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6. Summary and Conclusions

This study was conducted to evaluate and enhance composting process of date palm residues (DPR) by different ligno-cellulolytic microorganisms. The four used microorganisms were: *Aspergillus niger* (AUSB-27401), *Aspergillus subsessilis* (AUSB-271102), *Thermomyces lanuginosus* (AUSB- 271103) and *Bacillus* sp. (AUSB-271104).

Seventeen treatments were used for inoculation each compost with these microorganisms used each alone or mixed with another. All treatments accelerated composting process and the best contained the four species in mix.

<u>Part 1: Microflora of raw materials (DPR), additive materials and composting process can be summarized in the following:</u>

1-Thirty fungal species and 3 species varieties belonging to 20 genera were collected during the present investigation from date palm residues (DPR), farmyard manure (FYM) and chicken manure (CM) and during composting process that were isolated and identified on PDA and AGA media at 28 and 45˚C

2- Twenty – six species and 2 species varieties belonging to 16 genera were collected at 28˚C, and 9 species plus 2 species varieties belonging to 9 genera were isolated at 45˚C.

3- *Aspergillus niger* and *A. fumigatus* were the most common fungi collected from DPR on both media at 28˚C. While *A.subsessilis, A.*

fumigatus, *Malbranchea sulfurea* and *Mucor fuscus* were the most common fungi on both media at 45˚C.

4- *Botryotrichum piluliferum* , *A.fumigatus* and *A. niger* were the most dominant fungi collected from FYM on both media at 28˚C. While, *Emericella nidulans* var. *nidulans w*as the most dominant fungi on both media at 45˚C.

5- *Scopulariopsis brevicaulis* was the most common species collected from CM on both media at 28˚C. where as *A. fumigatus, Malbranchea sulfurea* and *Thermomyces lanuginosus* were the most common species on both media at 45˚C.

6- Twenty–six species and two varieties belonging to16 genera were collected from composting process which treated with 17 treatments, that were isolated on both media at 28 and 45 ˚C.

8- *Aspergillus niger* was the most dominant species in treatments No. (3, 4, 7, 8, 9, 11, 13, 14 and 15), which were inoculated with the same fungus. Thus due to the antagonistic activity of this fungus against other fungi:- *Scopulariopsis brevicaulis* was the second common species and *Botryotrichum piluliferum* was the third dominant species.

7- *Penicillium chrysogenum* was also prevalent during composting process and its frequencies and total counts were flourished on PDA medium at 28˚C.It was also, isolated on the same medium at 28˚C from FYM.

8- *Aspergillus fumigatus* and *A. subsessilis* were common in composting process with some treatments, *A. fumigatus* was promoted on AGA but *A. subsessiliswas* flourished on PDA.

9- *Emericella nidulans* var.*nidulans* appeared in most of treatments on both media with high counts and irregular frequencies.

10- *Acremonium strictum*, *Alternaria alternate*, *Cochliobolus spicifer* and *Mucor circinelloides* were isolated only from the control, the first treatment .

11- Nine fungal genera including 9 species and 2 varieties were collected from composting process on both media at 45˚C. The total counts of all treatments except T1 (control) ranged between 10^3 – 10^4 cfu/g.

12- *Aspergillus fumigatus* was the most common species on both media at 45˚C.

13- *Thermomyces lanuginosus* was predominantly isolated on PDA, but it was appeared in rare occurrence on AGA at 45˚C. It seems to be not cellulose decomposer but lignin degrading fungus.

14-*Emericella nidulans* var. *nidulans* was common in some treatments on both media or in each one alone at 45˚C.

15- *Malbranchea sulfurea* was isolated in high counts from composting treatments on both media at 45˚C and it was common in treatments T3,T6 on both media and T14 on AGA.

16- *Mucor fuscus* was isolated from treatments No. (3, 8, 10, 11 and 13) in low counts at 45˚C.

17- The total counts of mesophilic and thermophilic bacteria increased in early stages of composting process, then decreased to the end of the experiment thus due to changes in temperature profile during composting process.

Part 2: Physical and chemical changes of compost can be summarized in the following:

1- Temperatures of inoculated treatments reached to the thermophilic phase (>45˚C) within 7 days of composting process compared to the uninoculated treatments in T1:- DPR (control-1) and T2:- DPR+ CM+FYM (control-2).

