J. Agric. Sci. Mansoura Univ., 31 (12): 8073 - 8079, 2006

UTILIZATION OF AGRICULTURAL RESIDUES IS AN ENVIRONMENTAL AND AGRICULTURAL NECESSITY: I- EVALUATION OF SOME SOURCES OF AGRICULTURAL RESIDUES TO USE AS SEED-BED MATERIAL

Sherif, H. O. * and A. S. Mohammad**

*** Chemical Engineering Department, Faculty of Engineering, Minia University, Minia, Egypt**

****Soil Science Department, Faculty of Agriculture, Minia University, Minia, Egypt**

ABSTRACT

The compost from some agricultural and industrial wastes was prepared by aerobic composting. All types of compost were tested for germination and growth of cucumber and tomato seeds in the treatments of 1) final product of compost, 2) compost mixed with vermiculite 1:1 (v/v), 3) compost mixed with vermiculite 1:3 (v/v), 4) compost washed with water at 1:10 ratio and 5) compost completely washed with water. The imported peat moss was used as a control. The results of germination show that, the germination percentage of cucumber and tomato seeds sown in different types of compost without mixing with vermiculite or washed with water were very low compared with peat moss. This result was related to the highly electrical conductivity of the final product of compost. Reducing the EC values by mixing the compost with vermiculite at 1:1 and 1:3 ratios gave some advances. Although the germination percentage was improved by increasing the mixing ratio with vermiculite, the media becomes smoother and find a difficulty for seedlings transport.

The germination percentage of cucumber and tomato seeds was improved when they sown in compost washed with water at 1:10 ratio as well as completely washing with water. The growth of both seedlings of cucumber and tomato was better in compost completely washed than those grown in compost washed with measured volume. The results also show the sugar cane bagasse followed by banana and/or rice straw compost may be used a seed-bed like material in Egyptian agriculture. More studies will be needed on these materials to establish the production of growing media to substitute the imported peat moss.

INTRODUCTION

Recycling of agricultural residues is an important natural process to give us a clean environment and useful product. Although the agricultural wastes can be disposed by chemical means (burning) or by largely physical means (landfill) but only when it is disposed of biological means (composting) are plant nutrients conserved by returning wastes in the form in which they can be most efficiently used. Utilization of agricultural residues is an environmental and agricultural necessity is serious of research trying to illustrate how can produce seed-bed like material institute of imported peat moss, organic liquid fertilizers provide both nutrients addition and plant diseases suppression and improving the fertility of the final product of agricultural compost by adding some natural rocks for reducing the use of chemical fertilizers in the traditional agriculture and using in organic farming.

Composting is a biological decomposition process by microorganism which needs a moisture content during production of about 50-60% (Sherif,

1989; Rynk, 1992; Mathur *et al.*, 1993), C/N ratio 25-30:1 (Sherif, 1989; Rynk, 1992; Kayhanian and Rich, 1996; Abdel-Motaal, 2004), particle size below 5 cm (Mathur *et al.*, 1993) and turning frequency every four days to aeration and ensure a minimum oxygen concentration of 5% (Rynk, 1992) but more activity was obtained at the level of 10-18% O_2.

Some compost products from agricultural residues may be appropriate to substitute peat moss material which is imported and used on a large scale for vegetable and ornamental planting. The evaluation of some of the available agricultural residues is the aim of this study.

MATERIALS AND METHODS

1. Raw Agricultural residues and Industrial wastes for Composting:

Some available agricultural residues of banana leaves and stem, palm leaves and rice straw were collected from some farms nearest from the Minia Factory of Agricultural Residues Utilization. Industrial wastes of geranium, sugar beet and sugar cane bagasse were collected from two factories. Geranium residues from ornamental oil extraction, Beni Suef Governorate and the sugar beet and bagasse were collected from Abou-Qurqas Sugar Factory, Minia Governorate. The Chemical and physical composition of agricultural and industrial wastęs available in this study are presented in Table (1). Each kind of residue was separately prepared for suitable particle size, heaped after adding about 5% from old compost and composted aerobically according to Sherif (1989) for 120 days for banana leaves and stem, palm leaves and rice straw, 75 days for geranium, 90 days for sugar beet and 135 days for bagasse. After the mentioned time of each kind of material, the final product of compost was sieved and analyzed according to Page *et al.* (1982).

