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IMPACT OF COMPOSTED BANANA TREES RESIDUES AND CERTAIN MICROBIAL INOCULA ON SORGHUM PLANTS GROWN ON SANDY SOIL

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ABSRTACT

Two piles of banana trees residues inoculated with *Trichoderma viride* + *Phanerochaete chrysosporium* were prepared to get a C/N ratio of 30: 1 on dry weight basis , the first pile received ammonium sulphate and superphosphate (compost A), the second pile was supplemented with cattle dung at a ratio of 3 (banana trees residues) : 1 (cattle dung) on dry weight basis to represent compost B. Both piles were composted aerobically for 16 weeks to obtain (compost A and compost B). Both composted materials (compost A & B) were applied in different treatments, i.e., Compost A and/or Compost B Plus NPK and Compost A or Compost B Plus NPK plus microbial inoculation (*Azospirillum lipoferum* + *Bacillus circulans*) in a pot experiment at a rate of 3% (w/w on dry weight basis) using sandy soil to study their effect on the growth, NPK uptake of sorghum plants grown in the greenhouse for 8 weeks. Results indicate that the addition of both compost A & B combined with microbial inoculation increased both the growth and nutrients uptake of sorghum plants. .The highest increments of these tested parameters were achieved by compost B rather than compost A. On other hand, compost B showed a positive effect on soil NPK availability, which in turn enhanced NPK uptake by sorghum plants. Total count of bacteria, *Azospirilla* count and silicate bacteria count in soil as well as the availability of N, P and K were enhanced by organic manuring and microbial inoculation. Moreover, the addition of organic manure increased the soil organic matter and total N, P and K percentage, which lead to a slight decrease in soil pH and EC values. Therefore, adding banana trees residues compost to sandy soil in presence of chemical fertilizer combined with microbial inoculation could be recommended to be applied for sorghum to enhance growth and favorable nutrients uptake.

INTRODUCTION

The annual Egyptian demands for organic fertilizers are estimated to be more than about 150 million tons /year, while the different types of farm wastes were estimated by about 26 million tons /year, out of which about 15.6 million tons (60%) are disposed through burning (El-Shimi, 1997).

Composting according to Diza *et al.* (1993) is the biological decomposition of wastes consisting of organic substances of either plant or animal origins under controlled conditions to a state sufficiently stable for nuisance-free storage and utilization. Regarding to saw-dust, it is plant materials and also industrial wastes. Harun *et al.*, (1991) compared the inclination of saw –dust to be used as a compost substance amended to soil with the effect of organic substrates (composted bark hard wood and softwood saw –dust and peat) and/or inorganic fertilization on productivity of melon cv. Polidor. They concluded that there were no significant differences in yield between the inorganic and/or compost or organic substrates. Krapisz (1992) in a field trial applied 25 tons/ha of composted pine bark , composted saw-dust each with and without vegetable materials or farmyard manure in a comparison with NKP mineral fertilization to cabbage and carrot cropping sequence and found that organic fertilizers in all cases improved cabbage and carrot growth through 3 years.

Another comparison between organic and inorganic fertilization was conducted by Brito and Hadley (1993) using factorial combinations of organic wastes, a town wastes compost and a paper mill waste composted with bark and top dressing of ammonium nitrate applied to cabbage, lima and lettuce. They detected increases in yield of the tested crops due to the order of ammonium nitrate > paper mill + bark compost >town waste compost.

