4. Results

4.1.Isolation of the cellulolytic bacteria and fungi:

Data presented in Table (2) showed that the most active cellulolytic isolates were B_3 sh, B_4 sh, B_6 ch and B_{14} v for bacterial isolates and F_2 r, F_3 sh, F_4 sh, F_8 Ri, F_{12} g and F_{14} v for fungal isolates as their growth and activity on filter paper (F.P) .

4.2. Assay of cellulase activity of cellulolytic bacterial and fungal isolates :

The most active cellulolytic isolates were tested for their FPase and CMCase activity . Data presented in Table (3) indicated that the most active bacterial isolates in CMCase and FPase activity were B_3sh and B_{13}v. and with respect to fungal isolates , the most active one is F_8r isolate .

4.3. Identification of the most active cellulolytic bacterial and fungal isolates :

The most active bacterial isolates B_3sh and B_{13}v were identified by the Biolog microlog 420 Fig. (1) as *Micrococcus luteus* and *Kocurea rosea*, (*Micorcoccus roseus*), respectively , and the fungal isolate was identified as *Stachybotrys sp*. according to **Parameter and Whitney (1970**) . Fig. (2).

4.4. Effect of nutritional and environmental requirements on the cellulase activity:

4.4.1. Effect of different carbon source:

Data presented in Table (4) and Fig. (3) showed that different carbon sources namely filter paper, CMC, cellulose, rise straw and garbage were separately added to the basal media in the concentration of 10 g/ L to determine the most suiTable carbon source for the enzyme production .

Table (2) : Isolation of the cellulolytic bacteria and fungi :

Bacterial isolates	**Site of isolation**	**Growth On F.P.**	**Fungal isolates**	**Site of isolation**	**Growth On F.P.**
B_1r	Rabbit manure	++	**F_1r**	Rabbit manure	+
B_2r	Rabbit manure	++	**F_2r**	Rabbit manure	++
B_3sh	Sheep manure	+++	**F_3sh**	Sheep manure	++
B_4sh	Sheep manure	+++	**F_4sh**	Sheep manure	++
B_5sh	Sheep manure	+	**F_5ch**	Chicken manure	+
B_6ch	Chicken manure	+++	**F_6ch**	Chicken manure	+
B_7ch	Chicken manure	+	**F_7ri**	Rice compost	+
B_8ri	Rice compost	++	**F_8ri**	Rice compost	++
B_9ri	Rice compost	+	**F_9ri**	Rice compost	+
B_{10}ri	Rice compost	+	**F_{10}ri**	Rice compost	+
B_{11}g	Garbage compost	++	**F_{11}g**	Garbage compost	+
B_{12}g	Garbage compost	+	**F_{12}g**	Garbage compost	++
B_{13}v	vegeTable compost	++	**F_{13}g**	Garbage compost	+
B_{14}v	vegeTable compost	+++	**F_{14}v**	vegeTable compost	++
B_{15}v	vegeTable compost	+	**F_{15}v**	vegeTable compost	+
B_{16}v	vegeTable compost	+	**$F_{16}S_1$**	Soil	–
$B_{17}S_1$	Soil	+	**$F_{17}S_2$**	Soil	–
$B_{18}S_2$	Soil	–	**$F_{18}S_3$**	Soil	–
$B_{19}S_3$	Soil	–			
$B_{20}S_4$	Soil	–			

Table (3) :Assay of cellulase activity (EU) of cellulolytic bacteria and fungi isolates :

Cellulolytic isolates	Cellulase activity (EU) FPase	Cellulase activity (EU) CMCase
B_1r	ND	0.06
B_2r	ND	0.08
B_3sh	0.09	0.16
B_4sh	0.07	0.15
B_6ch	0.08	0.15
B_8ri	ND	0.08
B_{13}v	0.1	0.18
B_{14}v	ND	0.1
B_{11}g	ND	0.08
F_2r	ND	ND
F_3sh	0.06	0.12
F_3sh	ND	0.1
F_{12}g	0.12	0.2
F_8r	0.1	0.18
F_{14}v	0.06	0.14

* ND: (Not detected) which means that the enzyme is produced in very small quantity below the detection limits of the assays (0.05- 1 mg/ml)

* EU: Enzyme activity (mg/ml/hour)

=> Species ID: Micrococcus luteus(ATCC 9341) <=

	Species	PROB	SIM	DIST	TYPE
=>1)	Micrococcus luteus(ATCC 9341)	100	0.81	2.86	GP-COC CAT+
2)	Dermacoccus nishinomiyaensis	0	0.00	8.98	GP-COC CAT+
3)	Kocuria rosea	0	0.00	16.00	GP-COC CAT+
4)	Staphylococcus lentus	0	0.00	16.00	GP-COC CAT+
5)	Staphylococcus sciuri	0	0.00	17.00	GP-COC CAT+
6)	Staphylococcus haemolyticus	0	0.00	18.85	GP-COC CAT+
7)	Staphylococcus delphini	0	0.00	19.00	GP-COC CAT+
8)	Staphylococcus gallinarum	0	0.00	21.00	GP-COC CAT+
9)	Staphylococcus kloosii	0	0.00	21.00	GP-COC CAT+
10)	Deinococcus grandis	0	0.00	24.00	GP-COC CAT+
Other)		---	---	96.00	---

=> Species ID: Kocuria rosea <=

	Species	PROB	SIM	DIST	TYPE
=>1)	Kocuria rosea	100	0.97	0.51	GP-COC CAT+
2)	Corynebacterium xerosis (GPC)	0	0.00	18.23	GP-COC CAT+
3)	Micrococcus luteus	0	0.00	19.69	GP-COC CAT+
4)	Micrococcus luteus(ATCC 9341)	0	0.00	19.97	GP-COC CAT+
5)	Kytococcus sedentarius	0	0.00	19.99	GP-COC CAT+
6)	Dermacoccus nishinomiyaensis	0	0.00	20.38	GP-COC CAT+
7)	Kocuria varians	0	0.00	20.71	GP-COC CAT+
8)	Staphylococcus saprophyticus	0	0.00	20.90	GP-COC CAT+
9)	Staphylococcus equorum	0	0.00	21.24	GP-COC CAT+
10)	Macrococcus bovicus	0	0.00	22.12	GP-COC CAT+
Other)					

: GP2

Fig (1) : Identification of bacterial isolates by the Biolog microlog.

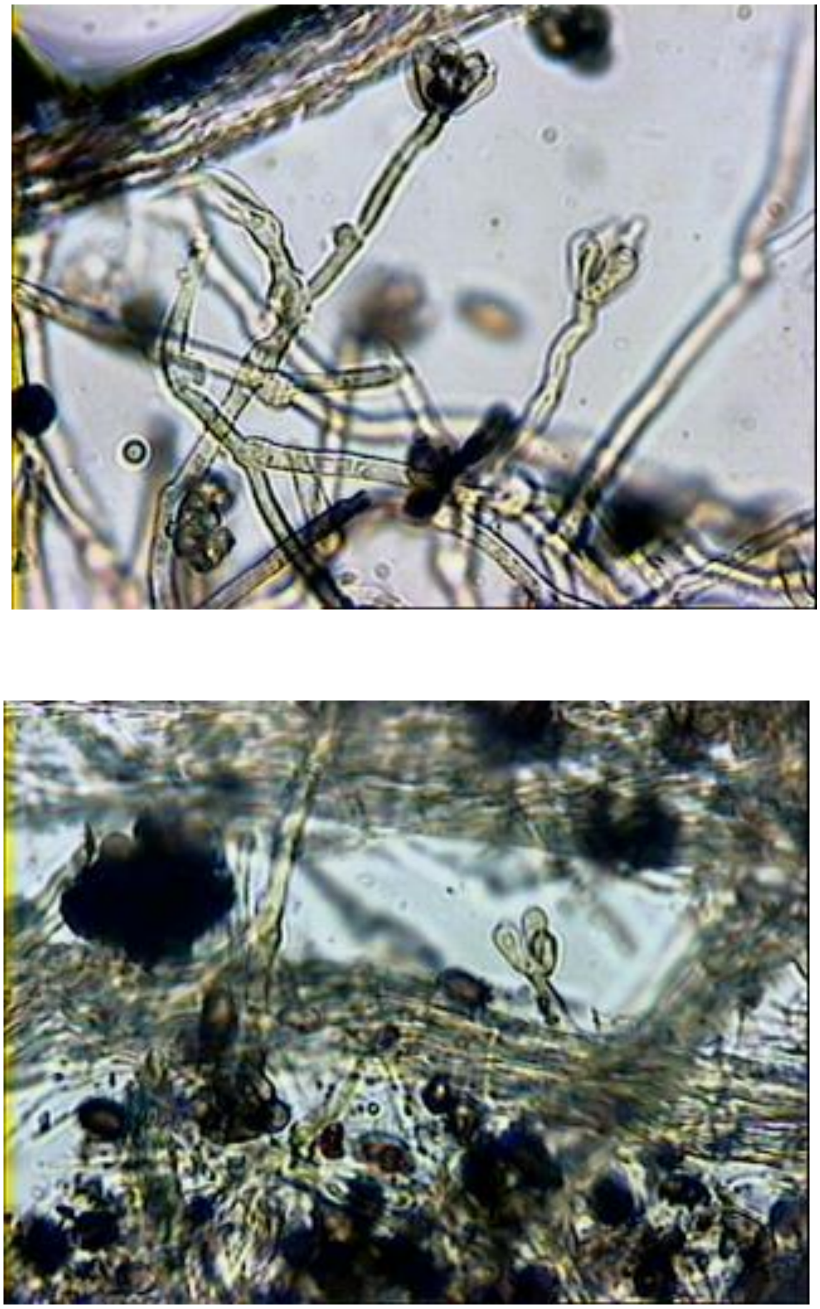


Fig (2): Vegetative cells of *Stachybotrys sp*. (x 1000) .

It has been found that CMC was the most active carbon source for growth proliferation and enzymatic activity for all cellulolytic strains .

4.4.2.Effect of CMC concentrations:

Data recorded in Table (5) and Fig. (4) revealed that, optimum CMC concentration for cellulase activity was 1% concentration followed in descending order by 0.5% concentration for all tested strains.

4.4.3. Effect of incubation period:

Data in Table (6) and Fig. (5) showed that the highest enzyme activity were recorded after 1 day (0.44 EU) , 4 days (0.4 EU) and 5 days (0.48 EU) for *M. tuteus, K. rosea* and *Stachybotrys sp.*, respectively.

4.4.4. Effect of incubation temperature:

Data showed in Table (7) and Fig. (6) clearly indicated that the enzyme activity increased as temperature increased for *M.lutaus* and *K.rosea* to reach its maximum at 45°C (0.48 EU) but for *Stachybotrys sp*. the maximum enzyme activity was recorded at 30ºC (0.48 EU) .

4.4.5. Effect of pH:

Regarding to the influence of pH on cellulase activity (Eu) produced by *M. luteus, K.rosea* and *Stachybotrys sp*, the results in Table (8) and Fig. (7) showed that, enzyme activity increased with the increase in pH values, reaching the maximum activity at pH 7 for the bacterial strains and pH 5.5 for *Stachybotrys sp*. as fungus.

4.4.6. Effect of different nitrogen sources:

Data presented in Table (9) and Fig. (8) revealed that enzyme activity (Eu) was variable according to both nitrogen source and type of the organism. Yeast was the most effective promoter for the cellulase activity of both *M. luteus* (0.56 EU) and *K.rosea* (0.54 EU) but peptone was the

Table (4): Effect of different carbon source (substrates)on the cellulase activity of most active cellulolytic strains :

C-source	Cellulase activity (EU)					
	M.luteus		*K.rosea*		*Stachybotrys sp.*	
	EU	**RA**	**EU**	**RA**	**EU**	**RA**
F.B. (control)	0.16	100	0.18	100	0.2	100
CMC	0.4	250	0.4	222	0.44	220
Cellulose	0.16	100	0.14	77.7	0.34	170
Rice straw	0.2	125	0.2	111.1	0.28	140
Garbage	0.22	138	0.24	133.3	0.26	130

RA = Relative activity

EU = Enzyme activity expressed as mg/ml/hour

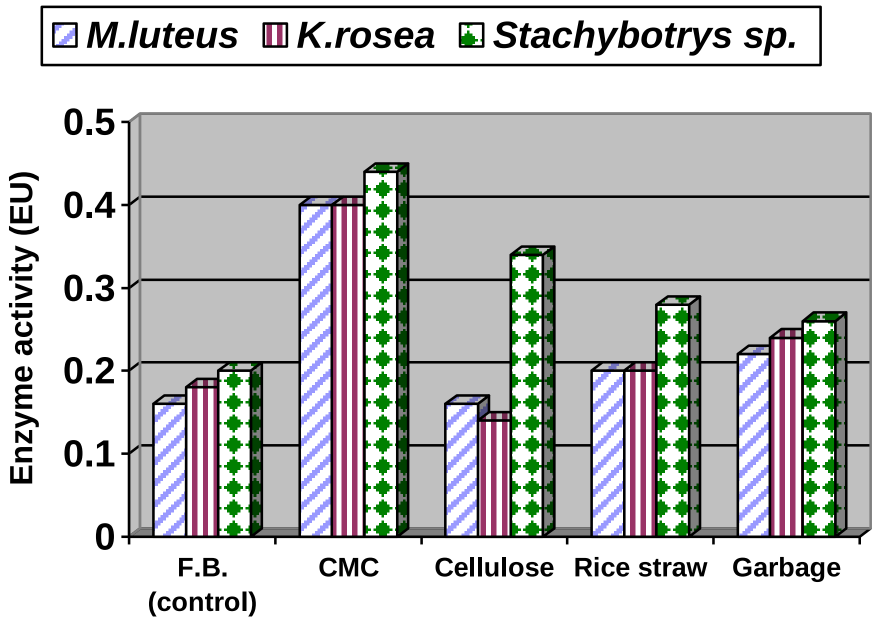


Fig (3): Effect of different carbon source (substrates)on the cellulase activity of most active cellulolytic strains :

