Available Online at http://www.journalajst.com

ASIAN JOURNAL OF
SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol. 5, Issue 11, pp.682-687, November, 2014

RESEARCH ARTICLE

AN ASSESSMENT OF AGRICULTURAL SOLID WASTE COMPOST QUALITY PRODUCED IN LEBANON

[1*]Mohamad Ezzedine, [1]Mirna Sabra, [2]Fadwa Berri, [1]Mohamad Mortada and [3]Salem Hayar

[1]Lebanese University, Faculty of Sciences and Ecole Doctorale PRASE, Hadath, Lebanon
[2]Lebanese University, Faculty of Pharmacy and Ecole Doctorale PRASE, Hadath, Lebanon
[3]Ministry of Agriculture, Pesticide laboratory, Kfarchima, Lebanon

ARTICLE INFO

Article History:
Received 30th August, 2014
Received in revised form
03rd September, 2014
Accepted 09th October, 2014
Published online 19th November, 2014

Key words:
Composting, Olive marcs,
Germination, *Lepidium sativum*,
Cucumis sativus.

ABSTRACT

In the present work, we tried to valorize the agricultural garbage in order to get a substratum fertilizing soil. For it, gone up us in batteries of the miscellanies of olive marcs, of banana residues, of the lootings of grapes, the feathers as well as the residues of tobacco. These batteries have been followed regularly by physical-chemical measures (T, pH, Hu, EC...) and whose maturity has been studied by tests of germination and elongation of the roots of cress and cucumber. The physical-chemical sizes allowed custom to notes has progress correct of the operations of dating and the tests of germination showed the necessity to dilute every takes of compost in order to avoid the inhibitory effect one germination.

INTRODUCTION

There are many organic wastes in Lebanon owing to the fact that agriculture occupies an overriding position in the economy and resources of Lebanese's life, and it is mostly waste bananas, olive pomace, the stalks and grape skins, tobacco waste as well as organic waste from the food industries causing great environmental problem such as poultry feathers [24]. Huge amount for a country the size is so small as Lebanon. The principal aim of our work consists in manufacturing composts made up of various mixtures of organic wastes into variable proportions and by comparing their evolution in time while checking the quality of the composts obtained and seeking the best solutions for their improvement.

MATERIALS AND METHODS

This methodology is based on the follow-up of relevant and rational parameters of the bio-wastes during the treatment phase: physico-chemical analyzes (T, pH, Hu, M.O, C, N…) allowed to follow the status of various mixtures [4][12][17], then germination tests were used to examine the degree of maturation and phytotoxicity of the compost obtained, using watercress seeds (*Lepidium sativum*) and cucumber (*Cucumis sativus*). Among the raw materials used, only residues banana and tobacco rods were ground to facilitate processing during composting. Mixtures were prepared with the raw materials chosen according to the following proportions (table 1): After completion, the stacks have been watering and turning every 5 days for one month, then every 10 days for two months and finally every 14 days until the end of composting. At each turning, we carried out a sampling of approximately 2 kg of each stack. The taken samples underwent drying air in a closed room for a week, then grinding. After sieving, the samples were stored at 0° C to avoid any form of evolution, then subjected as soon as possible to the various analyzes.

Corresponding author: Mohamad Ezzedine
Lebanese University, Faculty of Sciences and Ecole Doctorale PRASE, Hadath, Lebanon

Physico-chemical analyzes

Evolution of the temperature (figure 1)

The temperature is monitored on a periodic basis using a thermometer probe and three mesures are performed (two on the sides and one in the center) and the value given is the average of the three. The average depth at reading temperatures is about 1 meter (heart of the stack).