Recently, El-Gizi and Rifaat (2001) composted saw-dust under anaerobic followed aerobic conditions, while Estefanous and Sawan (2002) composted it with cattle dung under aerobic conditions. The resulted compost materials were applied to pots filled with calcareous soil at a rate of 2.5 and 5% of the soil pot capacity , where significant increases in tomato cultures ,okra and their nutrients uptake were noticed by using 2.5or 5%of that saw-dust compost

(Lee *et al.*, 2004) compared the effect of food waste (FW) composted with Miraculous Soil Microorganisms (MS) with commercial compost (CC) and mineral fertilizer (MF) on bacterial and fungal populations, soil enzyme activities and growth of lettuce in a greenhouse. experiment. They found that fungi and bacteria populations and soil enzyme activities in the rhizosphere of FW treatments increased significantly in comparison with control treatment, CC and MF at 2, 4, and 6 weeks intervals. The fresh weight of lettuce in FW treatments was about 2–3 times higher than that in CC at 4 and 6 weeks. They also noted that the soil pH, EC, total nitrogen content, organic matter and sodium concentration in FW treatments were generally higher than those recorded by control, CC and MF treatments.

The aim of this work is to study the effect of two types banana trees residues compost (compost A & compost B) combined with or without inoculation with *Azospirillum lipoferum* + *Bacillus circulans* either in combination with NPK fertilization or without on growth and nutrients uptake of sorghum plants .Moreover, the changes in some biological and chemical properties of the used sandy soil during 8 weeks of planting were also recorded.

MATERIALS AND METHODS

The greenhouse experiment:

A pot experiment was Dorado plants conducted in the greenhouse of the Training Center for Recycling of Agricultural Residues (TCRAR), Agric Res. Center at Moshtohor, Kalubia Governorate to study the effect of two types of compost (Table 1) having a modified C/N ratio (30: 1) by means of adding either chemical activator (ammonium sulphate) or animal activator (cattle dung) and inoculation with *Azospirillum lipoforum* and *Bacillus* *circulans* on the growth and NPK uptake of sorghum (*Sorghum bicolor* L.) variety Dorado cultivated in sandy soil. As well as, st their effects on some chemical and biological characters of the tested sandy soil was considered. The soil used was sandy collected from the upper 30 cm layer of Sheikha - Salma, Shibin El-Qanater, Kalubia Governorate. The main soil physical, chemical and biological properties are presented in Table (2).The soil passed through a 2- mm sieve and distributed into 54 earthenware pots (30 cm in diameter) at the rate of 5 kg / pot . At sowing time, ammonium sulphate, super phosphate and potassium sulphate (NPK) were added at the rate of 0.5, 0.75 and 0.25g/pot, respectively. The soil moisture content was adjusted to 60% W.H.C.

Table (1): Some properties of banana trees residues, cattle dung and matured composts used the study (dry weight basis)

Property	Banana trees residues	Cattle dung	Compost A	Compost B
Total solids %	96.92	18.02	40.63	45.18
pH (1:10 manure suspension)	6.44	7.50	7.23	7.40
EC (1:10 manure suspension)	5.47	2.15	4.15	4.05
N- No_3 (ppm)	17	78	318	1240
N-NH^+_4 (ppm)	44	511	124	500
Organic matter %	87.70	77.12	75.14	59.43
Organic carbon %	50.87	44.73	43.58	34.47
Total nitrogen %	1.49	1.53	2.26	2.17
C/N ratio	34.14:1	29.24:1	19.28:1	15.88:1
Total phosphorous (%P)	0.71	1.35	2.02	2.11
Total potassium(%K)	2.26	0.79	4.46	4.75

in a complete randomized design with three replicates for each treatment. The treatments for this experiment were as the following:

1- Chemical fertilizer (NPK)
2- Compost A
3- Compost B
4- Compost A + NPK
5- Compost B + NPK
6- Compost A + certain microbial inocula
7- Compost B + certain microbial inocula
8- Compost A + certain microbial inocula + NPK
9- Compost B + certain microbial inocula + NPK

Both compost A and B were added basically to the soil at a rate of 3% =150 g/pot (w/w on dry weight basis).

Azospirillium lipoferum + *Bacillus circulans* inocula was added to the soil at a rate of 10 ml /pot after 15 days from sowing near the plant roots. In each pot, 5 sorghum seeds were sowed at 5 th May 2007 and upon germination the seeds were thinned out to 3 healthy plants.