Table (5) : Effect of CMC concentrations on the cellulase activity of most active cellulolytic strains :

Concentration of CMC	Cellulase activity (EU)		
	M.luteus	***K.rosea***	***Stachybotrys sp.***
0.5 %	0.36	0.34	0.38
1 %	0.4	0.4	0.44
1.5 %	0.32	0.32	0.4
2 %	0.24	0.2	0.34

Table (6): Effect of incubation periods on the cellulose activity of most active cellulolytic strains :

Incubation period (days)	Cellulase activity (EU)		
	M.luteus	***K.rosea***	***Stachybotrys sp.***
1	0.44	0.34	0.16
2	0.4	0.34	0.2
3	0.4	0.38	0.36
4	0.36	0.4	0.44
5	0.2	0.34	0.48
6	0.2	0.3	0.46
7	0.18	0.26	0.44
8	0.18	0.2	0.4
9	0.16	0.18	0.36

EU = Enzyme activity expressed as mg/ml/hour

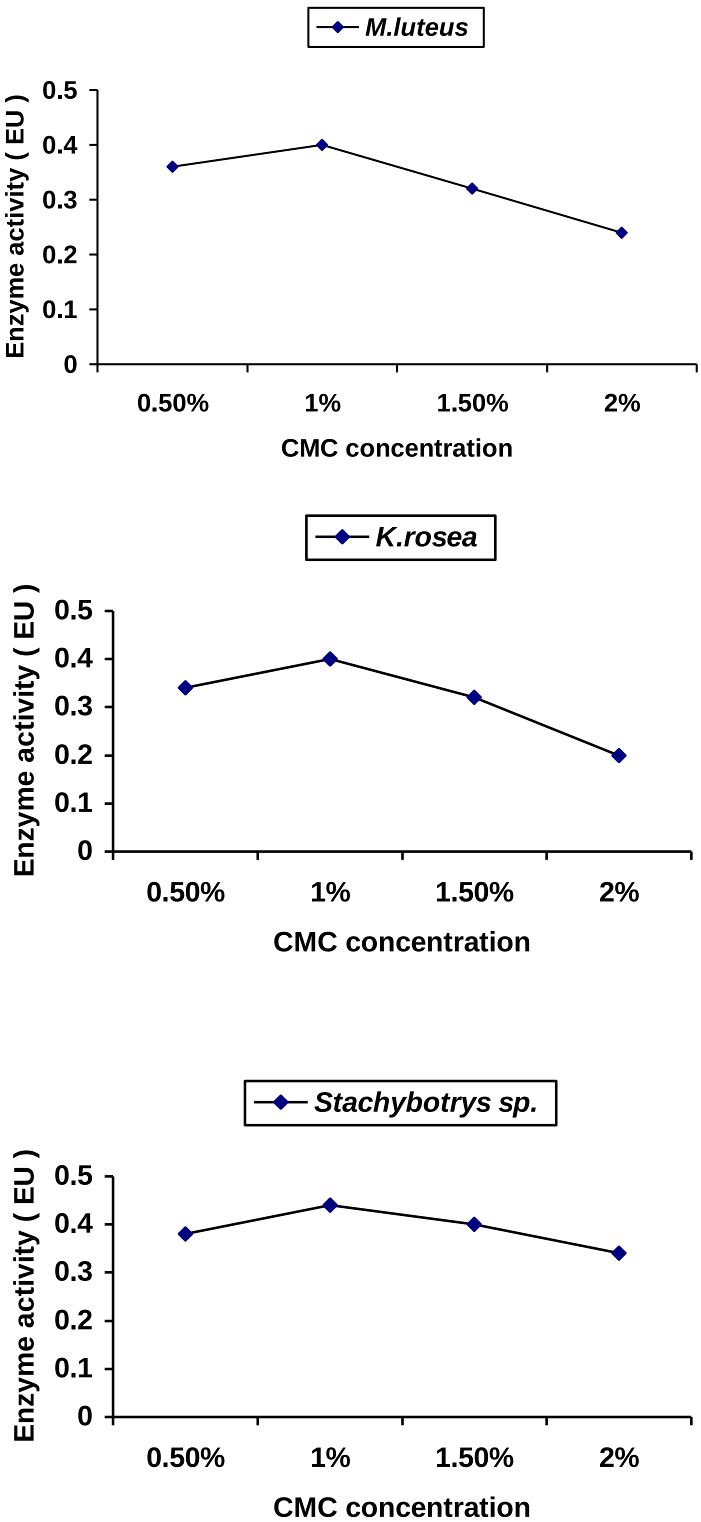


Fig (4): Effect of CMC concentrations on the cellulase activity of most active cellulase strains.

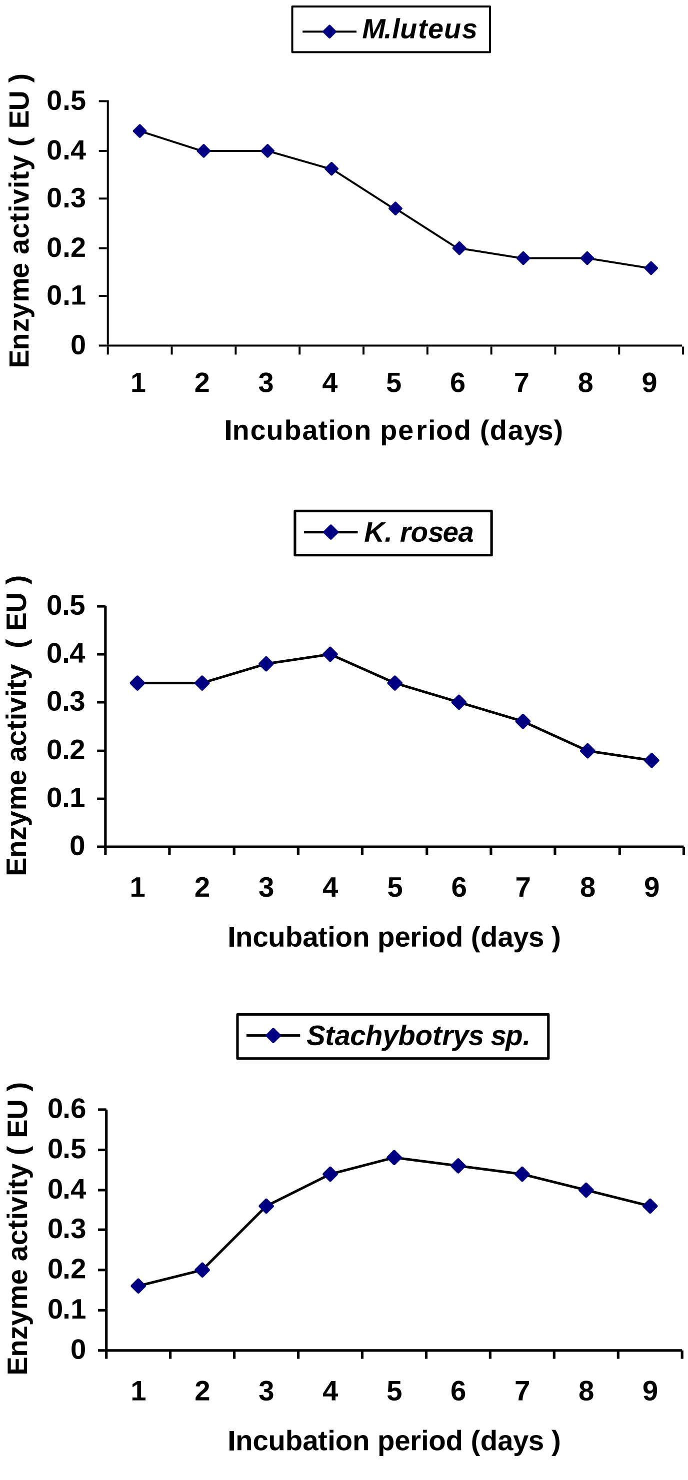


Fig (5): Effect of incubation periods on the cellulase activity of the most active cellulolytic strains .

Table (7): Effect of incubation temperature on the cellulase activity of most active cellulolytic strains :

Temperature °C	Cellulase activity (EU)		
	M.luteus	***K.rosea***	***Stachybotrys sp.***
25	0.4	0.4	0.44
30	0.44	0.4	0.48
35	0.46	0.42	0.4
40	0.46	0.46	0.12
45	0.48	0.48	0
50	0.44	0.42	0

Table (8): Effect of pH on the cellulase activity of most active cellulolytic strains :

pH	Cellulase activity (EU)		
	M.luteus	***K.rosea***	***Stachybotrys sp.***
4	0.1	0.1	0.24
4.5	0.24	0.1	0.5
5	0.3	0.22	0.56
5.5	0.32	0.3	0.6
6	0.46	0.42	0.56
6.5	0.48	0.48	0.48
7	0.52	0.5	0.4
8	0.46	0.44	0.32
9	0.4	0.32	0

EU = Enzyme activity expressed as mg/ml/hour

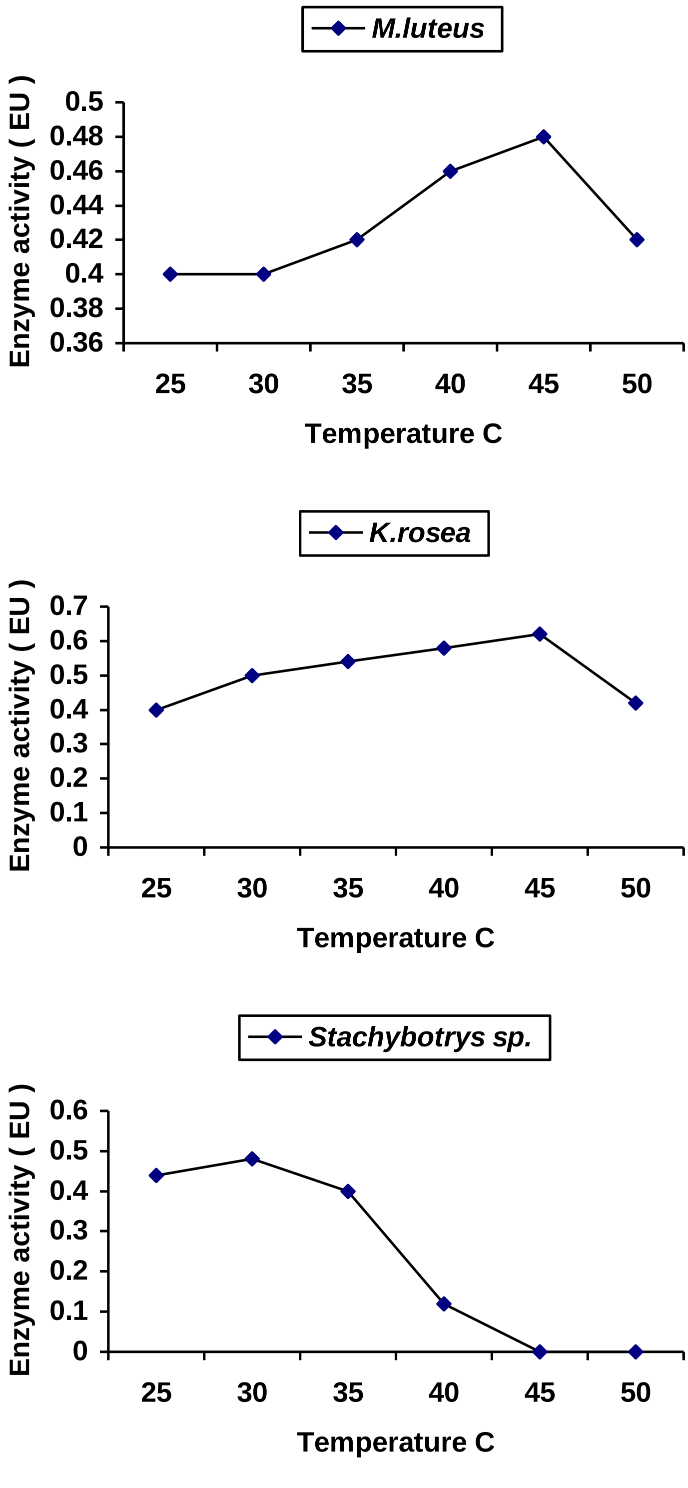


Fig (6): Effect of incubation temperature on the cellulase activity of most active cellulolytic strains