Table 1. Chemical and physical composition of some different agricultural and industrial wastes available in Egypt before composting

	Banana stem & leaves	Palm leaves	Rice straw	Geranium	Sugar beet	Bagasse
Density Kg/m^3	625	150	150	350	900	380
Moisture %	88	20	12	40	80	52
Total N %	1.24	0.92	0.88	1.61	1.40	0.47
Total P %	0.20	0.60	0.45	0.35	0.18	0.35
Total K %	0.67	0.40	0.65	1.45	0.30	0.99
Organic carbon %	52.33	55.50	44.40	45.10	56.00	56.55
C:N ratio	42:1	60:1	50:1	28:1	40:1	120:1
Organic Matter %	90.00	95.46	76.37	77.57	96.32	97.27
Ash %	10.00	4.54	23.63	22.43	3.68	2.73

- **All the measures are on dry weight basis except density and moisture**

2. Reducing EC Values in Different Sources of Compost:

2.1. Reducing EC Values by Mixing with Vermiculite

Different sources of compost mixed with vermiculite with two levels i.e. 1:1 and 1:3 (v/v)

2.2. Reducing EC by Washing the Compost by Measured Volume of Water (Ratio of 1:10)

Washing the different sources of compost by measured volume of water was done under the ratio of 1:10 for retention time of 12 hours (Sherif, 2001). The results of Density, EC, TDS and pH are recorded in Table (3).

2.3. Reducing EC by Washing the Compost by Unmeasured Volume of Water

Washing the different sources of compost by unmeasured volume of water was done until the solution of extract is not dark. The results of Density, EC, TDS and pH are recorded in Table (4).

3. Germination of Cucumber and Tomato Seeds in Prepared Compost

Each kind of compost was placed separately in 84 eyes foam tray. It replicated 3 times for each. One seed of cucumber (*Cucumis sativus L.*) and tomato *(Lycopersicon esculentun L.)*, were sown in each eye of foam tray then they watered until the seedlings were collected. The seedlings of cucumber and tomato were collected after 3 and 4 weeks from sowing, respectively. Fresh weight was recorded; oven dried at 105 °C and the dry weight was recorded. The data obtained were statistically analyzed by M-Stat package.

RESULTS AND DISCUSSION

1. Composting and Compost Properties:

Different sources of agricultural and industrial wastes are different in their chemical component which is referred on the time of their composting. A geranium residue takes a short time of 75 days while the sugar cane bagasse takes more time i.e. 135 days. Other agricultural and industrial wastes are in between. The Chemical and physical composition of different sources of compost are presented in Table (2).

Table 2. Chemical and physical composition of agricultural and industrial wastes compost

	Banana	Palm leaves	Rice straw	Geranium	Sugar beet	Bagasse
Composting period/day	120	120	120	75	90	135
Density Kg/m^3	610	640	600	670	650	650
Moisture %	25	27	26	25	28	25
pH (1:10)	8.40	7.95	8.11	8.51	6.92	7.60
EC (1:10)/dS/m	5.38	3.11	4.50	6.67	4.20	2.96
Total N %	1.82	1.75	1.60	1.82	2.10	1.36
Total P %	0.51	0.44	0.60	0.45	0.60	0.43
Total K %	1.68	1.48	1.62	1.75	1.70	1.38
Organic carbon %	28.80	33.25	30.40	30.94	33.60	24.48
C:N ratio	15.8:1	19:1	19:1	17:1	16:1	18:1
Organic Matter %	49.54	58.19	52.29	53.22	57.79	42.11
Ash %	50.46	41.81	47.71	46.78	42.21	57.89

- **All the measures are on dry weight basis except density and moisture.**

2. The Washing Effect on Some Properties of Compost Values:

Washing the compost with water by measured volume (1:10 ratio) or unmeasured water volume reduced the density, Electrical conductivity (EC) and total dissolved solid (TDS) values but it arise the pH values (Tables 3 and 4). Reduced density is related to the washing of the fine particle size however the coarse particle sizes are not removed. Water extract takes most of the soluble nutrients in the compost and leave the compost with less EC value. When EC and TDS decreased the pH was increased where some soluble organic acids were lost with water extract.

Table 3. Density, Electrical conductivity (EC), total dissolved solid (TDS) and pH of different agricultural and industrial compost after washing with water at 1:10 ratio

	Banana	Palm leaves	Rice straw	Geranium	Sugar beet	Bagasse
Density Kg/m^3	520	540	510	550	530	500
Moisture %	25	26	26	25	27	26
TDS (g/l)	1.25	0.8	0.9	1.7	1.05	0.45
EC (1:10)/dS/m	1.5	1.6	1.8	2.4	2.1	0.95
pH (1:10)	8.5	8.2	8.4	8.6	7.2	8.0

Table 4. Density, Electrical conductivity (EC), total dissolved solid (TDS) and pH of different agricultural residues compost after completely washing with water