After 8 weeks of growing period , the plants were harvested , washed and then oven dried at 70°C for 48 hour up to a constant weight to obtain the plant dry weight shoots and roots dry weights. Plants were analyzed for nitrogen, phosphorus and potassium contents. At intervals of 0 , 4 , 8 weeks from sowing, remained soil in pots were sampled to determine the soil reaction (pH), electric conductivity (EC), organic carbon and organic matter percentages , total and available nitrogen , potassium and phosphorus .Total bacteria count, *Azospirillium* count and silicate bacteria count.

Table (2): Some physical, chemical and biological characteristics of the studied soil

Soil characteristics (%)	
Sand	86.32
Silt	2.88
Clay	10.80
Texture class	Sandy
Cations (meq/100g soil)	
Ca^{2+}	0.47
Mg^{2+}	0.22
Na^{+}	0.76
K^{+}	0.15
Anions (meq/100g soil)	
CO_3^{-}	-
HCO^{-}_3	0.13
Cl^{-}	0.92
SO_4^{-2}	0.55
Available nutrients(ppm)	
$N\text{-}No^{-}_3$	5
$N\text{-}NH^{+}_4$	5
P	29
K	120
pH (1:5soilwater suspension)	7.70
EC (dSm^{-1})	0.16
Macro –nutrients (%)	
N	0.02
P	0.16
K	0.20
Soil moisture (%)	2.56
Organic carbon (%)	0.24
Biological activity	value
Total count of bacteria $x10^{6}$	25
Azospirillum count $x10^{3}$	3
Silicate bacteria count $x10^{2}$	12

Methods of analyses

The determination of banana trees residues compost was done as described by Brunner and Wasmer (1978). Soil mechanical analysis was done according to Piper (1950), while, soil reaction (pH) and Electrical conductivity (EC) measurements were run in a suspension of 1:5 as described by Richads (1954) using pH glass electrode of orion Expandable ion analyzer EA920 and EC meter ICM modle 71150, respectively .Total phosphorus and total potassium were determined according to standard methods of APHA (1989). Ammoniacal and nitrate –nitrogen (available nitrogen) were determined in fresh soil samples using the recommended methods of Page *et al.* (1982). The soil total nitrogen was determined according to Jackson (1973), available phosphorus according to Troug and Mayer (1949), available potassium according to Chapman and Pratt

(1961).Organic carbon and the calculated organic matter were estimated according Walkley and Black's method given by Black et al . (1981). Shoots N, P and K contents were determined in fine powder of dry shoots according to the methods of APHA (1989). The total viable bacteria counts were estimated by the standard plate count method using Nutrient agar medium Difco (1977). Counts of *Azospirillum* were determined by the most probable number technique for Cochran (1950) using nitrogen free semi-solid malate medium of Döberiener (1978). Silicate bacteria count were estimated by the standard plate count method using Aleksandrov's medium modified by Zahra (1969). Obtained results were statistically analyzed due to the methods described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1. Dry weight of sorghum plants and growth:

Data in Table (3) show the dry weights of sorghum plants, shoots and roots. Generally, growth of sorghum plants responded positively to microbial inoculation and /or composts amendments during 8 weeks growth period. Plants inoculated with microbial inocula gave remarked increases in these parameters compared to non-inoculated ones. In the other words, addition 3% of banana trees residues compost (with cattle dung) to soil reduced the differences between the inoculated and non-inoculated plants due to improved growth of the non-inoculated plants resulted from supplementation with the soil amendments. In this concern, Abd El-Lateef *et al.* (1998) found a significant response to biofertilization on yield component characters of soybean ,sesame and sunflower .