Moisture monitoring (figure 2)

The moisture of the samples is measured after drying in an oven at 105° C. Moisture does not give any index known about

Table 1. A raw materials component stacks

	Bananas		Olive pomace		Feather		Tobacco		Grappe	
	%	Kg	%	Kg	%	Kg	%	Kg	%	Kg
stack A	30	900	30	900	30	900	2	60	8	240
stack B	45	1350	45	1350	0	0	2	60	8	240
stack C	45	1350	0	0	45	1350	2	60	8	240
stack D	0	0	45	1350	45	1350	2	60	8	240
stack E	33,3	1000	33,3	1000	33,3	1000	0	0	0	0

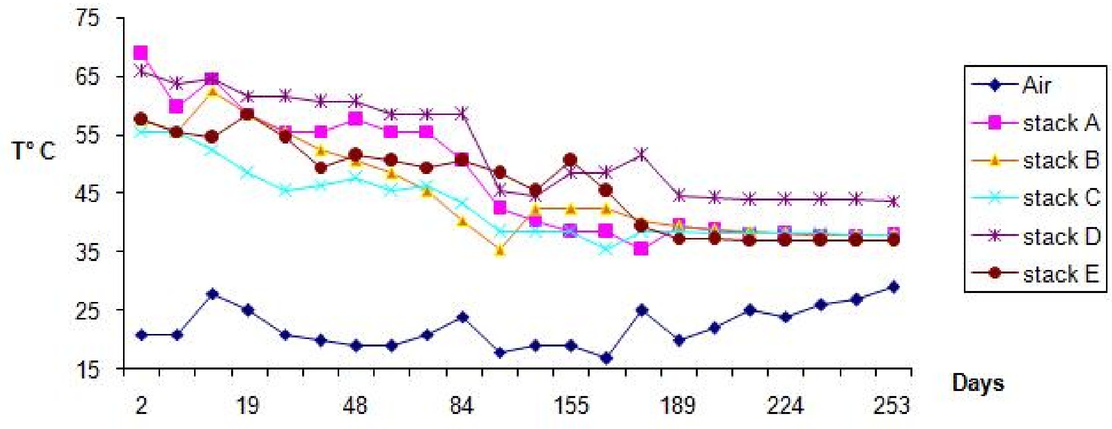

Figure 1. Variation of temperature according to time for the 5 stacks

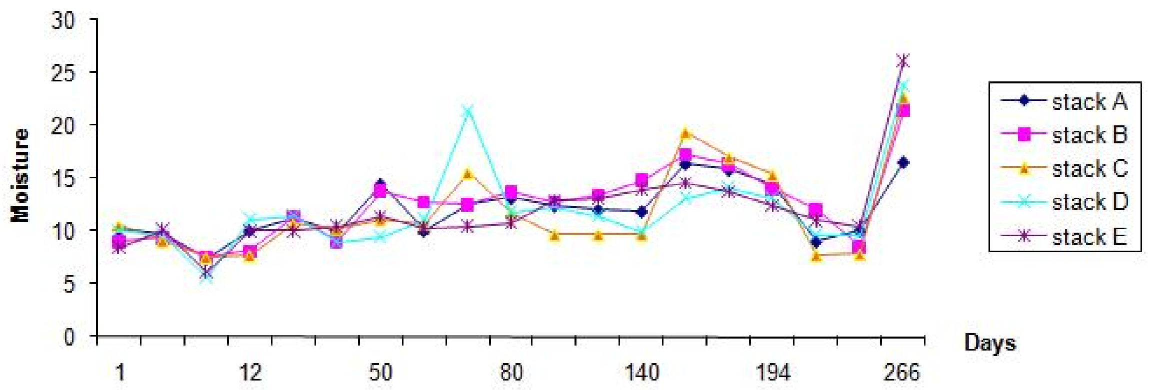

Figure 2. Variation of moisture according to time for the 5 stacks

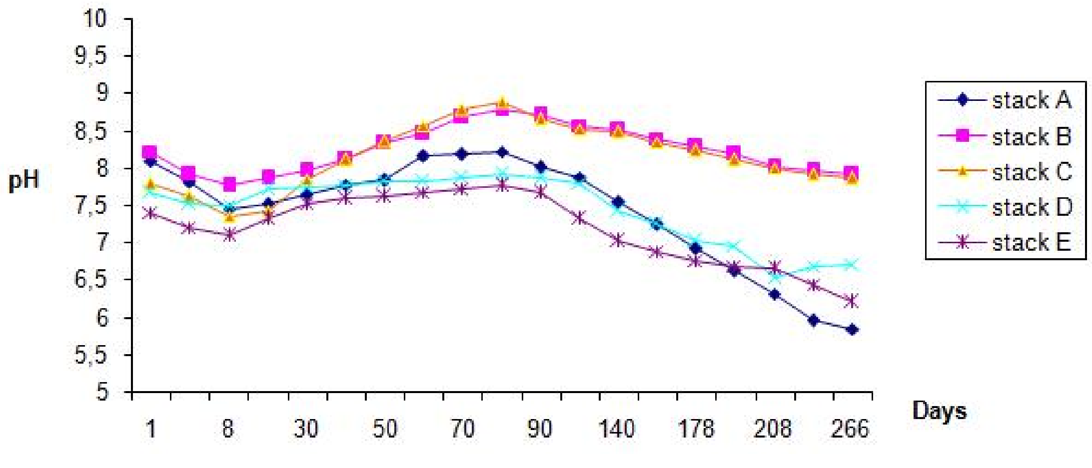

Figure 3. Variation of pH according to time for the 5 stacks

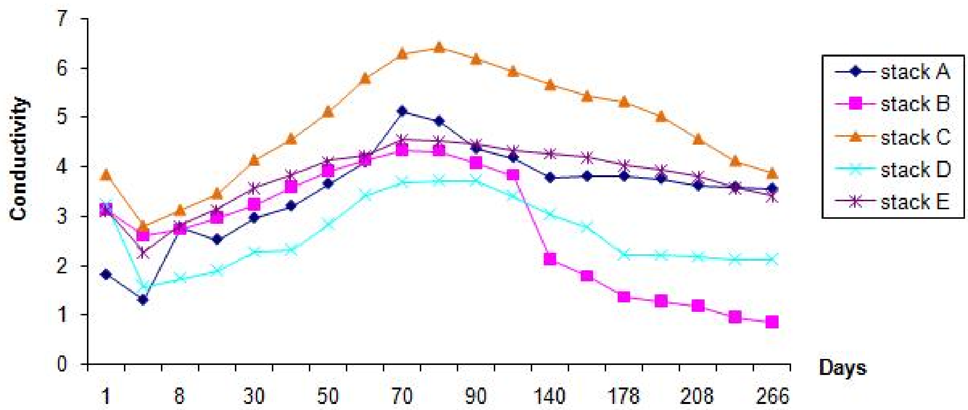

Figure 4. Variation of conductivity according to time for the 5 stacks

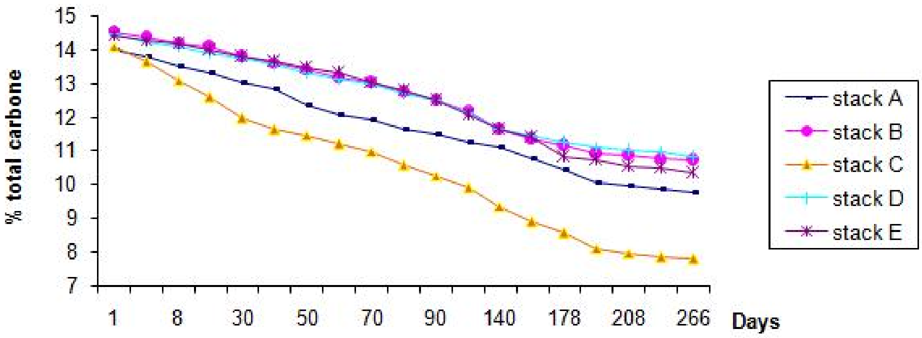

Figure 5. Variation of total carbone according to time for the 5 stacks

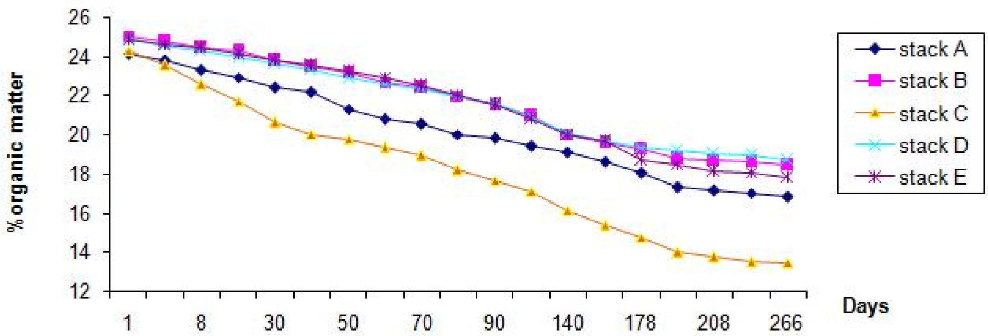

Figure 6. Variation of the organic matter according to time for the 5 stacks

Table 2. Start composting

	stack A	stack B	stack C	stack D	stack E