	Banana	Palm leaves	Rice straw	Geranium	Sugar beet	Bagasse
Density Kg/m^3	430	470	400	480	460	380
Moisture %	26	26	25	25	25	25
TDS (g/l)	0.4	0.4	0.45	0.5	0.6	0.2
EC (1:10)/dS/m	0.8	0.8	0.9	1.0	1.2	0 4
pH (1:10)	8.9	8.7	8.9	8.9	8.2	8.4

3. Cucumber and tomato growth in different sources of compost

3.1. Growth under Compost Mixing with Vermiculite:

The germination percent of cucumber and tomato seeds sown in final product of different sources of compost were very low compared with peat moss. This result was related to the highly electrical conductivity (EC) of the final product of compost. Reducing the EC values by mixing the compost with vermiculite (EC = 0.24 dS/m) at 1:1 and 1:3 ratios gave some advances in germination percent (Table 5) and fresh weight (Table 6).

Although the germination percentage and growth of cucumber and tomato were improved by increasing the mixing ratio with vermiculite, the media becomes smoother and finds difficulty for seedlings transport. Nearly the same results found by Abdallah *et al.* (2000). They reported that tomato and cucumber transplants grown in 50% bagasse compost media and 50% vermiculite were significantly better in their growth than those grown in 25% bagasse compost media. The best compost media under these conditions was bagasse followed by rice straw then banana compost.

Table 5. Germination percent of cucumber and tomato seeds sown in different compost mixed with vermiculite (v/v)

	Mixing ratio	Banana	Palm leaves	Rice straw	Geranium	Sugar beet	Bagasse	Peat moss
Cucumber	Without mix	35	30	36	18	25	44	95
	1:1	68	58	70	32	56	77	100
	1:3	75	71	80	58	62	85	100
L.S.D (P=0.05)		9.30						
Tomato	Without mix	15	15	13	4	6	20	95
	1:1	45	52	50	26	32	65	100
	1:3	71	74	75	44	58	80	99
L.S.D (P=0.05)		12.40						

Table 6. Fresh weight (mg/seedling) of cucumber and tomato seedlings grown in different compost sources mixed with vermiculite (v/v)

	Mixing ratio	Banana	Palm leaves	Rice straw	Geranium	Sugar beet	Bagasse	Peat moss
Cucumber	Without mix	59	55	61	52	48	60	115
	1:1	70	60	72	58	55	77	132
	1:3	75	65	74	60	60	70	110
L.S.D (P=0.05)		5.95						
Tomato	Without mix	38	35	36	34	32	40	95
	1:1	60	55	55	49	49	65	100
	1:3	70	63	64	60	55	78	87
L.S.D (P=0.05)		8.59						

3.2. Growth Under Compost Washed with Water:

The germination percentage of cucumber and tomato seeds was improved when they sown in compost washed with water at 1:10 ratio as will as compietely washing with water (Table 7). The figures in Table (7) show the highest germination percent with sugar cane bagasse and banana compost compared with other residues compost. It is also better than the germination percent of cucumber and tomato grown in peat moss which is used without mixing with vermiculite.

Table 7. Germination percentage of cucumber and tomato seeds sown in different compost sources after washing with water

	Washing ratio	Banana	Palm leaves	Rice straw	Geranium	Sugar beet	Bagasse	Peat moss
Cucumber	1:10	92	80	85	80	75	96	95
	Complete	100	86	88	90	86	100	95
L.S.D (P=0.05)		3.96						
Tomato	1:10	90	78	80	75	68	94	95
	Complete	96	82	86	82	76	97	95
L.S.D (P=0.05)		2.50						

The growth of both seedlings of cucumber and tomato was better in compost completely washed than those grown in compost washed with measured volume (Table 8). More enhancing was found for the weight of seedlings of tomato as well as cucumber. Sugar cane bagasse, banana residues and rice straw were the best sources for composting and produce a seeds media after mixing with vermiculite 1:1 ratio (v/v) or washing with water.

Table 8. Fresh weight (mg/seedling) of cucumber and tomato seedlings grown in different compost sources after washing with water

	Washing ratio	Banana	Palm leaves	Rice straw	Geranium	Sugar beet	Bagasse	Peat moss
Cucumber	1:10	80	70	82	68	65	85	115
	Complete	108	75	98	85	72	110	115
L.S.D (P=0.05)		10.23						
Tomato	1:10	77	42	44	38	45	78	95
	Complete	95	65	78	70	58	92	95
L.S.D (P=0.05)		10.48						

Conclusion

Compared to control of peat moss media, cucumber and tomato seedlings emerged and produced transplants of similar or even better quality when grown in agricultural as well as industrial waste compost washed with water. The results obtained indicate the sugar cane bagasse followed by banana and/or rice straw compost may be able to use as a seed-bed like material in Egyptian agriculture. More studies will be done on these materials to establish the production of growing media to substitute of imported peat moss.