Table (3): Effect of NPK, microbial inocula and composts on dry weight of sorghum plant and shoots in the sandy soil

Amendments	Plants Dry weight (g/pot)	D.W. Shoots (g/pot)	D.W. roots (g/pot)
NPK	2.22	2.04	0.18
Compost A	2.36	2.10	0.26
Compost B	2.45	2.14	0.31
Compost A+ NPK	2.99	2.66	0.33
Compost B+NPK	3.16	2.80	0.36
Compost A+ microbial inocula	2.51	2.24	0.27
Compost B+ microbial inocula	2.61	2.32	0.29
Compost A+NPK +microbial inocula	3.43	3.04	0.39
Compost B+ NPK+ microbial inocula	3.80	3.36	0.44
L.S.D (0.05) %	0.730	0.691	0.039
Interaction: Composts x NPK :N.S Composts x microbial inocula :N.S Composts x NPK x microbial inocula :N.S			

*Compost A= Dry banana trees residues + chemical activator +*Trichoderma viride* +*Phanerochaete chrysosporium*

*Compost B= Dry banana trees residues + cattle dung +*Trichoderma viride* + *Phanerochaete chrysosporium*

*Microbial inocula = *Azospirillium lipoferum* +*Bacillus circulans*

The stimulating influence of organic amendments on sorghum vigour might be attributed to improving the microbial activities in soil and this probably improves the availability of the nutrients .Similar results were obtained by (Estefanous and Sawan 2002) who found that the productivity of sorghum plants can be improved though application of organic matter and biofertilization .

The double and triple interaction of the three individual factors (NPK, microbial inocula and composts) showed no significant effect on dry weight of sorghum plants in sandy soil .The best treatment was combination NPK, microbial inocula and compost B.

2. Nitrogen, phosphorus and potassium uptake by sorghum shoots :

Table (4) illustrated the effect of different manure treatments on nitrogen, phosphorus and potassium uptake by sorghum shoots during 8 weeks. Data reflects significant results due to the different treatments. However, inoculation with certain microbial inocula were clearly effective in increasing N, P and K uptake by sorghum shoots during 8 weeks. These increases were presumably due to improvement of nutritional status of sorghum plants and synergistic effect due to growth promoting substances secreted by the inoculated bacteria.

In this concern, Koreish *et al.* (1998) found that soil nutrients especially phosphorous and micronutrients were significantly improved by phosphate dissolving bacteria inoculation (PDB).They also found that inoculation with PDB enhanced nutrient uptake by maize plants compared to uninoculated treatments.

Table (4): The percentages and contents of nitrogen, phosphorus and potassium (mg/pot) in shoots of sorghum plants grown in the NPK, microbial inocula /or composts

Amendments	Nitrogen		Phosphorus		Potassium	
	%	Uptake	%	Uptake	%	Uptake
NPK	0.58	11.83	0.20	4.08	0.65	13.26
Compost A	0.51	10.71	0.22	4.62	0.71	14.91
Compost B	0.55	11.77	0.24	5.14	0.76	16.26
Compost A+ NPK	0.74	19.68	0.29	7.710	0.90	23.94
Compost B+NPK	0.77	21.56	0.30	8.40	0.98	27.44
Compost A+microbial inocula	0.68	15.23	0.25	5.60	0.81	18.14
Compost B+microbial inocula	0.70	16.24	0.27	6.26	0.84	19.49
Compost A+NPK+microbial inocula	0.80	24.32	0.36	10.94	1.04	31.62
Compost B+NPK+microbial inocula	0.88	29.57	0.40	13.44	1.10	36.96
L.S.D (0.05) %		1.84		1.20		2.06

Interaction:
Composts x NPK :N.S
Composts x microbial inocula :N.S
Composts x NPK x microbial inocula :N.S

*Compost A= Dry banana trees residues + chemical activator +Trichoderma viride + Phanerochaete chrysosporium

*Compost B= Dry banana trees residues + cattle dung +Trichoderma viride + Phanerochaete chrysosporium

*Microbial inocula = Azospirillium lipoferum +Bacillus circulans

Concerning compost application, results showed that the total uptake of N, P and K were greatly enhanced and recorded a significant difference in all cases due to the presence of decomposable organic material, which caused high accumulation of the elements by plant with increasing the level of added compost .This could be due the dual beneficial effect of organic materials, which led to increase the available forms of these nutrients that greatly enhanced plant growth .