% Moisture	10,14	9,1	10,53	10,04	8,46
pH	8,09	8,21	7,78	7,65	7,4
Electrical conductivity (mS/cm)	1,81	3,12	3,83	3,21	3,11
% Total carbone	13,97	14,5	14,08	14,46	14,38
% Organic matter	24	25	24,28	24,93	24,8
Total phosphorus (mg/100 g de compost)	134,4	147,38	134,64	235,44	220,13

Table 3. End of composting

	stack A	stack B	stack C	stack D	stack E
% Moisture	16,52	21,47	22,7	23,8	26,17
pH	5,84	7,91	7,85	6,7	6,2
Electrical conductivity (mS/cm)	3,55	0,83	3,86	2,1	3,39
% Total carbone	9,75	10,69	7,79	10,81	10,32
% Organic matter	16,82	18,44	13,44	16,38	17,79
N-ammonium (mg/100 mg compost)	419,4	18,15	12,38	1044,6	501,55
N-nitrates (mg/100 g compost)	706,91	7,97	1215,6	242,25	717,48
total phosphorus (mg/100 g compost)	233,74	311,88	367,27	230,67	553,85
Available phosphorus (mg/100 g compost)	41,9	30,86	82,05	138,1	31,36

the quality of the compost since it varies on weather conditions and stack watering periods**.** But in all the types of compost, the water content should not exceed 65% (what is our case) because during composting water replaces the air in the interstices between wastes which has the effect to drown the aerobic bacteria and to trigger an anaerobic fermentation. High temperatures indicate a period of activity of the micro-organisms. At the end of composting, microbial activity decreases due to the transformation of the biodegradable substances, resulting in a reduction of the temperature, which is stabilized at the end of the operation around room temperature (maturation phase) [8][13][14]. Usually, the ideal temperature for a good composting operation ranges between 35º C and 60° C [11]. In our hands, we obtained maximum temperatures between 65º C and 68° C (stacks A and D) and this difference is, a priori, by the choice of mixture proportions [10][18]. But in all cases, high temperatures are the guarantors of sterilization [20][22] and stability of substrate [12].

pH (figure 3)

The pH values of the 5 stacks vary experimentally close to the theoretical variation of the pH during composting [17]. Note that a slightly basic pH is an indicator of the stability of compost [9][10][18].

Electrical conductivity (figure 4)

The conductivity values obtained for some stacks (higher than 3 ms/cm) can be the result of the production of salts during mineralization. This salinity can inhibit the germination of seeds [18] and this is to be demonstrated with the germination test done later.