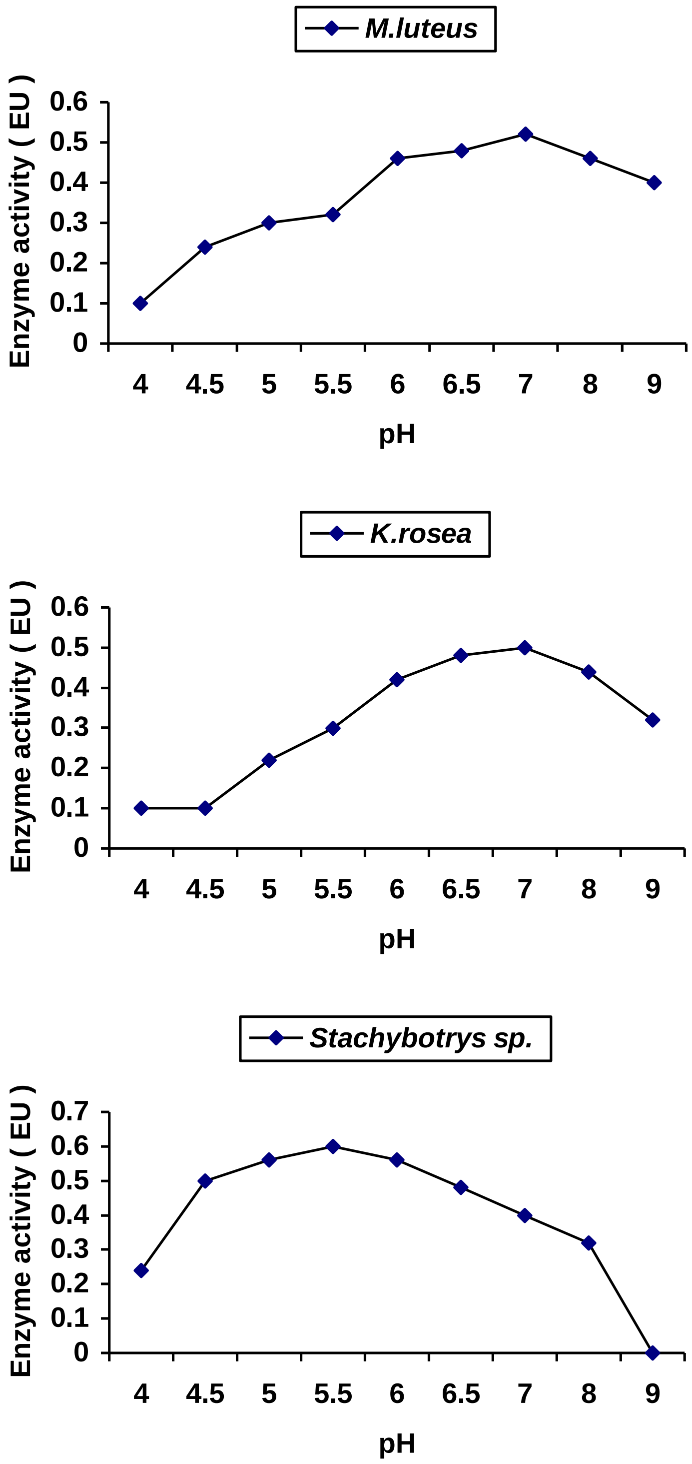


Fig (7): Effect of pH on the cellulase activity of the most active cellulolytic strains.

Table (9): Effect of different nitrogen sources on the cellulase activity of most active cellulolytic strains:

N-source	Cellulase activity					
	M.luteus		***K.rosea***		***Stachybotrys sp.***	
	EU	RA	EU	RA	EU	RA
Control	0.52	100	0.5	100	0.6	100
Amm. nitrate	0.48	93.7	0.46	93.5	0.64	106.6
Amm. sulphate.	0.48	93.7	-ve	0	0.62	103
Amm. chloride	-ve	0	-ve	0	0.5	85.2
Amm. acetate	-ve	0	-ve	0	0.6	106
yeast	0.56	107.7	0.54	.108	0.6	106
Peptone	0.52	100	0.5	100	0.66	110
Urea	0.52	100	-ve	0	0.62	103
Arginine	0.46	88.5	-ve	0	0.56	94.1
Asparagines	0.44	84.6	0.5	100	0.6	100

EU = Enzyme activity expressed as mg/ml/hour

Control = Sodium nitrate

RA = Relative activity

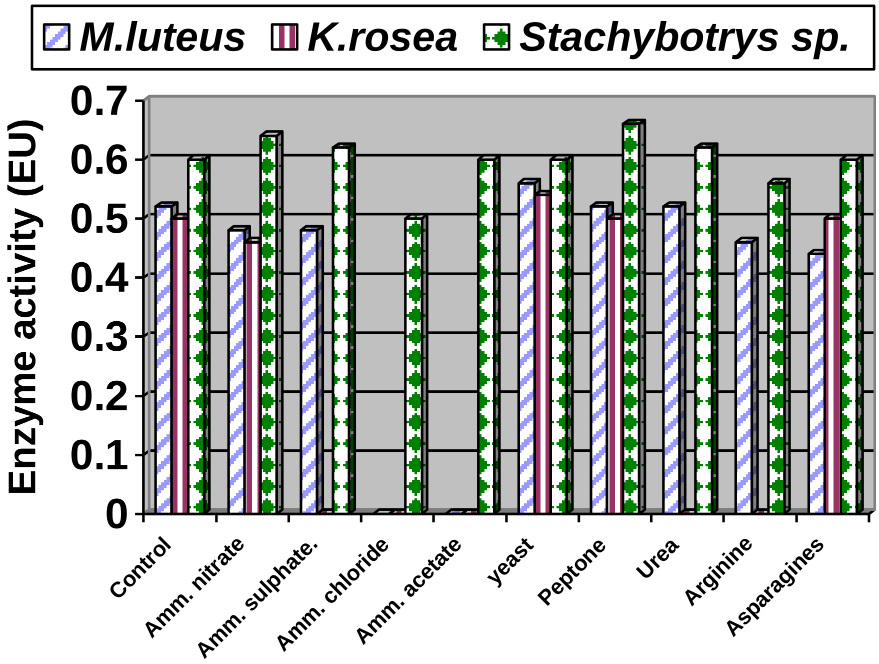


Fig (8): Effect of different nitrogen sources on the cellulase activity of most active cellulolytic strains.

most effective one for *Stachybotrys sp*. (0.66 EU). Other nitrogen sources resulted considerable reduction in the cellulolytic activity.

4.4.7.Effect of trace elements:

The metallic ions may act as activators or inhibitors for the enzymes. Data presented in Table (10) and Fig. (9) showed that cellulase activity increased by the addition of 500 ppm of Mn SO_4 , $CaCl_2$, and $CoSO_4$ for *M.luteus* (0.62 *EU) K. rosea* (0.58 Eu), and *Stachybotrys sp*. (0.68 Eu), respectively. On the other hand the enzyme activity was inhibited or repressed by other metallic ions added.

4.4.8. Effect of vitamins:

Data recorded in Table (11) and Fig. (10) revealed that all vitamins used in this study acted as inhibitors for the enzyme activity of *M.luteus, K. rosea* and *Stachybotrys sp*. comparing with control (without vitamin)

4.4.9. Media and condition recommended for maximum enzyme activity:

Data presented in Table (12) showed that the optimum condition for maximizing enzyme activity of *M.luteus* was 1% CMC as carbon source , yeast as nitrogen source 0.5 %, Mn SO_4 as metallic ion and incubation at pH 7 for 1day at 45°c, and for *M. rosea* was 1% CMC, yeast 0.8 gm/l as nitrogen source , 0.5 % $CaCl_2$ as metallic ion at pH 7 and incubation for 4 days at 45°C. Also, CMC as carbon source at 1% conc., peptone 2.2 g/l as nitrogen source and 0.5 % $CoSO_4$ as metallic ions was the optimum condition for *Stachybotrys sp*. when incubated at pH 5.5 for 5 days at 30°C.

Table (10): Effect of addition of different metallic ions on the cellulase activity of most active cellulolytic strains:

Trace elements 500 p.p.m.	Cellulase activity (EU)					
	M.luteus		*K.rosea*		*Stachybotrys sp.*	
	EU	**RA**	**EU**	**RA**	**EU**	**RA**
control	0.56	100	0.54	100	0.66	100
$MnSO_4$	0.62	110.7	0.56	103	0.42	63.2
$CaSO_4$	0.3	53.5	0.54	100	0.34	52.6
$ZnSO_4$	-ve	0	-ve	0	0.43	65.8
$CoSO_4$	-ve	0	-ve	0	0.68	103
$FeSO_4$	0.28	50	0.54	103	0.46	71
$NiSO_4$	-ve	0	-ve	0	0.57	86.8
$CuSO_4$	-ve	0	-ve	0	0.48	73.7
$CaCl_2$	0.56	100	0.58	106.2	0.36	55.2

Control = without treatments

EU = Enzyme activity expressed as mg/ml/hour

RA = Relative activity

Table (11): Effect of vitamins on the cellulase activity of most active cellulolytic strains :

Vitamins	Cellulase activity					
	M.luteus		*K.rosea*		*Stachybotrys sp.*	
	EU	**RA**	**EU**	**RA**	**EU**	**RA**
control	0.62	100	0.58	100	0.68	100
Riboflavin 50 ppm	0.58	93.5	-ve	0	0.47	60.2
Riboflavin 100 ppm	-ve	0	-ve	0	-ve	0
Biotin 50 ppm	0.58	93.5	0.5	86.2	0.6	88.2
Biotin 100 ppm	0.34	54.8	0.48	82.7	0.2	29.4
Ascorbic acid 50 ppm	0.62	100	0.58	100	0.62	91.1
Ascorbic acid 100 ppm	0.5	80.6	0.58	100	0.6	88.2
Nicotinic acid 50 ppm	0.52	83.8	0.3	51.7	0.54	79.4
Nicotinic acid 100 ppm	0.5	80.6	0.36	62	0.5	73.5

Control = without vitamins

EU = Enzyme activity expressed as mg/ml/hour

RA = Relative activity

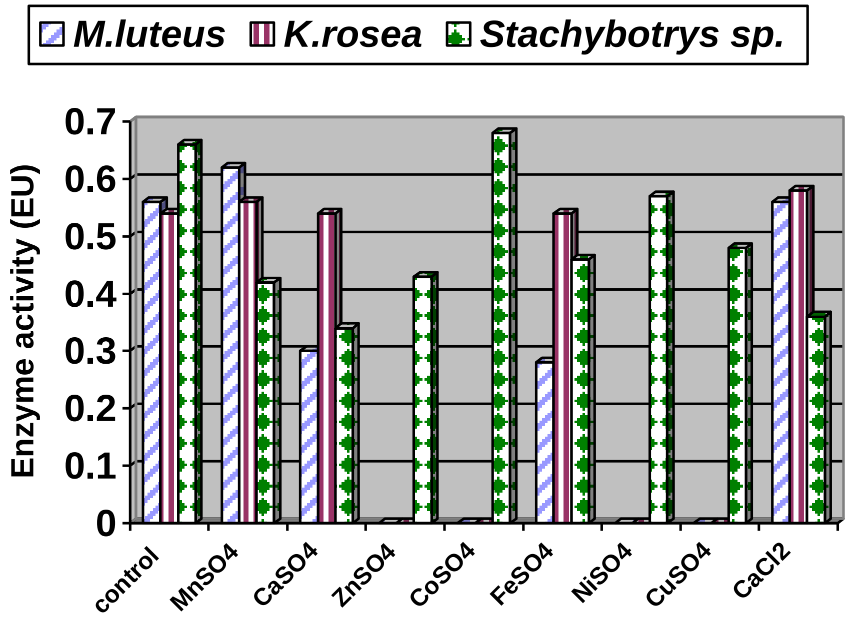


Fig (9): Effect of addition of different metallic ions on the cellulase activity of most active cellulolytic strains.

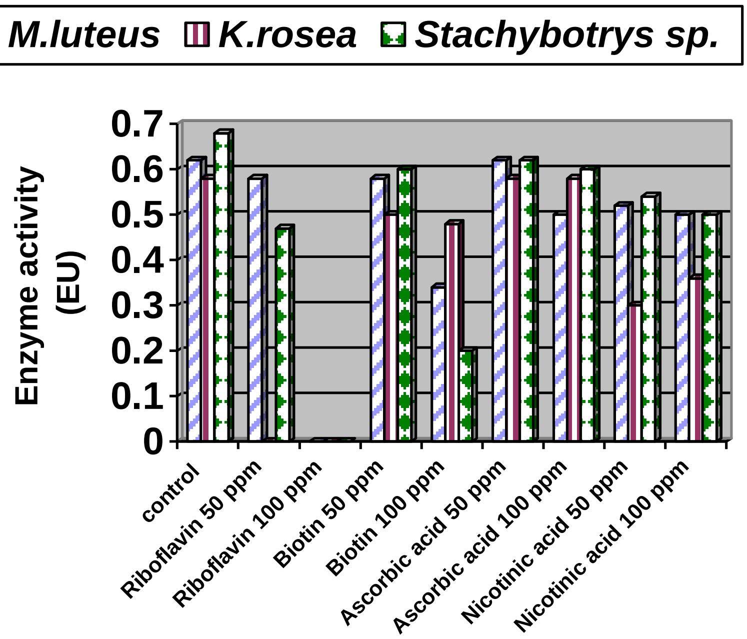


Fig (10): Effect of vitamins on the cellulase activity of most active cellulolytic strains.