Obtained results were in agreement with those of Kalembasa and Deska (1998) who explained that the organic acids produced through the organic matter decomposition contribute to increase the available nutrients in soil that improve the plant growth. However, the double and triple interaction effects between the individual factors on N,P and K uptake generally were insignificant in all cases The best treatment was combination NPK, microbial inocula and compost B .

3. Soil reaction (pH):

Data presented in Table (5) showed that addition of 3% banana trees residues composts (A or B) to the studied sandy soil led to slight decrease in soil pH. However, the application of banana trees residues compost B in combination with certain microbial inocula was relatively more active to reduce pH values than those of the non-inoculated ones.

Table (5): Periodical changes in soil reaction (pH) and electrical conductivity (dSm^{-1}) of sorghum cultivated sandy soil amended with NPK, microbial inocula and/ or compost

Sandy soil amendments	periods, weeks		
	0	4	8
	Soil reaction (pH)		
NPK	7.74	7.16	7.85
Comopst A	7.50	7.83	7.74
Comopst B	7.73	7.76	7.44
Comopst A+NPK	7.66	7.47	7.68
Comopst B+NPK	7.30	7.11	7.40
Comopst A+ microbial inocula	7.33	7.31	7.39
Comopst B+ microbial inocula	7.74	7.22	7.45
Comopst A+NPK+ microbial inocula	7.15	7.23	7.50
Comopst B+NPK+ microbial inocula	7.19	7.26	7.49
	Electrical conductivity(EC)		
NPK	0.69	0.39	0.31
Comopst A	0.56	0.61	0.50
Comopst B	0.54	0.65	0.62
Comopst A+NPK	1.23	1.55	1.23
Comopst B+NPK	1.72	1.64	1.25
Comopst A+ microbial inocula	0.60	0.62	0.48
Comopst B+ microbial inocula	0.49	0.60	0.52
Comopst A+NPK+ microbial inocula	1.71	1.62	1.37
Comopst B+NPK+ microbial inocula	1.49	1.68	1.39

*Compost A= Dry banana trees residues + chemical active +*Trichoderma viride* +*Phanerochaete chrysosporium*

*Compost B= Dry banana trees residues + cattle dung +*Trichoderma viride* + *Phanerochaete chrysosporium*

*Microbial inocula = *Azospirillium lipoferum* +*Bacillus circulans*

In this respect several investigators observed a slight decrease in soil pH after organic matter addition, which is probably due to by production of CO2 and organic acids during the breakdown of the organic matter .This certainly contributes to the decrease in soil pH and to increase nutrients availability (Khalil and El-Shinnawi, 1989).

4. Electric Conductivity (EC):

Results in Table (5) revealed that application of banana trees residues EC of the soil proportionally. These changes in EC of the soil reflected the initial EC of the various additives that have been added to the sandy soil .In NPK amended soils, the EC decreased throughout the experimental period whereas the soil received compost with or without NPK, or with bacterial inoculation or with the combination of them all, EC increased till the 4^{th} weeks then depleted at 8^{th} week. However, the increase in EC in sandy soil could be attributed to the release of soluble salts of composted materials during their decomposition in soil. These findings agree with those obtained by (Abdel-All, 2001) who reported that the increasing in EC could be attributed to the dissolving action of organic acids on the native salts in soils.

5. Soil available forms of nitrogen, phosphorus and potassium:

Data in Table (6) also indicate the superiority of inoculated treatments on the Soil availability of N (NH_4-N + NO_3-N), P and K than none inoculated ones. This effect was more pronounced in none –amended soil and this reflects the beneficial effect of microbial inocula. This seems to be to release of soluble N, P and K during the degradation of the added organic materials by soil microorganisms .The decrease in soil pH after organic matter addition and microbial inocula may contribute to soil N, P and K availability (Estefanous *et al.*, 1997).