2- Values of pH tend to decrease during the first 15 days of composting process of all treatments except (T1) at which pH values tend to increase regularly until 45 days then decrease at the end of the composting process (60 days). Then, pH values begin to increase at 30 days to reach maximum value (9.54) for treatment T17:- DPR + CM + FYM + *A. niger* + *A. subsessilis* + *T. lanuginosus* + *Bacillus* sp. at 60 days.

3- Data show slight increases in electrical conductivity (EC) of all treatments except (T1) at which EC values decreased regularly during the composting process.

4- Organic carbon (OC) and organic matter (OM) values were significantly decreased with increasing the successive stages of composting process. These values reached the minimum values at the end of the composting process (60 days). The great reduction in OM % and OC % occurred in inoculated treatments and the greatest reduction occurred as a result of T17:- DPR + CM + FYM + *A. niger* + *A. subsessilis* + *T. lanuginosus* + *Bacillus* sp.

5- It is clear that the total N showed a gradual increase during the composting process and reached its maximum value after 45 days. The maximum increase in total N (16.07%) was obtained due to T14:- DPR + CM + FYM + *A. niger* +*T. lanuginosus* + *Bacillus* sp. compared to T2:- DPR+ CM+FYM (control-2) after 45 days of composting process.

6- Highly significant decrease in C/N ratio for all treatments of composting materials. The great reduction in C/N ratio value occurred in T17.

7- Total phosphorus (P) and potassium (K) concentrations of the composts were significantly increased in all treatments except in T1 (control-1) and T2 (control-2). The maximum value of P % (0.678%) was obtained due to T10:- DPR + CM + FYM + *A. subsessilis* + *T. lanuginosus*. While, the maximum potassium content (2.41%) was obtained due to T14:- DPR + CM + FYM + *A. niger* +*T. lanuginosus* + *Bacillus* sp. at the end of composting period (60 days). It is clear that the treatments containing inocula resulted in compost richer in phosphorus (P) and potassium (K) than with T1 (control-1) and T2 (control-2).

Part 3: Results obtained from Pot experiment can be summarized in the following:

- **Effect of selected composts on plant growth:**

1- Results showed that the plant height and dry weight of shoots and roots significantly increased as a result of the combined application of compost treatments with mineral-N. The minimum value of plant height (56.01cm) was obtained as a result of applying the recommended dose of N fertilizer in organic form (T8). While, the maximum value (80.50 cm) was obtained as a result of applying the recommended dose of N fertilizer in both mineral and organic form (T3).

2- Results indicated that the using of 50 % of N of compost combined with 50 % of recommended dose of mineral-N gave increases in fresh and dry of both shoot and root weight higher than or similar to the maize fertilized by the recommended dose of mineral-N.

- **Effect of selected composts on nutrients uptake:**

1- The obtained results indicated that using any type of compost combined with half dose of mineral-N gave values higher than those obtained by using the recommended dose of N-fertilizer (120 kg N/fed either in mineral or organic form). The N-uptake of shoot gave increases over the mineral N-fertilizer to be 49%, 16%, 15% and 28% of T3, T5, T7 and T9, respectively. While the N-uptake of root gave increases 39.73%, 24.66%, 2.74% and 5.48% of the same treatments over the mineral N-fertilizer, respectively.

2- Application of T3, T5, T7 and T9 gave increases of P-uptake of shoot over the mineral N-fertilizer to be 156%, 88%, 68% and 64% respectively, and gave increases of P-uptake of root over the mineral N-fertilizer to be 58.82%, 41.18%, 11.77% and 29.41%, respectively.

3- It is clear that the addition of any compost alone or compost combined with half dose of mineral-N gave values of K-uptake either by shoot or by root higher than that treated with the recommended dose of mineral-N (120 kg N/fed).

4- The regression analysis showed that quadratic equations best fitted the obtained results.

- **<u>Effect of different compost types on Nitrogen, P and K contents in the soil after maize harvesting (60 days):</u>**

Data show that the addition compost treatments to the soil increased the total nitrogen, available P and available K after harvesting maize plants (60 days).

1- Data show significant increases in total nitrogen by using any type of compost or compost combined with half dose of mineral-N compared to the using of full recommended dose of mineral-N. Application of compost combined with half dose of mineral-N of T3, T5, T7 and T10 gave increases 18.92%, 13.51%, 16.22% and 18.92%, respectively.

2- Results showed that the significantly increased of both available P and available K due to the addition of any type of compost as compared to the addition of full recommended dose of mineral-N.

3- Regression analysis showed positive and significant linear relationships between the application rate of compost types and available P and K in soil.