Table (12): Media and condition recommended for the maximum production of cellulases activity :

Media and conditions	Selective strains		
	M.luteus	***K. rosea***	***Stachybotrys sp.***
CMC-conc.	1% (10 g / l)	1% (10 g / l)	1% (10 g / l)
N-source	Yeast (0.8g / l)	Yeast(0.8g / l)	Peptone(2.2g/l)
Metallic iones	$MnSO_4$(0.5g /l)	$CaCl_2$ (0.5g / l)	$CoSO_4$(0.5g / l)
Incubation time	1 day	4days	5days
Temperature	45^0C	45^0C	30^0C
pH	7	7	5.5

4.5. Detection of cellulase (CMCase) activity of the most active cellulolytic strains :

Data presented in Table (13) and Fig. (11) indicated that the highest diameter of CMC degradation zone was 3.2 cm for *Stachybotrys sp*. followed by *M.luteus* (2.8 cm) and *M. rosea* (2.4 cm) using the optimum conditions comparing with 2.7 cm, 2.2 cm and 2 cm for control media, respectively. .

4.6. Assay of different cellulases of the most active cellulolytic strains :

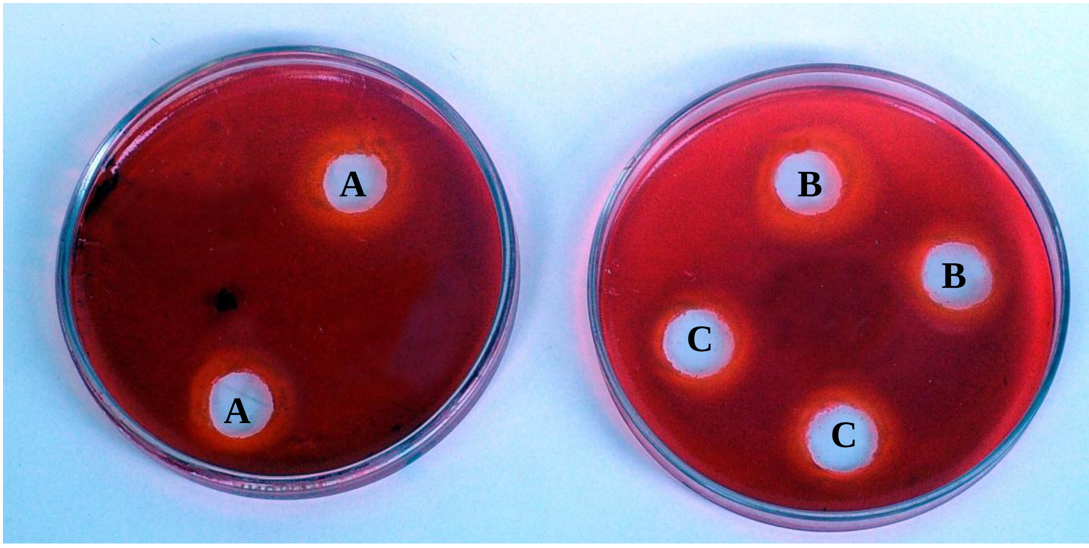
Data presented in Table (14) revealed that the most active cellulase enzyme was the CMCase followed by β-glucosidase and FPase for bacterial strains while for fungi strains FPase enzyne exceded β-glucosidase. The least active one for all the isolates was cellobiohydrolase . While the CMCase activity of *Stachybotrys sp*.(0.68 EU) was more than that of *M.luteus* (0.62EU) and *M. rosea* (0.58 EU) , the β-glucosidase of *Stachybotrys sp*.(0.17 EU) was less than that of both *M.luteus* (0.54 EU) and *M. rosea* (0.45 EU) .

4.7. Selection of the most active phosphate dissolving bacteria (PDB) isolates:

Data presented in Table (15, 16) revealed that the production of soluble phosphorus increased as pH values of inoculated medium decreased by growing the tested PDB isolates. The initial pH value for the inoculated medium was 7.2 and the soluble phosphorus was 4 ppm. The production of soluble phosphorus increased to reach its maximum levels being 101, 104 ppm at pH 4.6, 4.9 for isolates 9, 5, respectively after nine days of growth. Other isolates produced low soluble phosphorus. Isolate 9, 5 increased soluble phosphorus as much as 25, 26 folds comparing with control (soluble phosphorus 4 ppm).The most active isolate 5, 9 are identified as *Bacillus sp.*

Table (13) :Detection of cellulase (CMC ase) activity of the most active cellulolytic strains :

Cellulolytic strains	Diameter of CMC degradation zone (cm)	
	Before Optimization	**After Optimization**
Stachybotrys sp.	2.7 cm	3.2 cm
M..luteus	2.2 cm	2.8 cm
K.rosea	2.0 cm	2.4 cm



A: Degradation zone of CMC by *Stachybotrys sp*.

B: Degradation zone of CMC by *Micrococcus luteus*

C: Degradation zone of CMC by *Kocuria rosea*.

Fig (11) : Degradation zone of CMC by most active cellulolytic strains.

Table (14) : Assay of different cellulases of the most active cellulolytic strains :

Activity measured	The most active cellulolytic strains		
	M.luteus	***K.rosea***	***Stachybotrys sp.***
FPase mg/ml/hour	0.3	0.28	0.32
Cellobiohydrolase mg/ml/hour	0.018	0.043	0.031
CMCase mg/ml/hour	0.62	0.58	0.68
β-glucosidase mg/ml/hour	0.54	0.45	0.17
Total protein mg/ml	0.151	0.172	0.325

Table (15) : Estimation of pH of the modified Bunt Rovera medium contained rock phosphorus and inoculated with phosphate dissolving bacteria (PDB) isolates:

(PDB) isolates	PH of the inoculated media								
	1 day	2 days	3 days	4 days	5 days	6 days	7 days	8 days	9 days
1	7	7	6.8	6.7	6.6	6.6	6.6	6.5	6.3
2	7.2	7.1	7	6.9	6.7	6.6	6.4	6	5.8
3	7	6.9	6.8	6.8	6.8	6.7	6.5	6.4	6.4
4	6.9	6.9	6.8	6.8	6.8	6.7	6.7	6.6	6.6
5	5.9	5.6	5.5	5.4	5.2	5.1	4.9	4.9	4.9
6	6.8	6.8	6.7	6.7	6.6	6.5	6.5	6.2	6
7	7.1	7.1	7	7	7	6.9	6.9	6.8	6.7
8	7.1	7	7	6.9	6.9	6.8	6.7	6.7	6.5
9	6.5	6.3	6	5.4	5.1	5	4.7	4.6	4.6

pH of the medium at zero time (Control) : 7.2 pH

Table (16) : Estimation of soluble phosphorus produced in the media contained rock phosphate by different phosphate dissolving bacteria (PDB) isolates :

(PDB) isolates	**Soluble phosphorus p.p.m.**								
	1 day	2 days	3 days	4 days	5 days	6 days	7 days	8 days	9 days
1	5	5	9	15	27	28	30	33	34
2	16	29	37	38	39	39	39	40	40
3	4	5	5	8	10	21	28	39	42
4	5	6	9	9	9	9	10	11	11
5	12	18	20	33	70	87	98	103	104
6	5	5	6	7	9	27	30	42	47
7	5	6	6	8	10	10	10	11	12
8	8	9	12	12	16	22	30	42	48
9	28	54	70	82	90	95	97	101	101

Soluble phosphorus at (Zero time) : 4 p.p.m.

4.8. Composting of rice straw and garbage:

4.8.1. On small scale :

4.8.1.1.1. Chemical analysis:

Data in Table (17) revealed that, rice straw and garbage organic carbon content gradually decreased during composting for both uninoculated and inoculated treatments. The highest organic carbon contents were 37% and 24% for rice straw and garbage raw materials. Organic carbon percent decreased to 32, 25.2 and 19.6, 16.5 for uninoculated and inoculated rice straw and garbage after 90 days of composting, respectively.

For total nitrogen content, inoculating rice straw and garbage with cellullolytic micrgranisms and composting for 90 days increased total nitrogen from 0.53 to 1.3 and 1.6 and from 1.05 to 1.15 and 1.4% for uninoculated and inoculated treatments for rice straw and garbage respectively. C/N ratio for composted rice straw and garbage were 69.8 and 22.8 reached to 24.6, 15.8 and 17, 11.8 for uninoculated and inoculated treatments after composting for 90 days, respectively.

4.8.1.2 Microbiological analysis:

Data presented in Table (18) revealed that total microbial counts reached to 14, 20 x 10^6 for composting rice straw comparing with uncomposted rice straw raw material being 6.4 x 10^6 cfu/ gm dry rice straw for compositng uninoculated and inoculated one, respectively.

For thermophilic bacteria, counts increased from 4 to 7.7 and 12 x 10^6 cfu/ gm dry rice straw for raw material, uninoculated and inoculated rice straw, respectively.

Also, fungi, actinomycetes and cellulolytic agents reached to 3, 7, 20, 92 and 0.47, 2.8 comparing with control being 2x10^3, 8 x 10^4, 0.02x 10^4

Table (17) بعرض

Table (18) بعرض

cfu/ g dry rice straw for uninoculated and inoculated rice straw, respectively .

Also, for composting garbage and inoculation with cellulolytic agents increased counts of all microbes studied as presentes in Table (18) to reach their maximal levels after 90 days of composting.

4.8.2. Composting of rice straw and garbage at Maryut station (on large scale):

4.8.2.1. Microbiological analysis:

Data presented in Table (19) revealed that the total microbial counts, aerobic cellulose decomposers reached their maximal levels after 100 days of composting for rice straw and garbage materials: For total microbial counts , counts increased from 6 to 11.1 and 5.1 to 25 $x10^6$ cfu/ gm dry rice straw and garbage organic matter, respectively.

Also, aerobic cellulose decomposers, increased from 0.042 to 12.6 and 0.023 to 9 x 10^4 cells/ gm dry rice straw and garbage organic matter, respectively.

Obtained data generally showed that coliform group, *E-coli*, *Salmonella* , *Shigella* or *Proteus* counts reached their minimal levels after 100 days of composting.

Coliform group decreased from 120 to 4 and 148 to 7 x 10^3 cfu/ gm dry rice straw and garbage organic matter, respectively.

Also, other microbes detected as shown in Table (17) reached to zero after composting.

4.8.2.2. Chemical analysis:

It is clear from the data in Table (20) that, organic carbon was decreased gradually during composting to reach their minimal levels being

Table (19): Microbiological analysis of rice straw and garbage compost at different intervals (At Maryut station) :

Compost Samples	Totalcount $x10^6$ CFU g^{-1} dry matter	Cellulose decomposer x 10^4 cells g^{-1} dry matter	Coli form x 10^3CFU g^{-1} dry matter	*E.coli*	*Sallmonela, Shigella*,or *Proteus*
R^0	6	0.042	120	- ve	-ve
R_1	5.7	0.3	45	- ve	-ve
R_2	6.4	1.4	30	-ve	-ve
R_3	8.1	9.1	17	-ve	-ve
R_4	10.9	12.5	6	-ve	-ve
R_5	11.1	12.6	4	-ve	-ve
G^0	5.1	0.023	148	+ve	+ve
G_1	4.5	0.1	60	+ve	+ve
G_2	9.2	0.52	44	-ve	-ve
G_3	16	7	25	-ve	-ve
G_4	24	8.8	10	-ve	-ve
G_5	25	9	7	-ve	-ve

R_0 : rice straw raw material
R_1: 20 days after composting
R_2: 40 days after composting
R_3: 60 days after composting
R_4: 80 days after composting
R_5: 100 days after composting

G_0 : garbage raw material
G_1 : 20 days after composting
G_2 : 40 days after composting
G_3 : 60 days after composting
G_4 : 80 days after composting
G_5 : 100 days after composting

Table (20): Chemical analysis of rice straw and Garbage compost at different intervals during composting process (At Maryut station):

Compost samples	C%	C.loss %	N%	C/N	Phosphorus (p.p.m)	Humic iones %
R_0	37	0	0.53	69.8	500	2.3
R_1	32	13.5	0.7	45.7	590	2.5
R_2	29.8	19.5	0.98	30.4	750	2.6
R_3	28.5	23	1.4	20.3	930	3.8
R_4	26.8	27.6	1.4	16.7	1200	4.1
R_5	26.7	27.8	1.66	16.1	1250	4.2
G_0	24	0	1.05	22.8	250	2
G_1	21	12.5	1.08	19.5	510	2.2
G_2	19.2	20	1.1	17.4	850	2.5
G_3	18.2	24.2	1.19	15.3	900	4.0
G_4	17.2	28.3	1.22	14.1	1100	4.2
G_5	17	30	1.32	12.9	1500	4.4

R_0 : rice straw raw material
R_1: 20 days after composting
R_2: 40 days after composting
R_3: 60 days after composting
R_4: 80 days after composting
R_5: 100 days after composting

G_0 : garbage raw material
G_1 : 20 days after composting
G_2 : 40 days after composting
G_3 : 60 days after composting
G_4 : 80 days after composting
G_5 : 100 days after composting

26.7% and 17% and carbon loss increased from zero to 27.8% , 30% while N % increased from 0.53 % to 1.66 % and from 1.05 % to 1.32 % for rice straw and garbage after 100 days of composting, respectively. The corresponding increase figures for phosphorus from 500 to 1250 ppm and from 250 to 1500 ppm.