6. Soil organic carbon and organic matter contents:

Table (7) showed the values of organic carbon and by which organic matter content was calculated. Compost application at 3% rate increased organic matter content, especially compost B when compared with NPK treatment either in the presence or absence of the microbial inoculation. This increase is likely due to the beneficial effect of root exudates during plant growth. As well as increasing of the microbial activities in soil during the decomposition of compost material .Many earlier investigators revealed that the addition of organic manure increased the carbon and mineral nitrogen of the soil (Estefanous *et al.*, 1997).

Table (6): Periodical changes in available forms of some nutrients, (ppm) of the sorghum -cultivated sandy soil amended with NPK, microbial inocula and /or composts

Periods (weeks)	NH^+_4+NO^-_3-N	P	K
	Sandy soil +NPK		
0	62	36	320
4	108	40	375
8	78	35	330
	Sandy soil +Compost A		
0	116	45	440
4	137	60	395
8	105	48	330
	Sandy soil +Compost B		
0	127	52	460
4	152	69	410
8	115	55	340
	Sandy soil +Compost A + NPK		
0	163	65	530
4	221	71	610
8	150	60	430
	Sandy soil +Compost B + NPK		
0	180	60	560
4	225	76	645
8	160	64	455
	Sandy soil + Compost A+ microbial inocula		
0	120	46	448
4	154	65	500
8	115	48	455
	Sandy soil +Compost B + microbial inocula		
0	126	54	530
4	176	70	580
8	120	56	540
	Sandy soil+Compost A+NPK+microbial inocula		
0	183	62	670
4	227	77	735
8	167	65	655
	Sandy soil+Compost B+ NPK+microbial inocula		
0	208	70	790
4	263	86	865
8	213	73	775

*Compost A=Dry banana trees residues+ chemical active +*Trichoderma viride* + *Phanerochaete chrysosporium*

*Compost B = Dry banana trees residues + cattle dung + *Trichoderma viride* + *Phanerochaete chrysosporium*

*Microbial inocula = *Azospirillium lipoferum* +*Bacillus circulans*

Table (7): Periodical organic matter and organic carbon percentage of the sorghum – cultivated sandy soil amended with NPK, microbial inocula /or composts

Sandy soil amendments		Periods (weeks)		
		0	4	8
NPK	O.C	0.18	0.14	0.115
	O.M	0.31	0.24	0.20
Compost+ A	O.C	1.60	1.37	0.92
	O.M	2.76	1.21	1.03
Compost +B	O.C	1.66	1.39	0.97
	O.M	2.86	2.40	1.67
Compost A+NPK	O.C	1.58	1.16	0.85
	O.M	2.72	2.00	1.47
Compost B+NPK	O.C	1.62	1.13	0.90
	O.M	2.79	1.95	1.55
Compost A+ microbial inocula	O.C	1.65	1.24	0.84
	O.M	2.84	2.14	1.45
Compost B+microbial inocula	O.C	1.68	1.21	0.90
	O.M	2.90	2.09	1.55
CompostA+NPK +microbial inocula	O.C	1.70	1.02	0.76
	O.M	2.93	1.76	1.31
CompostB+NPK+microbial inocula	O.C	1.75	1.00	0.82
	O.M	3.02	1.72	1.41

* O.M =O.C x 1.72. **In relation to initial quantity

*Compost A=Dry banana trees residues + chemical active +*Trichoderma viride* +*Phanerochaete chrysosporium*

*Compost B= Dry banana trees residues + cattle dung +*Trichoderma viride* + *Phanerochaete chrysosporium*