Total organic carbon (C/N) (figure 5)

Since during the phases of active aerobic fermentation, the carbon uptake is from 15 to 30 times greater than the nitrogen

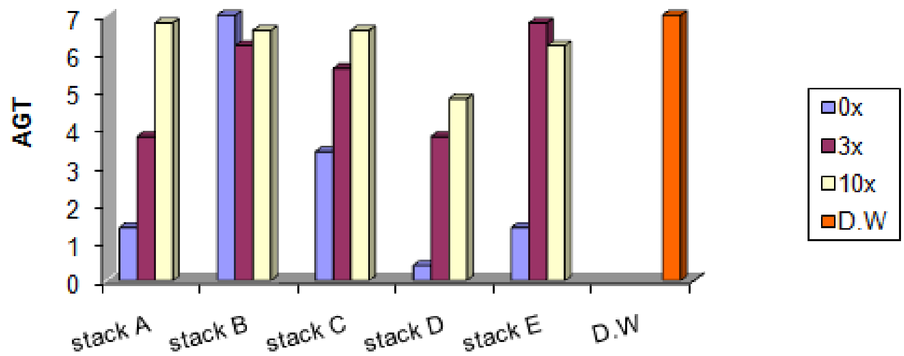

Figure 7. Number of seeds germinated for various dilutions

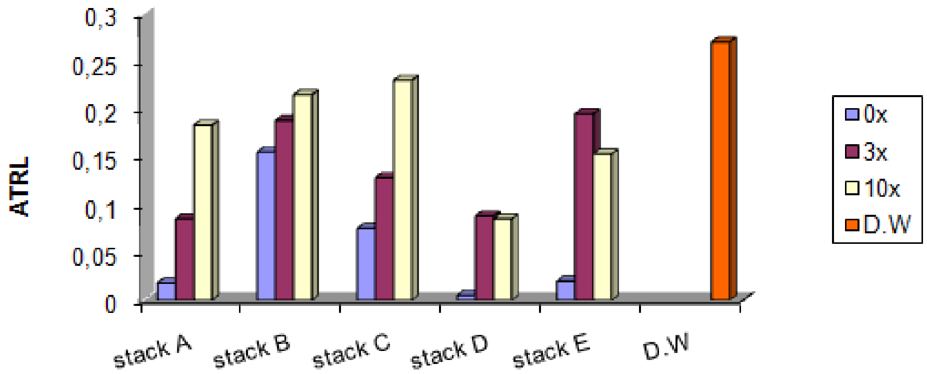

Figure 8. Average lengths of the roots for various dilutions

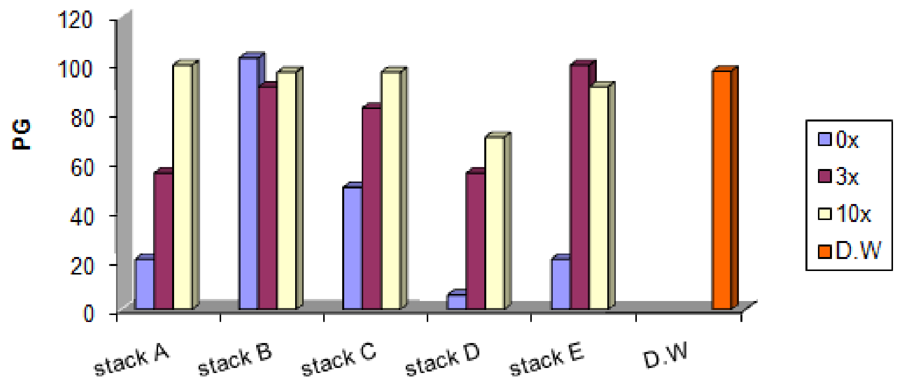

Figure 9. Percentage of germination for various dilutions

uptake, C/N ratio thus decrease during composting to stabilize at a given value. In our case, the total carbon organic decrease in over the time, this coincides with the theoretical data [3][16][19].

Organic materials (figure 6)

The percentages obtained for the 5 stacks are normal percentages [2][8][13].

Phosphorus

The quantities of total phosphorus on the one hand and phosphorus available on the other hand are normal [10][17][18].

$NH4^+/NO_3^{2-}$ ratio

For the 5 stacks, this ratio is lower than 3, indicating compost maturity [10][17][18]. Summary of physico-chemical analyzes for the 5 stacks at time zero and at the end of composting.