Also, C/N ratio showed that uncomposted raw materials exhibited wide C/N ratio and narrow C/N ratio recorded after 100 days of composting being 16.1 and 12.9 for rice straw and garbage, respectively.

Humic ions increased as percentage from 2.3 to 4.2 for rice straw and from 2 to 4.4 for garbage organic matter after 100 days of composting .

4.9.1. Microbial densites of sun flower :

4.9.1.1. Total microbial count :

Data presented in Table (21) and Fig. (12) showed that microbial growth increased towards heading stage, then decreased to reach their lowest counts at the end of experiment (90) days after cultivation, and their counts at harvesting growth were lower than those of vegetating stage of sunflower plants growth . In all growth stages of plants, biofertilizer separately or in combination with garbage or rice straw manure gave the highest counts figures of microbes in the rhizosphere region.

Obtained data generally showed that application of the full dose of inorganic N- fertilizer considerably stimulates microbial counts in the rhizosphere of sunflower plants more than those provided with half N- dose or those received no inorganic N-fertilizer. The highest counts figure, being 122 and 117 $x10^5$ cfu /g dry soil for rice straw and garbage organic manures combined with biofertilizer and receiving full dose of inorganic N-fertilizer . It was also noticed that the reduction of N- fertilization dose resulted in decreasing microbial counts in sunflowers rhizosphere region reaching their minimal levels in the absence of inorganic N-fertilizer at harvesting stage of plant growth.

Table (21): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the total microbial counts in the rhizosphere of sunflower plants.

Treatments	Total microbial counts x 10^5 CFU g^{-1} dry soil								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	30	43	44	38	40	66	22	41	40
BIO	41	70	61	44	78	70	30	60	50
½ N	40	50	52	44	48	66	21	42	41
½ N +BIO	53	64	61	68	92	84	32	59	48
N	48	53	55	58	68	60	25	38	38
N+BIO	71	80	72	92	122	117	30	62	50

Initial count = 12 x 10^5 CFU g^{-1} dry soil

W : without organic matter

R: Composted rice straw G : Composted garbage

Fig (12)

4.9.1.2. Phosphate dissolvers:

It is clear from the data recorded in Table (22) and represented graphically in Fig. (13), that control treatments exhibited less counts if compared with treated ones in all stages of plant growth.

Also, data showed that the counts of phosphate dissolvers increased as inorganic N-dose increased. The highest count of PDB group of microorganisms were in the presence of full dose of inorganic N-fertilizer,biofertilizers and organic manures (garbage or rice straw) being 46 and $41x10^3$ cfu/ g dry soil then followed descendingly in the presence of $^1/_2$ N fertilizer being 40 and 38 $x10^3$ cfu/ g dry soil amended with garbage and rice straw, organic manures, that increased counts as much as (5.1,4.9) and (3.9 ,3.8) folds if compared with control treatments being 11, 10 $x10^3$ cfu/ g dry soil at flowering stage of sunflower plant growth.

4.9.1.3. Azotobacters:

In all growth stages of sunflower plant, biofertilization separeately or in combination with composted garbage or rice straw gave the highest count figures of azotobacters in the rhizosphere region, Table (23) and Fig. (14).

Application of (garbage manure or rice straw manure) in combination with biofertilization and inorganic N- fertilizer stimulates azotobacter densities in all stages especially at flowering stage of sunflower plant growth.

4.9.1.4. Cellulose decomposers:

Data presented in Table (24) and Fig. (15) showed that addition of organic composts either rice straw or garbage had a strong effect on the densities of cellulolytic agents. The densities of cellulose decomposers

Table (22): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on phosphate dissolving bacteria counts in the rhizosphere of sunflower plants.

Treatments	Phosphate dissolving bacteria counts x 10^3 CFU g^{-1} dry soil								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	8	9	9	8	10	11	3	4	6
BIO	12	14	15	30	24	28	5	7	8
½ N	8	14	18	10	19	22	3	8	7
½ N +BIO	20	25	26	32	38	40	6	10	14
N	10	13	14	16	18	19	4	7	9
N+BIO	21	23	24	30	41	46	6	9	12

Initial count = 3 x 10^3 CFU g^{-1} dry soil

W : without organic matter

R: Composted rice straw G : Composted garbage

Fig (13)

Table (23): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on Azotobacters count in the rhizosphere of sunflower plants.

Treatments	**Azotobacters count x 10^2 cells g^{-1} dry soil**								
	Vegetating			**Flowering**			**Harvesting**		
	W.	**R.**	**G.**	**W.**	**R.**	**G.**	**W.**	**R.**	**G.**
Control	10	13	12	11	19	19	5	12	14
BIO	20	26	29	22	39	49	17	20	22
½ N	11	14	15	12	24	27	9	14	15
½ N +BIO	20	29	32	26	45	42	20	26	26
N	12	17	18	13	24	21	9	13	16
N+BIO	19	24	26	20	32	39	13	24	26

Initial count = 4 x 10^2 cells g^{-1} dry soil

W : without organic matter

R: Composted rice straw G : Composted garbage

Fig (14)

Table (24): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on cellulose decomposer counts in the rhizosphere of sunflower plants.

Treatments	Cellulose decomposer counts x 10^2 cells g^{-1} dry soil								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	4	10	10	9	24	28	21	28	38
BIO	8	13	12	10	26	30	21	33	50
½ N	9	13	12	21	27	32	22	34	40
½ N +BIO	9	16	21	20	23	39	23	40	48
N	8	10	24	18	24	32	27	38	44
N+BIO	10	17	20	21	30	46	29	50	54

Initial count = 2 x 10^2 cells g^{-1} dry soil

W : without organic matter

R: Composted rice straw G : Composted garbage

Fig (15)

detected in the rhizosphere of biofertilized sunflower plants were more than those enumerated in the rhizosphere of unbiofertilized plants even those provided organic manures. Cellulose decomposers reached their maximal densities after (90 days) of cultivation in the rhizosphere of biofertilized plants receiving N- fertilizer and amended with garbage or rice straw manures being 54 and 50 $x10^2$ cells/ g dry soil, increased densities as much as 1.4 and 1.78 folds comparing with control being 38 and 28 $x10^2$ cells/ g dry soil, respectively .

4.9.2. Plant characteristics of sun flower :

4.9.2.1. Plant height:

Data in Table (25) and Fig. (16) recorded that plant height significantly influenced by types of composted organic manures, biofertilization, inorganic N-supplementation and stages of sunflower plant growth. The control plants received neither organic manures nor biofertilizer in the absence of inorganic N- fertilization gave the lowest sunflower height plants in all growth stages. Application of inorganic N-fertilizer resulted in a remarkable increase in the plant height. Biofertilized plant cultivated in soil supplemented with rice straw or garbage composted organic manures and received the full dose of inorganic N- fertilizer gave plants more higher than those supplemented with half dose. The highest height recorded at harvesting stage of sunflower plant growth being 155 and 150 cm for the biofertilized treatments supplemented with rice straw and garbage ,respectively and received the full dose of inorganic N-fertilizer in comparison to only 129, 125 cm height after the same growth period of plants.

Table (25): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the height of sunflower plants

Treatments	Height of sunflower stem (cm) at different stages								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	76	87	83	109	118	114	121	129	125
BIO	97	104	98	112	120	115	127	135	133
½ N	98	103	100	119	123	123	137	140	140
½ N +BIO	100	109	107	120	122	128	140	144	146
N	103	109	107	118	131	127	138	151	146
N+BIO	108	114	114	124	134	130	147	155	150

- W : without organic matter

- R: Composted rice straw - G : Composted garbage

LSD at 5% :

- Treatments 4.839
- O.M. 3.42
- Stages 3.42
- Treatments **x** O.M. 8.37
- Treatments x Stages 8.37
- O.M x Treatments 5.912
- O.M x Treatments x Stages 14.48

Fig (16)

4.9.2.2.Shoot fresh weight:

Data presented in Table (26) and Fig. (17) recorded that the control sunflower plants received neither organic manure nor biofertilizer and in the absence of inorganic N- fertilizer gave the least fresh weights in all growth stages. Biofertilizer application increased fresh weight of sunflower stem comparing with organic manures supplementation. Full dose of inorganic N-fertilizer was more pronounced than that obtained by the application of half normal dose or in the absence of mineral fertilization. The plant shoots reached their maximal fresh weights being 672, 658 g /plant for rice straw and garbage manures mixed with biofertilizer in the presence of full dose of inorganic N- fertilizer at harvesting stage of plant growth.

4.9.2.3. Shoot dry weight:

Data presented in Table (27) and Fig. (18) represented the dry weights in gm/ plants as affected by plant stages and the applied treatments. Apparently, all the experimental factors improved the obtained dry weight. The lowest dry weight results achieved generally with control treatments. Combining garbage or rice straw manures with biofertilizer or inorganic nitrogen fertilizer significantly increased it. The highest significance increase was recorded with mixing organic manures and biofertilizer receiving half and full normal field dose of inorganic nitrogen fertilizer giving 149, 157 gm/ plant for rice straw and garbage, respectively.

From these results, it was noticed that the increasing of sunflower plant age led to increasing in fresh and dry weights for all treatments.

Also, fresh and dry weights significantly increased with increasing inorganic N fertilizer supplementation. Maximum values were significantly obtained by biofertilizer inoculation in the presence of full dose of

Table (26): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on shoot fresh weight of sunflower stem.

Treatments	Shoot fresh weight of sunflower stem (gm/plant)at different plant stages								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	197	315	265	325	333	344	400	447	429
BIO	271	440	301	343	461	494	422	567	550
½ N	272	375	309	445	570	567	502	595	604
½ N +BIO	367	466	443	524	622	601	570	650	660
N	301	360	336	500	624	602	543	653	624
N+BIO	324	471	460	520	639	638	554	672	658

- W : without organic matter

- R: Composted rice straw - G : Composted garbage

LSD at 5% :

-. Treatments 4.77

- O.M. 3.37

- Stages 3.37

- Treatments **x** O.M. 8.27

- Treatments x Stages 8.27

- O.M x Stages 5.85

- O.M x Treatments x Stages 15.1

Fig (17)

Table (27): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the shoot dry weight of sunflower

Treatments	Shoot dry weight of sunflower stem (gm/plant) at different plant stages								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	30	41.6	41.3	66.6	75	87	84	96	109.2
BIO	41	50.6	51	72	81	95	95	103.7	110
½ N	33	50	49.5	73.5	80	105	88.2	98	112.2
½ N +BIO	55	70.8	72	87	123	134	104.4	149	154
N	51	60	55	80	90	104	96	108	125
N+BIO	56.5	75	72	86	115	122	111.8	138	157

- W : without organic matter

- R: Composted rice straw - G : Composted garbage

LSD at 5% :

- Treatments 4.527

- O.M. 3.201

- Stages 3.201

- Treatments **x** O.M. 7.821

- Treatments x Stages 7.821

- O.M x Stages 5.52

- O.M x Treatments x Stages -. 13.56

Fig (18)

inorganic nitrogen using garbage manure being 157 gm/ plant and the half dose of inorganic N fertilizer for rice straw manure being 149 gm/plant for dry weights of shoots at harvesting stage of sunflower plant growth, respectively.

4.9.2.4. Chlorophyll content:

Concerning with chlorophyll content, the lowest ones were obtained in plants at vegetating stage significantly increased to reach its maximum at flowering stage of plants, Table (28) and Fig. (19). It has been found that the maximum chlorophyll content recorded with using rice straw followed by garbage manures in the presence of bioferitilizer and with half or full dose of inorganic nitrogen fertilizers .

4.9.2.5. Statistical analysis :

As shown in Table (29) , shoot length, fresh and dry weights of sunflower plants significantly increased to reach its maximum at harvesting stage of plants growth.

For organic manures, both rice straw and garbage have positive effects towards all plant parameters , but garbage manure was more significant for plant height and chlorophyll content than rice straw .

Concerning with treatments , the lowest significance values recorded with control. Inorganic nitrogen fertilizer significantly increased plant heights, fresh and dry weights and chlorophyll content of plant whatever N or $^{1}/_{2}$ N fertilizer. Using biofertilizer in the presence of inorganic nitrogen fertilizer was more effective than bioferitlizer alone for plant height, fresh and dry weights and chlorophyll content and there was no significant difference between $^{1}/_{2}$ N or N except for plant height.

Table (28): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the chlorophyll content of sunflower plants.

Treatments	Chlorophyll of sunflower plant at different plant stages					
	Vegetating			Flowering		
	W.	R.	G.	W.	R.	G.
Control	33.0	35.0	36.0	41.6	42.4	42.3
BIO	35.6	35.6	37.3	41.3	42.8	42.8
½ N	33.3	38.0	36.2	43.3	44.1	44.2
½ N +BIO	38.0	39.0	37.2	44.3	47.8	45.3
N	34.5	36.5	36.2	40.5	43.2	42.0
N+BIO	35.0	37.3	37.7	46.0	47.4	46.6

- W : without organic matter

- R: Composted rice straw - G : Composted garbage

LSD at 5% :

-. Treatments	1.24
- O.M.	0.72
- Stages	0.88
- Treatments x O.M.	2.15
- Treatments x Stages	1.75
- O.M x Stages	1.246
- O.M x Treatments x Stages	3.05

Fig (19)

Table (29): Statistical mean effects of stages, Organic matter , biofertilizer and N-supplementation (Treatments) on the length, fresh weight, dry weight and chlorophyll of sunflower plant .