*Microbial inocula = *Azospirillium lipoferum* +*Bacillus circulans*

7. Total nitrogen, phosphorus and potassium contents of the sorghum plants:

Data in Table (8) showed that, total nitrogen, phosphorus and potassium contents of the sorghum plants were generally increased by the addition of banana trees residues composts (compost A or compost B) to the sandy soil .These increases were absorbed from the NPK content of the plain soil, which is being up-taken by plants from compost –NPK-microbial inocula added to the soils. This trend explained that the application of composts benefited the growing plants much more than the inorganic NPK mineral fertilization alone. However, fertilization with both compost types in presence or absence of microbial inoculation achieved the most beneficial in the growth of sorghum plants. These results are in agreement with Mekail and Zarouny (1998) who documented that the addition of different kinds of organic materials to sandy soils increased both soil moisture retention and the availability of nitrogen, phosphorus and potassium.

Table (8): Total forms of nitrogen, phosphorus and potassium (ppm) of the sorghum – cultivated sandy soil amended with NPK, microbial inocula and /or composts

Periods (weeks)	N	P	K
	Sandy soil +NPK		
0	1430	300	1700
4	1200	250	1200
8	1080	220	1000
	Sandy soil +Compost A		
0	1600	670	3900
4	1200	610	2300
8	900	580	2000
	Sandy soil +Compost B		
0	2050	770	4200
4	1900	730	3000
8	1750	710	2500
	Sandy soil+ Compost A +NPK		
0	3700	750	5300
4	2900	6000	4100
8	2700	560	3700
	Sandy soil+ Compost B + NPK		
0	4100	830	6000
4	3600	720	4600
8	3300	660	4300
	Sandy soil +Compost A+ microbial inocula		
0	1660	680	4000
4	1250	620	2300
8	1060	600	2060
	Sandy soil +Compost B +microbial inocula		
0	2130	790	4300
4	1960	740	3040
8	1800	730	2500
	Sandy soil +Compost A+ NPK+ microbial inocula		
0	3760	770	5500
4	3000	650	4600
8	2860	600	4100
	Sandy soil+ Compost B+NPK+ microbial inocula		
0	4200	790	6020
4	3620	700	4770
8	3500	640	4430

*Compost A=Dry banana trees residues+ chemical active +*Trichoderma viride* +*Phanerochaete chrysosporium*

*Compost B= Dry banana trees residues + cattle dung +*Trichoderma viride* + *Phanerochaete chrysosporium*

*Microbial inocula = *Azospirillium lipoferum* +*Bacillus circulans*

8. Biological activity :

As for Table (9), the total count bacteria, Azospirillium and silicate bacteria were generally increased by the addition of banana trees residues compost to the tested soil. These increases might be due to the introduction of a large amount of living microorganisms and readily – utilizable carbon sources to the soil during organic manure application .These results agreed with previous findings of Estefanous and Sawan (2002) who found that the addition of organic manures to the soil increased its microbial population.

Generally, either composts applied alone or added with NPK or in combination with microbial inocula had a marked favorable effect on the 3 groups of bacteria ,whereas microbial inocula induced vigorously the increases in populations particularly Azospirillum and silicate bacteria.

In conclusion, adding banana trees residues compost to sandy soil in presence of chemical fertilizer combined with microbial inoculation could be recommended to be applied for sorghum to enhance growth and favorable nutrients uptake.

Table (9): Total count bacteria, *Azospirillium* and silicate bacteria (cfu/g. D.W) of the sorghum cultivated sandy soil amended with NPK, microbial inocula or/ composts.

