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Compost From Rice Straw and Sawdust as Growing media for Pot Plants

Naiem El-Keltawi; Azza Tawfik; Gamal Hassan and Omer Ibrahim

Department of Horticulture, Fac. Agric., Assiut Univ., Assiut 71562, Egypt.

ABSTRACT:

Rice straw and sawdust were wetted for certain periods (0, 15, 30, 45, 60 days) and compared with peat moss as growing media for pothos (*Scindapsus aureus* L.) and Gardenia (*Gardenia jasminoides* Ellis). Nutrient element analysis of the composted materials showed a noticeable increase in N, P, and K contents in rice straw and sawdust as a result of composting process. This improvement was more obvious in rice straw where nitrogen content in the end-product reached 3 folds that of the raw material. The increment in nitrogen reflected on lowering C/N ratio and in turn better growth of pothos and gardenia plants. Plants of both species grown in peat moss showed better vegetative growth, flowering and nutrient contents than those grown in rice straw or sawdust. Rice straw-grown plants recorded the next high values of the growth characteristics. The best composts were rice straw and sawdust wetted for either 45 or 60 days even though their pH value and nutrient elements content still not as suitable as peat moss, no significant differences between 45 and 60 days were observed in most cases. Maturity of the compost end-product was tested using germination bioassay. The results were in harmony with those obtained from the pot experiment.

KEY WORDS:

Composting,Gardenia jasminoides, Pothos, Rice straw, Sawdust, *Scindapsus aureus,*

INTRODUCTION:

Good quality of pot media is an important issue. In Egypt, peat moss, vermiculite and other popular potting medium amendments have been becoming more costly and less readily available to the foliage plant industry. Growers are looking for less expensive potting medium amendments to replace, in part, the more expensive ingredients in their mixtures, Poole and Conover, 1990. Consequently, they have tried to use organic wastes and plant residues as substitutes for traditional materials.

El-Mashad *et al.,* 2003 mentioned that agricultural wastes represent an important source of bio-energy and valuable products. One of the main agricultural wastes in Egypt is rice straw, which consists

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about 3.5 million tons annually, causing ecological problem unless it is not well exploited. Generally, 18% of the agricultural wastes in Egypt is used directly as fertilizer. Meanwhile, another 30% is used as animal food. The remainder is burnt directly on the fields or is used for heating in the small villages causing black clouds over Lower Egypt as a big environmental problem. Thus, bioconversion of part of such accumulated rice straw and other wastes, as sawdust, into compost could be a beneficial method for its utilization (Abdel-Azeem, 2001).

Nowadays, the interest has increased in composting as a way for bioorganic systems to be used in sustainable agriculture instead of ecologically undesirable materials. Plant residues, in most cases, cannot be used directly because of certain drawbacks such as phytotoxicity, nitrogen immobilization, high salt content or structural incompatibility. Therefore, composting is used to overcome many of these disadvantages and composted end-products, properly mixed, can make excellent horticultural substrates (Verdonck, 1988 and Abdel-Azeem, 2001). Sawdust and several composted materials were proved by several investigators to be used as fertilizers or as alternative components to form growing media for seedlings of different ornamental plants. (Gerding *et al*.,1996 and Egrinya Eneji *et al*., 2003)

Aforementioned information initiated the present trial in which we tried to convert rice straw and sawdust into growing media for pot plants. In the current work, two different methods; germination bioassay and plant assay, were used to assess the quality and reliability of compost end-product. In order to conduct the plant assay experiment, two different indoor plants, pothos and gardenia, representing neutral and acid loving plants, respectively, were chosen for testing the composted materials. Pothos (*Scindapsus aureus* L.) plant which belongs to Araceae family is one of the most fascinating evergreen houseplants used widely nowadays in hanging baskets or as an indoor climbing foliage plant.Besides,*Gardenia jasminoides* Ellis plant, family Rubiaceae, is a lovely flowering indoor shrub used for its large, white, waxy, fragrant flowers or for its attractive, glossy dark green leaves.

MATERIALS AND METHODS:

The present study was carried out at the Experimental Farm, Faculty of Agriculture, Assiut University, Assiut, Egypt during 2002/2003 and 2003.2004 growing seasons. Purified sawdust and shredded rice straw were subjected to a composting process in 70 cm height and 2 m wide piles involving regular wetting and turning over to keep about 50 - 60% moisture (Hoitink and Poole,1979). The composting process extended for five composting times ; 0 (control), 15, 30, 45 and 60 days. Five samples were taken from both sawdust and rice straw at different composting times to determine nitrogen, phosphorus and potassium in the same manner described hereinafter. Besides, pH value was measured in a 1:10 soil suspension (Jackson, 1973).

