 e
(SS+PM)2	6.03 b	10.00 b	12.00 c	20.0 bc	22.0 bc	24.0 bc	7.80 c	8.20 b	8.80 b	6.80 b	7.80 cd	9.00 cd
(SS+PM)3	8.00 a	12.00 a	16.00 a	24.0 a	25.0 a	30.0 a	8.40 bc	8.800 ab	10.00 a	7.15 a	9.00 b	9.23 c
RMF	4.00 c	7.00 cd	8.00 e	16.0 e	16.0 e	14.0 d	6.60 e	6.80 c	7.00 c	5.40 g	7.00 d	7.80 f
F test (c)	**	**	**	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**	**	**	**
LSD 5%	1.148	1.148	1.148	2.453	2.453	2.453	0.374	0.374	0.374	0.449	0.449	0.449
LSD 1%	1.586	1.586	1.586	3.255	3.255	3.255	0.504	0.504	0.504	0.604	0.604	0.604

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

Table (12): Cd,Cu, Ni and Pb contents, (mg kg^{-1} dry weight) of sunflower plants as affected by remedial and amendments.

Treatments	Added agrochemicals											
	None	G	S	None	G	S	None	G	S	None	G	S
	Seed-Cd			Seed-Cu			Seed-Ni			Seed-Pb		
Control	0.72 g	0.78 g	0.75 f	18.0 f	22.0 f	20.0 f	1.83 h	2.11 gh	2.01 g	6.92 i	7.52 f	7.19 g
SS3	0.92 f	1.14 d	1.12 c	24.0 de	30.0 d	28.0 d	2.13 f	2.55 d	2.43 c	8.52 e	9.55 bc	8.68 f
SS5	1.20 b	1.30 b	1.22 a	34.0 a	36.0 b	35.0 ab	2.25 d	2.66 c	2.54 b	9.17 b	9.59 bc	9.15 d
PM1	1.04 e	1.14 d	1.08 cd	22.0 e	27.0 e	26.0 e	2.51 c	2.85 ab	2.66 ab	7.39 h	9.39 c	8.93 e
PM2	1.18 b	1.24 c	1.19 bc	30.0 bc	40.0 a	34.0 b	2.73 a	2.88 a	2.74 a	8.2 4 f	10.54 a	9.65 b
PTR1	1.14 c	1.28 b	1.02 d	24.0 de	28.0 e	26.0 e	2.47 c	2.62 c	2.50 bc	9.14 b	9.46 c	9.40 c
PTR2	1.24 a	1.38 a	1.14 c	32.0 ab	38.0 ab	34. 0 b	2.61 b	2.72 b	2.68 ab	9.67 a	10.40 a	9.81 a
(SS+PM)1	0.92 f	0.96 f	0.94 c	26.0 d	33.0 cd	28.0 d	2.05 g	2.36 e	2.08 f	8.31 f	9.03 d	8.93 e
(SS+PM)2	1.02 e	1.20 d	1.01 d	29.0 c	34.0 c	30.0 c	2.15 e	2.52 de	2.19 c	8.81 d	9.28 c	9.13 d
(SS+PM)3	1.08 d	1.26 c	1.14 c	31.0 bc	40.0 a	36.0 a	2.28 d	2.59 cd	2.37 d	9.03 c	9.88 b	9.55 bc
RMF	0.80 e	0.88 f	0.92 e	23.8 e	29.0 de	26.0 e	2.27 d	2.33 ef	2.30 e	8.04 g	8.53 e	8.45 fg
F test (c)	**	**	**	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**	**	**	**
LSD 5%	0.032	0.032	0.032	2.146	2.146	2.146	0.052	0.052	0.052	0.145	0.145	0.145
LSD 1%	0.043	0.043	0.043	2.915	2.915	2.915	0.085	0.085	0.085	0.196	0.196	0.196
	Leave-Cd			Leave-Cu			Leave-Ni			Leave-Pb		
Control	0.35 f	0.38 g	0.36 g	32.0 g	42.0 g	41.5 e	1.85 g	1.92 f	1.89 h	8.26 g	9.08 g	8.93 f
SS3	0.51 b	0.58 c	0.52 d	40.0 c	48.0 e	44.0 d	2.36 d	2.65 c	2.48 de	9.14 de	9.61 f	9.52 e
SS5	0.53 a	0.68 a	055 c	46.0 b	50.0 d	50.0 c	2.53 bc	2.96 a	2.84 a	9.92 a	11.17 a	10.86 a
PM1	0.42 d	0.46 f	0.44 e	44.0 c	54.0 c	51.0 bc	2.43 cd	2.62 c	2.37 ef	9.22 d	9.70 f	9.54 e
PM2	0.48 c	0.54 d	0.49 de	50.0 a	58.0 b	56.0 a	2.56 b	2.88 a	2.68 b	9.23 d	10.72 b	10.63 ab
PTR1	0.46 cd	0.56 cd	0.51 d	42.0 d	51.0 d	44.0 d	2.47 c	2.63 c	2.48 de	9.06 e	10.62 b	9.59 de
PTR2	0.48 c	0.68 a	0.66 a	48.0 ab	56.0 bc	54.0 ab	2.60 a	2.72 b	2.63 c	9.83 ab	10.91 ab	10.19 b
(SS+PM)1	0.40 e	0.46 ef	0.42 f	39.0 ef	48.0 e	46.0 c	2.30 e	2.44 d	2.33 f	9.49 c	9.90 e	9.72 cd
(SS+PM)2	0.49 bc	0.48 e	0.48 de	42.0 d	54.0 c	49.0 cd	2.33 de	2.50 d	2.45 e	9.59 bc	10.17 d	9.77 cd
(SS+PM)3	0.52 b	0.6 2 b	0.55 bc	48.0 ab	66.0 a	50.0 c	2.41 cd	2.67 bc	2.54 d	9.66 b	10.30 c	9.82 c
RMF	0.36 f	0.47 ef	0.44 e	40.0 e	45.0 f	42.0 e	1.98 f	2.24 e	2.11 g	8.78 f	9.94 e	9.71 d
F test (c)	**	**	**	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**	**	**	**
LSD 5%	0.038	0.038	0.038	2.717	2.717	2.717	0.064	0.064	0.064	0.067	0.067	0.067
LSD 1%	0.051	0.051	0.051	3.626	3.626	3.626	0.086	0.086	0.086	0.090	0.090	0.090