Factors		Length	Fresh weight	Dry Weight	Chlorophyll
Stages	**Vegetating**	101.1 c	347.7 c	53.1 c	36.05 b
	Flowering	121.3 b	507.8 b	92.6 b	43.8 a
	Harvesting	139 a	559.9 a	111.8 a	ND
Organic matter	**Without O.M.**	116.2 b	409.9 c	72.52 c	38.9 b
	Rice straw	123.8 a	492.2 b	89 b	40.73 a
	Garbage	121.4 a	513.2 a	95.9 a	40.12 a
Treatments	**Control**	106.9 d	339.3 e	68.7 d	38.4 c
	Biofertilizer	115.2 c	427.3 d	77.6 bc	39.2 bc
	1/2 N	119.8 c	469.9 c	75.2 cd	39.9 b
	1/2 N+ Bio.	124.7 b	545.2 a	104.9 a	41.6 a
	N	125.4 b	505 b	85.3 b	38.8 bc
	N+Bio.	130.7 a	544.2 a	103.3 a	41.5 a

4.9.2.6. Disc diameters and yield:

Data presented in Table (30) and Fig. (20) showed that the control alone gave low disc diameter being 19.5 and weight of seeds being 1. 46 ton/ fed. Bio-organic treatments significantly increase disc diameter being 24.5, 23 cm and high production of seeds being 1.63, 1.85 ton/ fed for rice straw and garbage manure, respectively. The highest significant increase recorded with using biofertilizer inoculation supplemented with full dose of inorganic nitrogen fertilizer and amended with manures , for disc diameter being 25, 25 cm and production of seeds being 2, 2.1 ton/ fed for rice straw and garbage manures, respectively.

4.9.2.7. Weight of 1000 seeds and oil % :

Data presented in Table (31) and fig (21) show that the lowest oil percent and weights of 1000 seeds recorded with control treatment being 31.9 % and 95 gm significantly increased by amending soil with organic manures .Garbage manure was more effective than rice straw manure. The highest oil percent and weights of 1000 seeds were recorded with organic manures using biofertilizer supplemented with full normal field dose of inorganic N fertilizer .

4.9.2.8. Statistical analysis :

Generally , as shown in Table (32) all the parameters measured (disc diameter , weight of seeds/feddan ,weight of 1000 seeds and oil percent showed high significant increase in treatments received full normal dose of inorganic nitrogen fertilizer and amended with rice straw or garbage manure and biofertilizer. Also, using half normal field dose of inorganic nitrogen fertilizer amended with rice straw or garbage manure and biofertilization significantly increased the previous parameters equal to full normal field dose of N.

Table (30): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the yield of sunflower plants.

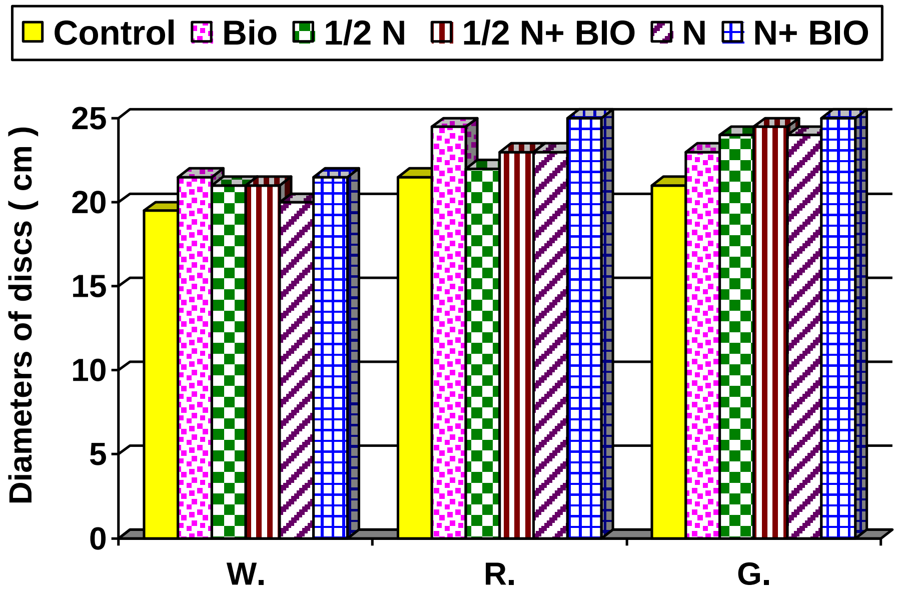
Treatments	Diameter of disc (cm)			weight of seed (ton)/ feddan		
	W.	R.	G.	W.	R.	G.
Control	19.5	21.5	21	1.46	1.57	1.53
BIO	21.5	24.5	23	1.59	1.63	1.85
½ N	21	22	24	1.61	1.6	1.76
½ N +BIO	21	23	24.5	1.7	1.67	1.93
N	20	23	24	1.7	1.83	1.9
N+BIO	21.5	25	25	1.76	2.0	2.1

W : without organic matter

R: Composted rice straw G : Composted garbage

LSD at 5% :

- Treatments 0.85 0.068
- Organic matter 0.6 0.048
- Treatments x O.M. 1.482 0.115



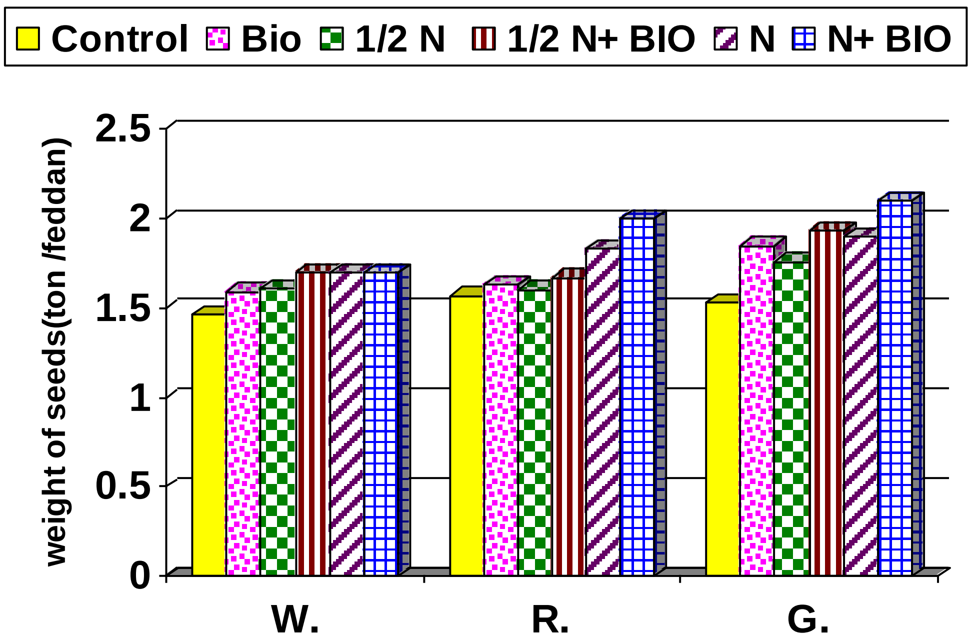


Fig (20): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the yield of sunflower plants.

Table (31): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the weight of 1000 seed (gm) and oil content (%) of sunflower plants.

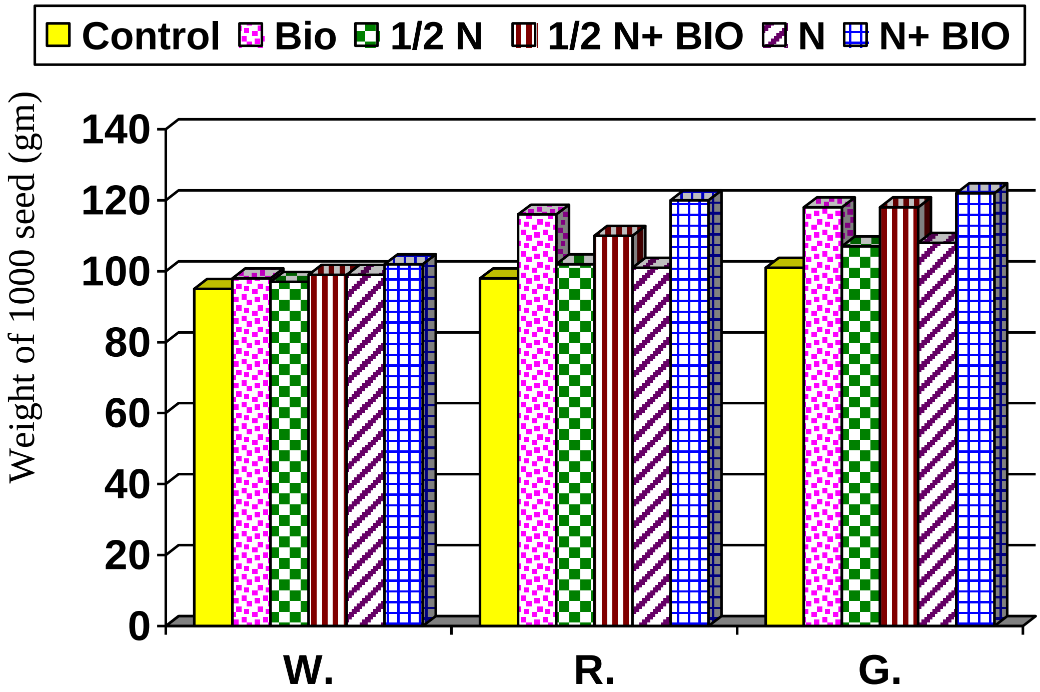
Treatments	weight of 1000 seed (gm)			Oil %		
	W.	R.	G.	W.	R.	G.
Control	95	98	101	31.9	32	33
BIO	98	116	118	33	36	39
½ N	97	102	107	32.4	35	37
½ N +BIO	99	110	118	35	37	38
N	99	101	108	35	37.6	38.6
N+BIO	102	120	122	36	38.9	40

W : without organic matter

R: Composted rice straw G : Composted garbage

LSD at 5% :

- Treatments	5.34	0.362
- Organic matter	3.77	0.256
- Treatments x O.M.	9.25	0.626



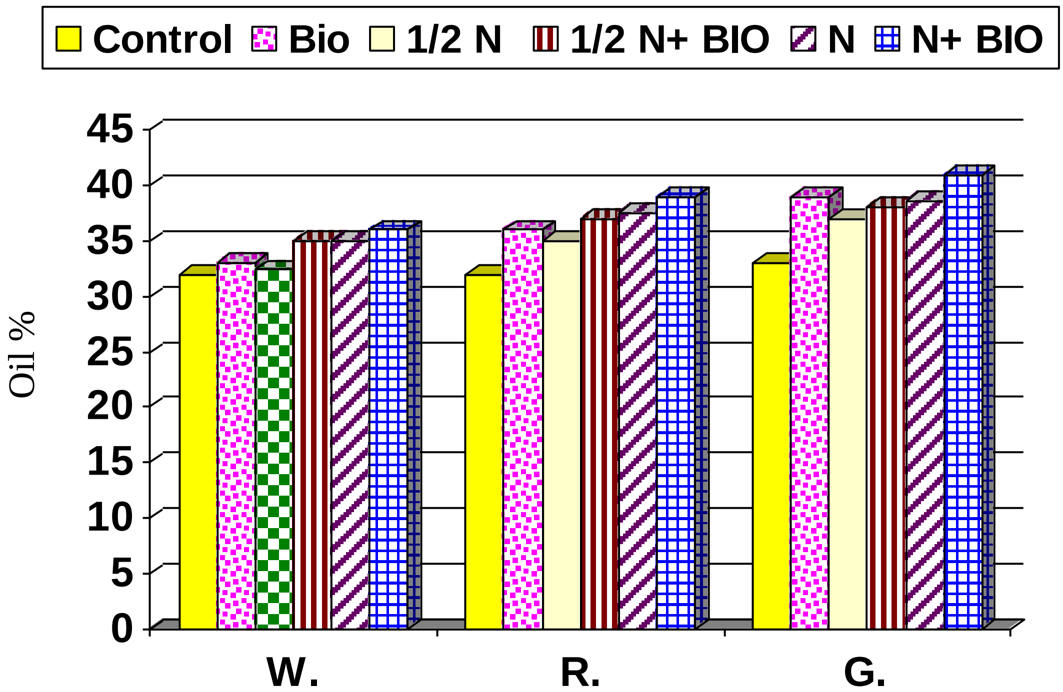


Fig (21): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the weight of 1000 seed (gm) and oil content (%) of sunflower plants.

Table (32) :Statical mean effects of organic matter , biofertilizer and N-supplementation (Treatments) on the diameter of discs , weight of seeds / feddan , weight of 1000 seeds and oil content of sun flower plant .