Test of germination and root elongation

This test is used to study the phytotoxicity of compost sample on seeds of *Lepidium sativum* and *Cucumis sativus* by calculating the index of germination (GI index) and the length of the roots for each sample [25][28][29]. From each compost sample, different dilutions were prepared (0x, 3x, 10x). Each dilution was tested in 5 boxes each containing 8 seeds of *Lepidium sativum* and 5 boxes each containing 8 seeds of *Cucumis sativus*. Germination and the elongation were compared with a control consisting of distilled water instead of the compost sample for 5 to 7 days (figures 7, 8, 9 and table 4).

AGT: average of germination for each treatment.
AGC: average of germination for distilled water.
ATRL: average of elongation of the roots for each treatment.
ACRL: average of elongation of the roots for water.

$$\text{RPL: Radical Percentage Length} = \frac{\text{MTRL}}{\text{MCRL}} \text{ x } 100.$$

$$\text{PG : Percentage of Germination} = \frac{\text{MTG}}{\text{MCG}} \text{ x } 100.$$

$$\text{ZUCCONI Index of germination of} = \frac{\text{PG x PRL}}{10000}.$$

Table 4. Classification of the composts according to their index of germination

	Germination index		
	Dilution 0x	Dilution 3x	Dilution 10x
stack A	0,013	0,176	**0,680**
stack B	0,593	0,636	**0,775**
stack C	0,139	0,391	**0,829**
stack D	0,001	0,182	**0,222**
stack E	0,15	0,724	**0,521**

No inhibition
Weak inhibition
Strong inhibition
Severe nhibition

Interpretation of the results

All the stacks showed an inhibitory effect on the germination and root elongation for compost extracts undiluted. To decrease the inhibition, we have mixed with the soil in the proportions 10:1 (soil-compost) for the stacks A, B and C and 3:1 for the stack E.

Conclusion

The raw materials chosen in these mixtures show important characteristics, but some of them require treatments before being used in composting. The mixtures applied gave good composts according to the criteria followed, but other chemical tests are needed to confirm the characteristics of the composts obtained and the conditions of their use (evaluation of the quality of the compost on the Lebanese ground).

Acknowledgments

This project was supported by a grant from the Lebanese University, Faculty of Sciences (Laboratory of Biochemistry and Microbiology) and the Ecole Doctorale, PRASE, Lebanese University.

REFERENCES

[1]. Achour F. Caractérisation de la matière organique dans les ordures ménagères. Recherche d'indicateurs de stabilité. Laboratoire de Génie Civil et d'Ingénierie Environnementale. Institut National des Sciences Appliquées de Lyon, 2008, 173 p.

[2]. Atkinson, C.F., Jones, D.D., Gauthier, J.J. Biodegradability's and microbial activities during composting of municipal solid waste in bench-scale reactors. *Compost Science & Utilization* 1996;4:14-23.

[3]. Barrington, S., Choiniere, D., Trigui, M., Knight, W. Effect of carbon source on compost nitrogen and carbon losses. *Bioresource Technology* 2002;83:189-194.

[4]. Bernal, M.P., Paredes, C., Sanchez-Monedero, M.A., Cegarra, J. Maturity and stability parameters of composts prepared with a wide range of organic wastes. *Bioresource Technology* 1998;63:91-99.

[5]. Canet, R., Pomares, F. Changes in physical, chemical and physicochemical parameters during the composting of municipal solid-wastes in 2 plants in Valencia. *Bioresource Technology* 1995;51:259-264.

[6]. Chanakyan H.N., Ramachandra T.V., Guruprasad M., Devi V. Micro-treatment options for components of organic fraction of MSW in residential areas. *Environ Monit Assess,* 2007;135:129-139.

[7]. De Betroldi, M., Ferrantin, M.P., Hermite, P.L. and Zucconi, F. Compost: Production, analysis and use. Elsevier Applied Science, London, 1987:30-50.

[8]. Francou, C., Linères, M., Derenne, S., Villio-Poitrenaud, M.L., Houot, S. Influence of green waste, biowaste and paper-cardboard initial ratios on organic matter transformations during composting. *Bioresource Technology* 2008;99:8926-8934.