REFERENCES

Abdallah, M.M.F.; A.A.G. Abdallah; I.I. El-Oksh and M.F. El-Sherif (2000). Production of tomato and cucumber transplants in greenhouse using local bagasse and water hyacinth composts as a substitute for peat moss. J. Agric. Sc. Mansoura Univ., 25(9):5851-5866.

Abdel-Motaal, H.M. (2004). Production of organic fertilizer enriched with phosphorus from some agricultural wastes mixed with rock phosphate. M.Sc. Theses, Fac. Agric., Minia Univ., Egypt.

Kayhanian, M. and D. Rich (1996): Sludge management using the biodegradable organic fraction of municipal sole water as a primary substrate. Water Environ. Res., 64 (2):240.

Mathur, S.P.; H. Dinel; G. Owen; M. Schintzerand and J. Dugan (1993). Determination of compost biomaturity . II. Optical density of water extracts of compost as a reflection of their maturity. Biol. Agric. and Hort., (10),87-108.

Page, A.L.; R.H. Miller and D.R. Keeney, eds.(1982). Methods of Soil Analysis. Part 2: Chemical and Microbiological Properties. American Society of Agronomy, Madison, Wisconsin, USA.

Rynk, R. (1992). On-Farm Composting Handbook. NRAES-54. Northeast Regional Agricultural Engineering Service, Cornell Univ., Ithaca, New York. pp. 6–45.

Sherif, H.O. (1989). Egyptian village waste treatment, design of appropriate solution. M.Sc. Thesis, Fac. Engin., Minia Univ., Minia, Egypt.

Sherif, M.A. (2001). Production of peat substitute from agricultural residues. Arabic Report introduced to the Egyptian Company for Agricultural Residues Utilization, Dokki, Giza, Egypt.

تدوير المخلفات الزراعية ضرورة بيئية وزراعية:

١ – تقييم استخدام بعض مصادر المخلفات الزراعية في إنتاج بيئة بديلة لانبات البذور

هشام عمر شريف * و محمد أحمد شريف **

* قسم الهندسة الكيميائية – كلية الهندسة – جامعة المنيا – مصر

** قسم علوم الأراضي – كلية الزراعة – جامعة المنيا – مصر

تم إعداد الكمبوست من ٦ أنواع من المخلفات الزراعية (مخلفات أشجار الموز – جريد النخيل – قش الأرز – مخلفات نباتات العنر بعد الاستخلاص – مخلفات بنجر السكر(تفل البنجر) – مخلفات قصب السكر (بجاس)) واختبار الكمبوست الناتج في إنبات ونمو بذور نباتات الخيار والطماطم بالاضافة إلى استخدامه مخلوطاً بالفيرميكيوليت بنسبة ١:١ ، ٣:١ بالحجم. كما تم استخدام الكمبوست أيضاً بعد غسله بالماء بنسبة ١٠:١ أو الغسيل بدون حجم محدد حتى تمام الغسيل ومقارنة كل ذلك بالبيت موس المستورد كمعاملة مقارنة.

ولقد أظهرت النتائج أن نسبة الإنبات لكل من بذور الخيار والطماطم كانت منخفضة بدرجة ملحوظة عند زراعتها في بيئة الكمبوست كمنتج نهائي بدون خلط مع الفيرميكيوليت أو غسيل بالماء مقارنة بمعاملة البيت موس. بينما ظير تحسن في الانبات وزيادة نسبته مع معاملات الخلط بالفيرميكيوليت وكانت نسبة ٣:١ أفضل إلا أن البادرات أظهرت صعوبة في نقلها بصلايتها.

كانت معاملات الغسيل سواء بنسب محددة (نسبة ١٠:١) أو بدون نسب محددة من الماء ملائمة للإنبات والنمو إلى الدرجة التي اقتربت فيها نسب النمو أو زادت على نسبة الانبات في البيت موس وهو ذات المؤشر الذي ظير.في الوزن الأخضر للشتلات. كان الاختلاف واضحاً بين أنواع الكمبوست المستخدمة في الاختبار إلا أن كمبوست بجاس قصب السكر كان الأفضل يليه كمبوست الموز ثم كمبوست قش الأرز بعد المعاملة بالخلط أو الغسيل ، لذا فإن الأمر يحتاج إلى مزيد من الدراسات حول أفضل المعاملات لإنتاج بيئة بديلة للبيت موس من هذه المصادر.