Factors		Disc diameter (cm)	Seeds weight (ton /feddan)	Weight of 1000 seeds (gm)	Oil percent %
Organic matter	Without O.M.	20.75 b	1.63 c	9.8 b	33.88 c
	Rice straw	23.2 a	1.71 b	10.9 a	36.08 b
	Garbage	23.58 a	1.84 a	10.93 a	37.6 a
Treatments	Control	20.6 c	1.52 d	9.8 d	32.3 e
	Biofertilizer	22.94 b	1.68 c	107.3 bc	36 d
	1/2 N	22.3 b	1.65 c	102.6 bc	34.8 f
	1/2 N+ Bio.	22.83 b	1.76 b	108.1 b	36.6 c
	N	22.94 b	1.81 b	102 cd	37.06 b
	N+Bio.	23.8 a	1.95 a	114.6 a	38.3 a

4.9.3. The microbiological characteristics of corn rhizosphere :

4.9.3.1. Total microbial counts :

It is obvious from the data presented in Table (33) and Fig. (22) that microbial counts affected by different treatments under study. Counts affected by stages of corn plant growth, organic and inorganic nitrogen fertilizer and biofertilizer application. The remarkable increase were recorded at flowering if compared with vegetating or harvesting stages of plant growth. Treatments amended with biofertilizer, or organic treatments were higher than those of inorganic nitrogen treatments in all stages of corn plant growth.

The highest increase for microbial densities were recorded with biofertilizer application amended with garbage manure being 125 x 10^5 cfu/ gm dry soil followed by rice straw manure being 120 x 10^5 cfu/ gm dry soil receiving full normal field dose of inorganic nitrogen fertilizer at flowering stage of plant growth .

4.9.3.2. Phosphate dissolving bacteria (PDB):

It is clear from the data in Table (34) and Fig.(23) that the changes in counts were considerably affected by stages of plant growth, types of organic manures, levels of inorganic nitrogen fertilizer and biofertilizer.

With respect to stages of corn plant growth, the highest counts were recorded during flowering stage then decreased towards harvesting. Biofertilizer and inorganic N fertilizer treatments were more pronounced than bio-organic treatments in all stages of plant growth. The highest PDB count was recorded with treatment receiving full normal field dose of inorganic nitrogen fertilizer and amended with garbage manure and

Table (33): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on total microbial counts in the rhizosphere of corn plants.

Treatments	Total microbial counts x 10^5 CFU gm^{-1} dry soil								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	36	47	43	70	82	89	28	44	44
BIO	55	66	60	76	95	96	53	62	64
½ N	38	48	44	73	88	89	37	45	46
½ N +BIO	54	67	64	90	102	110	50	61	62
N	39	50	44	77	90	90	34	50	52
N+BIO	62	71	60	100	120	125	54	65	66

W : without organic matter

R: Composted rice straw G : Composted garbage

fig (22)

Table (34): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on phosphate dissolving bacteria counts in the rhizosphere of corn plants.

Treatments	Phosphate dissolving bacterial countsx 10^3 CFU gm^{-1} dry soil								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	3	7	8	5	9	10	3	4	6
BIO	7	13	14	9	20	20	5	11	13
½ N	8	11	10	14	19	18	7	8	10
½ N +BIO	18	18	19	24	30	33	15	16	17
N	7	8	9	14	10	10	6	8	8
N+BIO	20	22	21	30	34	35	11	12	14

W : without organic matter

R: Composted rice straw G : Composted garbage

Fig (23)

biofertilizer being 35 x 10^3 cfu/ gm dry soil at flowering stage of plant growth.

4.9.3.3. Azotobacters :

Obtained results recorded in Table (35) and Fig.(24) apparently revealed that azotobacters densities, generally, increased in corn rhizosphere to reach its maximum levels at flowering stage of cultivation, nevertheless densities at plant maturity were lower than those obtained at vegetating. This may due to a shortage in biological nitrogen during the maturity of plant growth. Bio- organic treatments were higher than those of bio-inorganic nitrogen fertilizer in all stages of plant growth. The remarkable increase in azotobaters densities were obtained in bio-organic treatments receiving full or half normal field dose of inorganic nitrogen fertilizer being 39and 37 x10^2 cells/ gm dry soil for rice straw manures at flowering stage of corn plant growth, respectively.

4.9.3.4. Cellulose decomposers count :

In all growth stages of corn plant growth, organic treatments increased cellulose decomposers count significantly comparing with biofertilizer or inorganic nitrogen fertilizer treatments Table (36) and Fig. (25). generally , the counts increased progressively towards harvesting. However biofertilizer treatments amended with garbage followed by rice straw manures receiving full dose of inorganic nitrogen fertilizer recorded the highest figures being 46 and 42 x 10^2 cells / gm dry soil at harvesting stage of plant growth , respectively.

Table (35): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on azotobacters count in the rhizosphere of corn plants.

Treatments	Azotobacters count x 10^2 cells gm^{-1} dry soil								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	5	7	6	21	24	25	10	19	17
BIO	18	30	32	25	36	37	17	23	25
½ N	12	23	21	20	27	25	11	20	19
½ N +BIO	26	32	29	30	37	31	20	29	26
N	24	29	26	30	33	32	11	17	19
N+BIO	28	32	31	32	39	33	20	33	27

W : without organic matter

R: Composted rice straw G : Composted garbage

Fig (24)

Table (36): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on cellulose decomposer counts in the rhizosphere of corn plants.

Treatments	Cellulose decomposer counts x 10^2 cells gm^{-1} dry soil								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	5	23	27	17	33	34	11	35	47
BIO	9	33	32	14	33	36	14	39	45
½ N	17	24	27	16	38	39	12	47	49
½ N +BIO	18	36	36	19	40	41	13	42	46
N	8	26	29	18	30	32	10	42	45
N+BIO	10	28	29	18	38	38	12	45	49

W : without organic matter

R: Composted rice straw G : Composted garbage

Fig (25)

4.9.4. Plant Characterestics of corn:

4.9.4.1. Plant height:

Data presented in Table (37) and (26) revealed that the lowest shoot length for corn plants recorded at control treatments in all plant growth stages.

Bioorganic- inorganic nitrogen fertilizer treatments followed by bio-organic and then organic treatments increased plant height in all stages of plant growth in descending order. The highest significant increase for plant height recorded with biofertilizer application in treatments amended with rice straw followed by garbage manure receiving full normal field dose of inorganic nitrogen fertilizer being 250, 237 cm at harvesting stage of corn plant growth, respectively.

4.9.4.2. Shoot fresh weight:

It is obvious from the data presented in Table (38) and fig (27) that, increasing plant age led to increasing in fresh weight for all treatments. Organic manures followed in descending order by inorganic nitrogen fertilizer and biofertilizer application, stimulated and improved plant growth. Fresh weight significantly increased with increasing inorganic nitrogen supplementation and garbage more than rice straw manure.

From these results, it was noticed that biofertilizer application in the presence of full normal field dose of inorganic nitrogen fertilizer amended with garbage or rice straw manure recorded the highest significant increase being 749 gm/plant followed by half normal field dose of inorganic nitrogen fertilizer amended with garbage manure being 627 gm/plant and rice straw manure being 612 gm/plant, at flowering stage of plant growth.

Table (37): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the height of corn plants.

Treatments	Height of corn stem (cm) at different plant stages								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	49	56	58	120	140	148	160	195	188
BIO	65	67	70	155	162	163	193	204	201
½ N	56	70	64	141	163	161	206	215	202
½ N +BIO	66	77	81	158	190	195	225	240	226
N	65	70	68	160	172	170	219	240	235
N+BIO	66	79	86	167	192	195	221	250	237

- W : without organic matter

- R: Composted rice straw - G : Composted garbage

LSD at 5% :

Treatments	4.815
- O.M.	3.4
- Stages	3.4
- Treatments **x** O.M.	8.33
- Treatments x Stages	8.33
- O.M x Stages	5.89
- O.M x Treatments x Stages	14.45

Fig (26)

Table (38): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the shoot fresh weight of corn.

Treatments	Shoot Fresh weight of corn stem (gm/plant) at different plant stages					
	Vegetating			Flowering		
	W.	R.	G.	W.	R.	G.
Control	85	152	144	276	472	500
BIO	176	220	277	309	496	520
½ N	127	234	240	361	591	508
½ N +BIO	182	317	324	395	612	627
N	165	265	295	454	608	623
N+BIO	251	317	367	464	749	749

- W : without organic matter

- R: Composted rice straw - G : Composted garbage

LSD at 5% :

- Treatments 5.603
- O.M. 3.96
- Stages 3.23
- Treatments **x** O.M. 9.69
- Treatments x Stages 7.91
- O.M x Stages 5.603
- O.M x Treatments x Stages 13.718

Fig (27)

4.9.4.3. Shoot dry weight :

Data presented in Table (39) and Fig. (28) included dry weight in gm/plant as affected by organic manures, biofertilizers application and inorganic nitrogen fertilization. Apparently, all the experimental factors improved the dry significant increase for weight of corn plant, and the lowest results obtained with control. The highest dry weight was obtained with biofertilizer treatments receiving full normal field dose of inorganic nitrogen fertilizer amended with rice straw and garbage manures being 156, 160 gm/ plant, respectively.

From these result, it was noticed that increasing plant age led to increasing in fresh and dry weight for all treatments. Also, fresh and dry weights significantly increased within increasing inorganic nitrogen supplementation. The maximum values were significantly obtained by biofertilizer inoculation in the presence of full dose of inorganic nitrogen and amended with garbage or rice straw manures being 749 and 749 gm/plant as fresh weight at flowering stage and 160, 156 gm/plant for garbage and rice straw manures, as dry weight, at harvesting stage of corn plant growth, respectively.

4.9.4.4. Chlorophyll content:

Concerning with chlorophyll content, the lowest one was obtained in control treatments without organic manures, inorganic nitrogen fertilizer or biofertilizer. Chlorophyll content reached the highest significant increase by using biofertilizer application in the presence of full normal field dose of inorganic nitrogen fertilizer amended with rice straw manure followed by garbage manure at flowering stage of plant growth, Table (40) and Fig. (29) .

Table (39): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the shoot dry weight of corn.

Treatments	Shoot dry weight of corn stem (gm) at different plant stages								
	Vegetating			Flowering			Harvesting		
	W.	R.	G.	W.	R.	G.	W.	R.	G.
Control	20	30	28	55	60	57	65	75	70
BIO	30	32	34.5	62	64	69	77.7	80	82
½ N	23	36.2	31	59	76	80	80	84	82
½ N +BIO	29.5	33.8	42	75	82.5	101	97	134	130
N	29.6	35.3	32	76	87.5	80	98	105	111
N+BIO	31.8	38	34	80	95	91	140	156	160

- W : without organic matter

- R: Composted rice straw - G : Composted garbage

LSD at 5% :

- Treatments 4.796
- O.M. 3.39
- Stages 3.39
- Treatments x O.M. 8.29
- Treatments x Stages 8.29
- O.M x Stages 5.86
- O.M x Treatments x Stages 14.25

Fig (28)

Table (40): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the chlorophyll content of corn plant .

Treatments	Chlorophyll of corn plant at different plant stages					
	Vegetating			Flowering		
	W.	R.	G.	W.	R.	G.
Control	35	36	35.6	36	43.7	44
BIO	35	37	37.3	39.2	43.4	48.6
½ N	37	39.1	37.5	38.1	44.3	44.6
½ N +BIO	38.5	38.1	41	42.1	46	48.1
N	39.3	39.2	40	40	46.5	47.5
N+BIO	39.3	39.2	41	47	51	47.9

- W : without organic matter

- R: Composted rice straw - G : Composted garbage

LSD at 5% :

- Treatments	0.78
- O.M.	0.55
- Stages	0.451
- Treatments x O.M.	1.352
- Treatments x Stages	1.096
- O.M x Stages	0.777
- O.M x Treatments x Stages	1.912

Fig (29)

4.9.4.5. Statistical analysis :

Generally, data represented in Table (41) indicated that garbage manure followed by rice straw manure recorded the highest significance increase for plant height, fresh and dry weights and chlorophyll content.

For stage of corn plant growth, the least significant increase for plant height, fresh and dry weight was recorded at vegetating stage and the highest significant increase was obtained at harvesting stage except for chlorophyll content where the highest increase was recorded at vegetating stage plant growth.

Concerning with treatments, the lowest significant increase was noticed with control. For plant height, the highest remarkable increase was recorded with half or full normal field dose of inorganic nitrogen fertilizer and in the presence of biofertilizer and organic manures .

Also, the highest significant increase was recorded using N and bio-inoculation followed in descending order by 1/2 N and bio-inoculation for fresh and dry weights and chlorophyll content of corn plants.

4.9.4.6. Weight of kernels and yield :

Concerning with weight of kernels (gm/plant), data presented in Table (42) and Fig. (30) revealed that biofertilizer inoculation recorded significantly the maximum values of kernels weight when received full normal field dose of inorganic nitrogen fertilizer and amended with rice straw followed by garbage manure being 440 and 411 gm/plant, respectively.

For weight of grains, the highest weight was obtained in bio-treatments received full inorganic nitrogen fertilizer and amended with rice straw followed by garbage manure.

Table (41): Statistical mean effects of stages, Organic matter, biofertilizer and N-supplementation (Treatments) on the length, fresh weight, dry weight and chlorophyll of corn plant .