Sandy soil amendments	Periods ,weeks		
	0	4	8
	Total count bacteria $X10^7$		
NPK	5.00	8.20	5.15
Comopst A	8.20	12.10	8.50
Comopst B	10.20	13.15	6.24
Comopst A+NPK	10.50	12.50	7.50
Comopst B +NPK	11.20	13.10	8.20
Comopst A+microbial inocula	13.40	17.00	12.00
Comopst B+ microbial inocula	16.10	18.20	12.90
Comopst A+NPK+microbial nocula	17.14	20.00	14.16
Comopst B+NPK+microbial inocula	19.11	22.10	15.60
	Azospirillium $X 10^3$		
NPK	0.50	1.20	0.75
Comopst A	10.00	17.60	8.20
Comopst B	12.75	18.00	8.50
Comopst A+NPK	14.32	22.00	10.10
Comopst B +NPK	17.50	23.45	11.50
Comopst A+ microbial inocula	20.14	28.24	13.20
Comopst B+ microbial inocula	23.16	29.60	14.40
Comopst A+NPK+microbial inocula	26.10	30.78	16.08
Comopst B+NPK+microbial inocula	27.40	33.20	17.10
	Silicate -decomposing bacteria $X10^3$		
NPK	1.60	2.80	2.00
Comopst A	5.50	6.10	4.50
Comopst B	6.00	7.40	5.70
Comopst A+NPK	7.50	8.20	6.00
Comopst B +NPK	8.00	9.10	6.60
Comopst A+ microbial inocula	11.90	13.00	10.50
Comopst B+ microbial inocula	12.40	14.60	11.60
Comopst A+NPK+microbial inocula	12.50	13.00	11.50
Comopst B+NPK+microbial inocula	14.10	15.80	13.10

*Compost A=Dry banana trees residues+ chemical active +*Trichoderma viride* +*Phanerochaete chrysosporium*

*Compost B= Dry banana trees residues + cattle dung +*Trichoderma viride* + *Phanerochaete chrysosporium*

*Microbial inocula = *Azospirillium lipoferum* +*Bacillus circulans*

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تاثير مكمور بقايا أشجار الموز مع بعض اللقاحات الميكروبية المحددة على نمو نبات السور جم بالأراضي الرملية

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تم كمر كومتين من بقايا اشجار الموز مع *Phanerochaete chrysosporium*+ *Trichoderma viride* عند نسبة الكربون : النيتروجين ٣٠ : ١ على أساس الوزن الجاف , الكومة الأولى اضيف لها كبريتات نشادر وسوبر فوسفات بينما الكومة الثانية اضيف لها روث الماشية بنسبة ٣ : ١ على اساس الوزن الجاف (بقايا اشجار الموز : روث الماشية تحت الظروف الهوائية لمدة ١٦ اسبوع . ومن ثم المكمور الناتج تم اضافة ٣% على اساس الوزن الجاف لأرض رملية زرعت بمحصول السور جم لمدة ٨ اسابيع .

اوضحت النتائج المتحصل عليها أن تلقيح السورجم بالـ *Azospirillium lipoferum* +*Bacillus circulans* مع اضافة السماد العضوي ، السماد المعدني أدى الي زيادة في نمو النبات وكذلك امتصاص العناصر. وكان أعلى أعلي زيادة في هذه القياسات عند كمبوست المكمورة الثانية عن الأخرى.ومن ناحية أخرى فان أضافة كمبوست ٢ أعطى نتيجة ايجابية في تيسر العناصر مثل النتروجين ، الفوسفور والبوتاسيوم و الذي انعكس على امتصاص هذه العناصر بواسطة المجموع الخضري ، وادى التسميد العضوي و والتلقيح بواسطة اللقاحات الميكروبية الى زيادة العدد الكلي للبكتريا وأعداد الـ *Azospirillum* وأعداد البكتيريا المذيبة للسيليكات وكذلك زيادة في تيسر عناصر ن ،فو ،بو في التربة عموما فان إضافة الأسمدة العضوية أدى إلى زيادة النسبة المئوية للمادة العضوية والعناصر ن ،فو ،بو وانخفاض طفيف في رقم الـpH و EC لذلك فان أضافة السماد العضوي من بقايا أشجار الموز الى الأرض الرملية في وجود التسميد المعدني وكذلك التلقيح بواسطة اللقاحات الميكروبية قد يوصى به للحصول على أعلى نمو من السورجم وامتصاص اكبر للعناصر.