[9]. Gobat J.M., Aragno M., Matthey W. (1998). Le sol vivant. Bases de la pédologie. Biologie des sols. Presses Polytechniques et Universitaires Romandes. Collection Gérer l'Environnement 1998;14:519 pp.

[10]. Godden B. (1995). La gestion des effluents d'élevage. Techniques et aspect du compostage dans une ferme biologique. *Revue de l'Ecologie* 1995;13:p37.

[11]. Golueke C.G. Composting, a study of the process and its principles. Rodale Press, Inc., Emmaus, PA. 1972;110 pp.

[12]. Haug, R.T. The practical handbook of compost engineering, Lewis Publishers (Eds.), Boca Raton, USA 1993.

[13]. Leclerc, B. 2001. Guide des matières organiques. Institut Technique Agriculture Biologique, tomes 1et 2, 2001.

[14]. Lemunier, M., Francou, C., Rousseaux, S., Houot, S., Dantigny, P., Piveteau, P., Guzzo, J. Long-term survival of pathogenic and sanitation indicator bacteria in experimental biowaste composts. *Applied and Environmental Microbiology* 2005;71:5779-5786.

[15]. Madejón, E., Diaz, M.J., Lopez, R., Cabrera, F. New approaches to establish optimum moisture content for compostable materials. *Bioresource Technology* 2002;85:73-78.

[16]. Makan A., Mountadar M. Effect of C/N ratio on the in-vessel composting under air pressure of organic fraction of municipal solid waste in Morocco. *J Mater Cycles Waste Manag* 2012;14(3):241-249.

[17]. Mustin M. Le compost : gestion de la matière organique. Editions François Dubusc, Paris 1987.

[18]. Oueslati M.A., Ksontini M., Haddad M., Bahr H. Compostage des grignons d'olive et de l'acacia cyanophylla. *Phys. Chem. News* 2003;14:70-76.

[19]. Paredes C., Bernal M.P., Cegarra J., Roig A. Bio-degradation of olive mill wastewater sludge by its co-composting with agricultural wastes. *Bioresource Technology* 2002;85:1-8.

[20]. Pourcher A.M., Morand P., Picard-Bonnaud F., Billaudel S., Monpoeho S., Federighi M., Ferré V., Moguedet G. Decrease of enteric micro-organisms from rural sewage sludge during their composting in straw mixture. *Journal of Applied Microbiology* 2005;99:528-539.

[21]. Richard T.L., Hamelers H.V.M., Veeken A., Silva T. Moisture relationships in composting processes. *Compost Science & Utilization* 2002;10:286-302.

[22]. Steger K., Jarvis A., Vasara T., Romantschuk M., Sundh I. Effects of differing temperature management on development of Actinobacteria populations during composting. *Research in Microbiology* 2007;158:617-624.

[23]. Steven H., Clark J.B. Variability of Temperature, pH, and Moisture in an Aerobic Composting Process. *Applied and Environmental Microbiology* 1979;1040-1044.

[24]. Sweep-net: The Regional Solid Waste Exchange of Information and Expertise network in Mashreq and Maghreb countries. Country report on the solid waste management in Lebanon. 2010.

[25]. Test Methods for Examination of Composting and Compost. The US composting council research and education foundation 2001.

[26]. Ward A.J., Hobbs P.J., Holliman P.J., Jones D.L. Optimisation of the anaerobic digestion of agricultural resources. *Bioresource Technology* 2008;99:7928-7940.

[27]. Zayed G., Abdel-Motaal H. Bio-production of compost with low pH and high soluble phosphorus from sugar cane bagasse enriched with rock phosphate. *World Journal of Microbiology & Biotechnology* 2005;21:747-752.

[28]. Zucconi F., Pera A., Forte M. and de Bertoldi M. Biological evaluation of compost maturity. *Biocycle* 1981;22: 27-29.

[29]. Zucconi F., Pera A., Forte M. and de Bertoldi M. Evaluating toxicity of immature compost. *Biocycle* 1981;22: 53-57.

****