Factors		Length	Fresh weight	Dry Weight	Chlorophyll
Stages	Vegetating	67.38 c	230.2 b	32.31 c	44.29 a
	Flowering	63.96 b	529.6 a	74.7 b	38.05 b
	Harvesting	214.2 a	ND	100.2 a	ND
Organic matter	Without O.M.	138.4 c	271 c	61.3 b	38.8 c
	Rice straw	144.5 b	419.8 b	72.33 a	42.97 b
	Garbage	152.5 a	448.5 a	73.56 a	42.6 a
Treatments	Control	123.6 d	272.7 f	50.7 e	38.37 d
	Biofertilizer	129.1 c	361 d	60.25 d	41.45 b
	1/2 N	124.4 c	343.6 e	58.59 d	40.07 c
	1/2 N+ Bio.	145.5 a	415.1 b	80.62 b	42.05 b
	N	134.1 b	404.1 c	72.41 c	42.07 a
	N+Bio.	148.9 a	482.9 a	91.79 a	42.97 a

Table (42): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the weight of Kernels and the yield of corn.

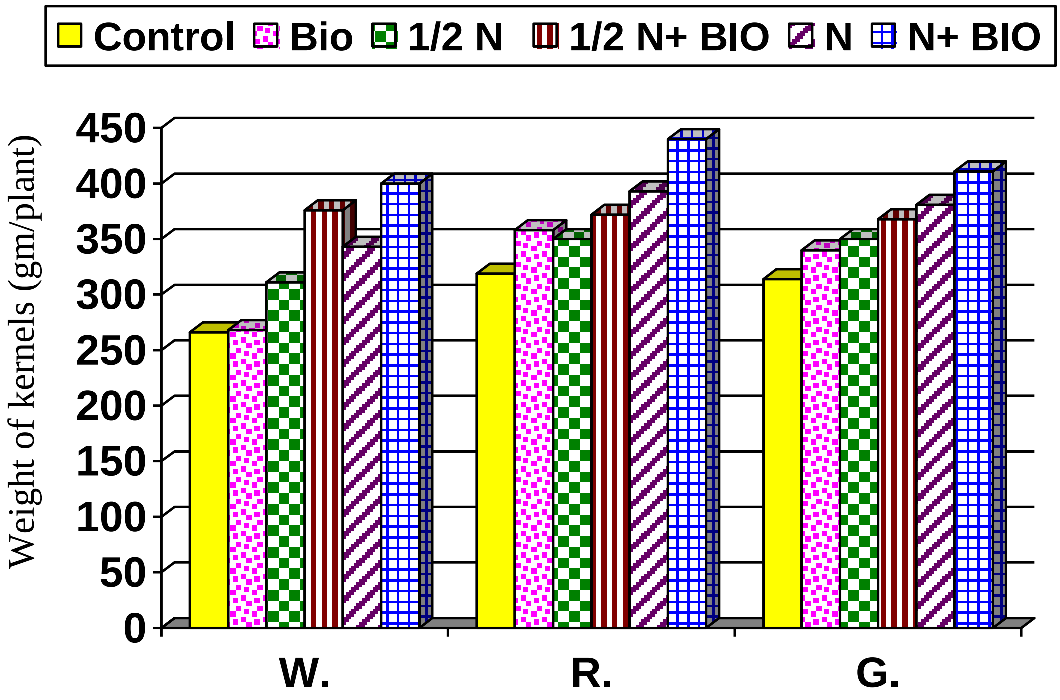
Treatments	Weight of Kernels (gm)/plant			Weight of grains Ardeb/ fadden		
	W.	R.	G.	W.	R.	G.
Control	266	319	314	13.7	18.7	17
BIO	268	358	340	18.17	20.5	20.6
½ N	311	350	350	19.9	21.5	23.4
½ N +BIO	376	372	368	21.4	21.6	26.7
N	343	393	381	21.0	23.14	23.6
N+BIO	400	440	411	25.7	28.3	27.6

W : without organic matter

R: Composted rice straw G : Composted garbage

LSD at 5% :

- Treatments	10.27	9.35	0.548
- Organic matter	7.26	6.617	0.387
- Treatments x O.M.	17.8	16.2	0.948



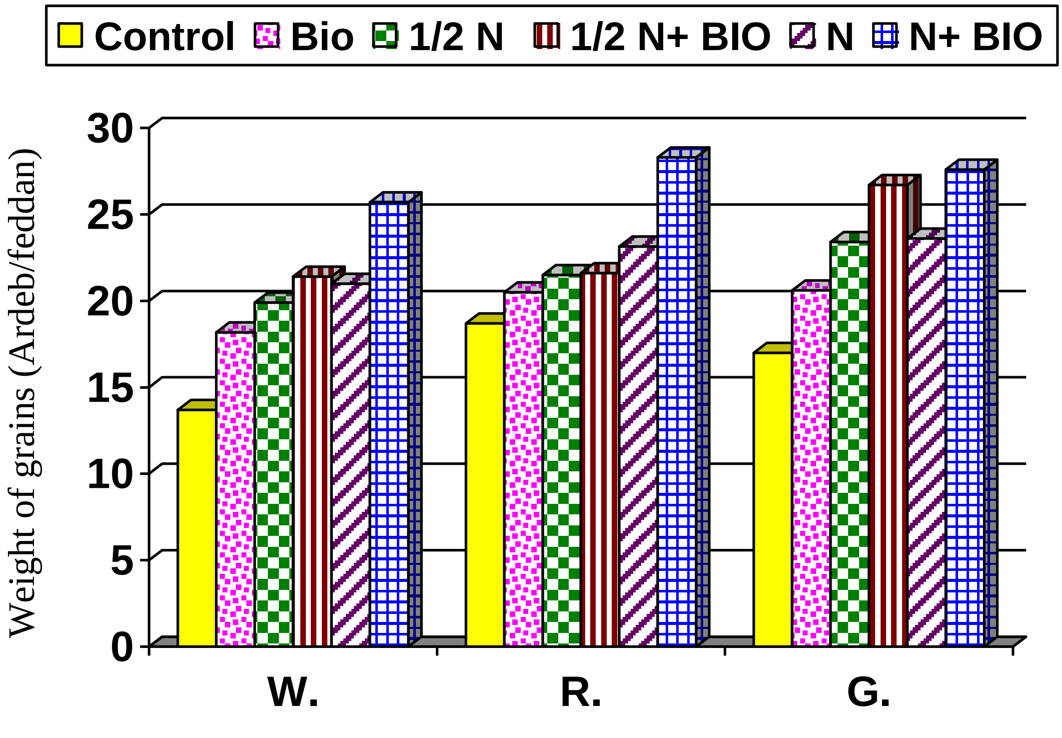


Fig (30): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the weight of Kernels and the yield of corn.

4.9.4.7. Weight of 100 grains and oil %:

Data presented in Table (43) and Fig. (31) revealed that the lowest oil percent was obtained by control treatment increased in ascending order by supplementation with inorganic nitrogen fertilizers than organic matter or biofertilizer. The highest significant increase for weight and oil% of grains were noticed with biofertilizer treatments amended with rice straw manure receiving full normal field dose of inorganic nitrogen fertilizer followed in descending order by garbage manure receiving half or full normal field dose of inorganic nitrogen fertilizer for oil % .

4.9.4.8. Statistical analysis :

In general ,data in Table (44) revealed that, kernels weight recorded the highest significant value in treatment amended with rice straw manure followed in descending order by garbage manure while the highest significant increase for both grains weight/ feddan and weight of 100 grains were noticed with garbage manure followed by rice straw manure.

For treatments (organic manure, biofertilizer and inorganic N supplementation) , the highest significant increase for all parameters was obtained by bio-organic treatments received full normal field dose of inorganic nitrogen fertilizer followed in descending order by half normal field dose of inorganic nitrogen fertilizer.

Table (43): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on weight of 100 grains and oil content of corn plant.

Treatments	weight of 100 grains (gm)			Oil %		
	W.	R.	G.	W.	R.	G.
Control	39.5	42.4	43.2	15.8	16	17
BIO	42	44	47	16.7	18.5	20
½ N	40	45.5	50	16.5	18.8	20
½ N +BIO	41	46.7	48.5	17.7	19.1	21
N	41	44.2	47.4	17.2	17.6	19
N+BIO	41.8	52.2	51	17.7	22	21

W : without organic matter

R: Composted rice straw G : Composted garbage

LSD at 5% :

- Treatments	0.305	0.257
- Oganic matter	0.216	0.182
- Treatments x O.M.	0.527	0.438

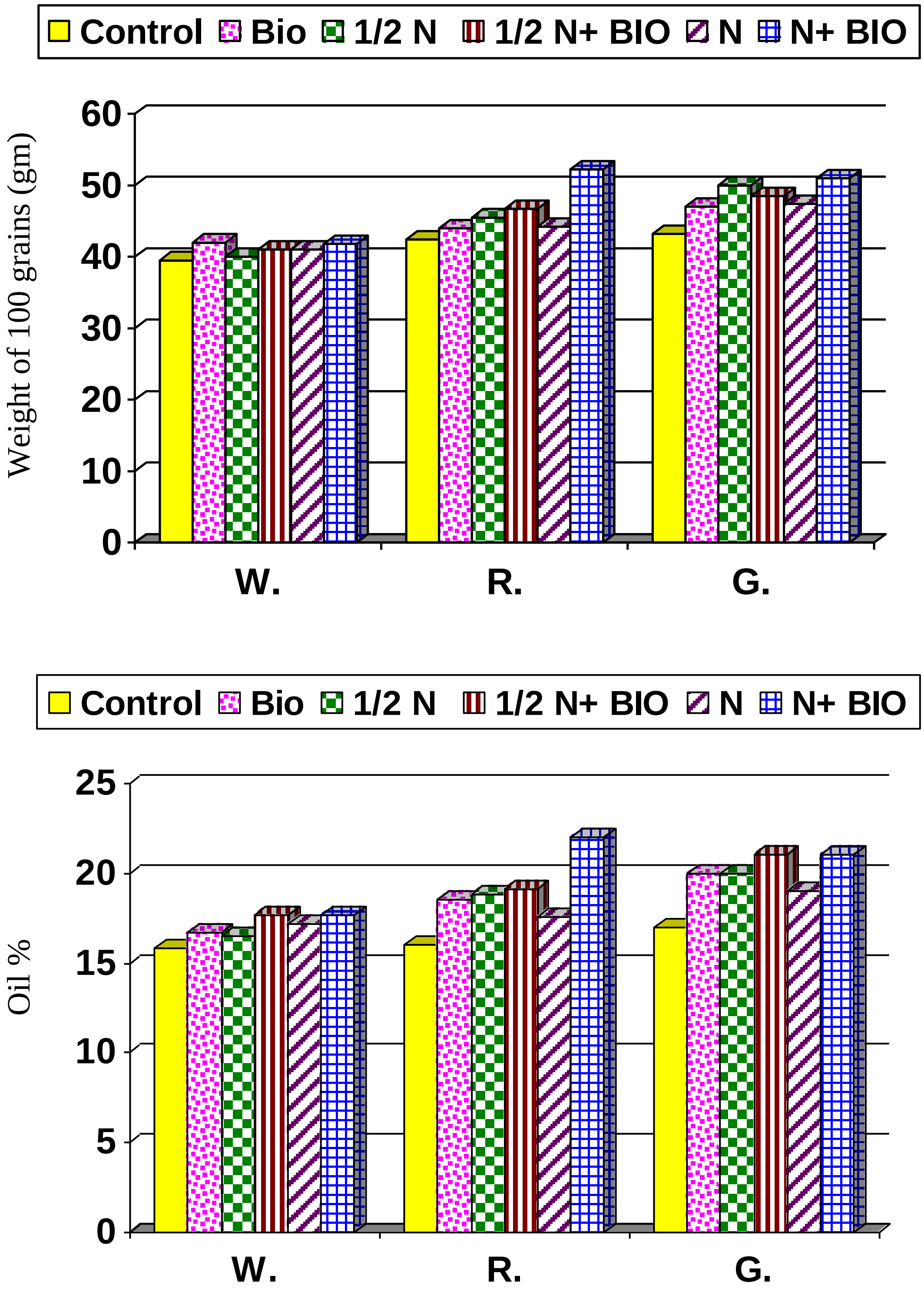


Fig (31): Effect of different treatments (organic matter, N. supplementation and biofertilizer) on the weight of 100 grain (gm) and oil content (%) of corn plant .

Table (44) :Statistical mean effects of organic matter , biofertilizer and N-supplementation (Treatments) on the weight of kernels , grains /feddan , weight of 100 grain and oil percent of corn plant.

Factors		Kernels weight (gm)	grains weight ardeb/ feddan (gm)	Weight of 100 grains (gm)	Oil percent %
Organic matter	**Without O.M.**	334 c	19.9 c	41 c	16.9 c
	Rice straw	370 a	22.4 b	45.8 b	18.6 b
	Garbage	360 b	22.9 a	47.8 a	19.6 a
Treatments	**Control**	301 e	16.2 f	41.7 e	16.2 e
	Biofertilizer	322 d	19.76 e	44.3 d	18.4 c
	1/2 N	337.2 c	21.33 d	45.15 c	18.43 c
	1/2 N+ Bio.	372 b	23.5 b	46.6 b	19.26 b
	N	371 b	22.56 c	44.2 d	17.9 d
	N+Bio.	417 a	27.2 a	47.5 a	20.2 a