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

Table (5):Zn, Mn and Fe contents, (mg kg^{-1} dry weight) of pea plants as affected by Remedial and amendments.

Treatments	Added agrochemicals								
	None	G	S	None	G	S	None	G	S
	Seed-Zn			Seed-Mn			Seed-Fe		
Control	20.00 f	23.00 i	22.00 g	9.00 c	10.60 b	10.20 c	10.90 d	16.00 e	13.00 d
SS3	26.00 e	30.00 g	27.00 ef	10.60 c	12.00 cd	11.40 c	13.00 c	15.00 ef	1425 e
SS5	34.00 d	44.00 d	40.00 c	10.80 c	13.80 c	12.40 c	15.00 c	17.75 e	16.00 d
PM1	25.00 e	36.00 f	30.00 e	11.00 a	13.00 cd	12.80d	16.60 cd	19.00 cd	15.50 e
PM2	40.00 c	62.00 c	52.00 c	11.80 a	14.40 bc	13.53cd	16.98 c	22.00 b	17.50 e
PTR1	42.00 b	68.00 b	62.00 d	13.00 b	17.15c	15.60 b	12.60 b	14.20 ef	13.0 d
PTR2	46.00 a	72.00 b	66.00 d	16.00 a	19.60 b	17.80 b	15.03 a	22.0 d	17.0 a
(SS+PM)1	22.00 f	54.00 g	30.00 b	9.55 c	10.55 e	10.20 ab	12.0 e	15.25 f	14.20 b
(SS+PM)2	36.00 d	56.00 de	40.00 ab	10.65 c	11.43 e	10.80 ab	15.0 e	18.50 ef	16.20 b
(SS+PM)3	52.00 c	76.50 a	58.00 a	11.00 c	13.00 a	12.40 a	18.0 c	24.0 a	18.50 b
RMF	23.00 e	24.00 i	25.00 g	11.00 b	11.55 b	11.50 c	14.0 d	18.0 e	16.00 c
F test (c)	**	**	**	*	*	*	ns	ns	ns
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	2.491	2.491	2.491	2.352	2.352	2.352	2.723	2.723	2.723
LSD 1%	3.319	3.319	3.319	3.184	3.184	3.184	3.664	3.664	3.664
	Straw-Zn			Straw-Mn			Straw-Fe		
Control	20.00 de	21.00 d	18.00 f	30.00 h	42.00 i	33.00 h	40.40 ef	48.80 ef	44.2 e
SS3	20.00 de	24.00 cd	22.00 cd	40.00 g	44.00 g	42.00 gh	41.40 f	43.40 de	41.65 f
SS5	28.00 c	36.00 c	30.00 bc	44.00 f	48.00 g	46.00 g	48.40 d	51.80 c	50.85 d
PM1	26.00 d	30.00 de	28.25 cd	50.00 b	60.00 f	52.00 f	45.00 g	55.20 h	49.00 d
PM2	28.00 a	35.00 d	29.00 bc	54.00 e	75.00 f	64.00 c	48.25 d	65.60 a	59.20 c
PTR1	22.00 b	30.50 b	25.00 de	58.00 e	68.00 e	60.00 b	56.60 c	74.80 b	64.40 b
PTR2	30.00 b	35.00 a	32.00 de	68.00 b	80.00 b	70.00 a	63.60 b	84.80 b	74.00 a
(SS+PM)1	22.00 de	24.00 d	23.00 cd	54.00 d	64.00 cd	60.00 ef	47.00 de	53.80 g	.50.80 g
(SS+PM)2	26.00 c	32.00 b	28.00 b	56.25 c	70.50 cd	66.00 e	59.45 c	68.60 f	61.80 f
(SS+PM)3	28.00 c	36.00 a	30.00 a	65.00 b	75.50 bc	68.00 b	63.00 a	77.80 c	67.60e
RMF	22.00 d	24.00 c	23.00 ef	34.00 h	45.00 de	42.00 g	39.40 g	45.60 d	42.40 f
F test (c)	**	**	**	**	**	**	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**
AC x B	**	**	**	**	**	**	**	**	**
LSD 5%	3.038	3.038	3.038	2.587	2.587	2.587	3.099	3.099	3.099
LSD 1%	4.050	4.050	4.050	3.449	3.449	3.449	4.169	4.169	4.169

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

Table (13):Yield characteristics of sunflower plants as affected by remedial and amendments

Treatments	Agrochemicals uses														
	None	G	S	None	G	S	None	G	S	None	G	S	None	G	S
	Seed yield(g)/plant			Seed100(g)			Seed yield (mg) fed^{-1}			Oil yield (kg) fed^{-1}			Oil %		
Control	94.27a	99.99d	102.56c	9.86de	10.18bcd	10.62d	1.89f	2.14f	2.27e	556.81e	667.02cd	568.39d	30.17d	31.91cd	28.78de
SS_3	116.36bcd	115.14ab	127.72abc	9.28f	10.40bc	10.82cd	2.22d	2.39cde	2.40bc	729.02b	733.54bc	844.16abc	37.35a	33.20ab	32.09c
SS_5	117.33ab	127.14ab	135.56abc	10.52c	10.51b	10.95bcd	2.42b	2.49b	2.71b	646.80a	821.86a	911.54a	33.68b	31.10de	27.93e
PM_1	115.44bc	120.70bcd	119.67ab	9.63a	12.00a	12.41b	2.41c	2.44bc	2.49b	656.39bc	768.64ab	744.96c	30.71d	28.42g	31.66c
PM_2	128.09a	135.13a	135.18a	10.54b	12.54bcd	13.03a	2.56a	2.90a	2.93a	747.52a	778.53bc	932.32a	32.13c	32.23bc	29.43d
PTR_1	99.36de	103.65d	105.57bc	9.32ef	9.57e	10.41cd	1.96ef	2.13f	2.39bcd	572.19dde	612.26d	788.53a	30.82d	27.58g	35.03a
PTR_2	101.76cde	114.61bcd	116.32abc	9.88de	10.51bcd	10.90bcd	2.03e	2.29e	2.41bc	577.10e	738.76ab	760.16abc	28.39e	33.19ab	31.17c
$(SS+PM)_1$	107.0cde	108.29cd	114.43abc	9.74def	10.24cd	10.44bcd	2.15d	2.24f	2.29de	638.06c	673.91d	723.47bc	33.58b	29.75f	29.44d
$(SS+PM)_2$	114.24cd	115.05a-d	119.46abc	10.52c	10.74bcd	10.83bc	2.31c	2.38cde	2.39cde	687.68cd	723.96bc	730.22abc	30.07d	30.68ef	31.31c
$(SS+PM)_3$	120.53bc	122.80abc	123.80ab	10.61c	10.83bcd	10.95bcd	2.40c	2.46bcd	2.49b	695.21cd	706.72ab	759.42abc	28.22e	30.65ef	28.72de
RMF	109.12cde	109.25bcd	109.92abc	10.17cd	10.25d	10.40cd	2.21d	2.34de	2.39bcd	739.09bc	740.39bc	764.38ab	33.81b	33.82a	33.81b
F test (c)	<1	<1	<1	*	*	*	**	**	**	Ns	Ns	Ns	**	**	**
Bio (B)	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
ACxB	*	*	*	**	**	**	**	**	**	**	**	**	**	**	**
LSD 5%	16.64	16.64	16.64	0.520	0.520	0.520	0.97	0.97	0.97	83.884	83.884	83.884	0.992	0.992	0.992
LSD 1%	22.303	22.303	16.64	0.696	0.696	0.696	0.131	0.131	0.131	112.972	112.972	112.972	1.343	1.343	1.343

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

2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057

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