Germination Bioassay: At the end of the composting process, a germination bioassay was conducted. Samples of rice straw and sawdust representing different composting times were extracted as follows; 100 ml of distilled water at 15º C was mixed with 50 g of wet sample (50% fresh weight water content). The mixture was shaken for 6 hr, and was then centrifuged at 8000 rpm for 20 min at 20º C. The extract was diluted with distilled water to obtain 25, 50, 75 and 100% extract. For the germination test, 10-cm diameter petri dishes were lined with fast speed qualitative filter paper. Each dish received 5 ml of the appropriate treatment extract, whereas the control received 5 ml of distilled water. Ten seeds of lettuce (*Lactuca sativa* L.) were sown on each dish with 3 replicates per treatment. The dishes were incubated at 25º C for 72 hr in the dark. The germinated seeds were counted (G) and the radical length (L) was measured. The germination index (Gi) was calculated according to the formula $Gi = G/G_0 \times L/L_0 \times 100$, where G_0 and L_0 are, respectively, the germination percentage and radical growth of the 100% distilled water (control). The global germination index (GI) was the Gi average of the 50 and 75 dilution treatments.

Plant assay: In early spring, uniform cuttings of pothos (*Scindapsus aureus* L.) were grown in 5-cm plastic pots filled with peat moss. Uniformly rooted cuttings of gardenia (*Gardenia jasminoides*, Ellis.) were brought from Egypt Green Nursery, El-Mansouria Canal, Cairo, Egypt. Two months later and under lath-house conditions, plantlets were transplanted into pots filled with the assigned treatment of composted rice straw or sawdust. Plants grown in peat moss were used as a control (general check). Pots were arranged in a complete randomized block design (split-plot) with three replicates. The main plots comprehend the growing substrates (rice straw, sawdust and peat moss). Each main plot was divided into five sub-plots representing composting periods (0, 15, 30, 45 and 60 days). Each plot comprised ten pots. All plants were sprayed weekly with Agrowmore fertilizer (2 gm/l).

At the end of the growing season data were recorded on plant height (cm), length of internodes (cm), number of internodes/plant, number of leaves / plant , leaf area (cm^2), total leaf area/plant (cm^2), fresh weight of roots (g), dry weight of roots (g), shoot-root ratio, fresh weight of shoots (g) and dry weight of shoots (g), in addition to flowering characteristics of gardenia, viz; number of flowers/ plant, mean of flower weight (g) and flower diameter (cm) of gardenia plant. Leaf pigments content was determined in freshly collected leaf samples which were extracted by using acetone 80% and determined colorimetrically according to Metzner *et al.*, 1965. Thereafter, chlorophyll “a”, chlorophyll “b” and carotenoids were measured using spectrophotometer at wave lengths of 663, 644 and 452.5 nm, respectively. They were then calculated as mg/g fresh weight of leaves. Leaf nutrient contents were determined in dried plant leaves digested using sulphuric and perchloric acids method pursuant to Piper (1967). The final digested solution was used to determine nitrogen by using the modified micro Kjeldahal method (Black *et al.*, 1965), phosphorus spectrometrically using the chlorostannus-phosphomolybdic acid method in a sulphoric acid system, potassium by the flame photometer method and calcium and magnesium (Jackson, 1973).

Data were subjected to statistical analysis using “F” test according to Snedecor and Cochran, 1973 and L.S.D. value for comparisons according to Gomez and Gomez, 1984.

Results and Discussion

Germination Bioassay:

Compost should be mature at the time of sale and distribution. To be mature, compost should meet certain requirements; C/N ratio, water holding capacity, pH, …etc. (Warman, 1999). For that reason, a germination bioassay was conducted and the obtained data are presented in Tables 1 and 2. Concerning the influence of composting time of both rice straw and sawdust on germination percentage of lettuce seeds, 30-day composted rice straw showed higher percentage of germination compared to sawdust. Differences between extracts of rice straw and sawdust composted for 45 or 60 days were negligible concerning germination percentage of lettuce seeds. The undesirable effect of sawdust extract during the beginning of composting could be attributed to the presence of phytotoxic phenolic compounds and salts as reported by Gariglio *et al*., 2002. Warman, 1999 demonstrated that immature composts might not be phytotoxic to seeds or seedlings, even though one would expect less germination or growth when they are used. Phytotoxic organic compounds are gradually eliminated during the composting process, which could explain the enhancement of germination percentage when the extracts of 45- or 60-day composted rice straw were used as presented in Table (1).

Humic substances found in the final compost products are supposed to have metabolic roles during germination and root initiation as reported by Bidegain *at al*., 2000.

Difference in radical length lettuce seedlings treated with sawdust or rice straw extracts were noticeably low with the superiority to sawdust treated ones in most cases. Fluctuations in radical length strongly affected global germination index (Table 2) resulting in significantly higher global germination index in sawdust-treated seeds comparing with rice straw-treated ones. In this concern, Warman, 1999 noticed that the toxic compounds, which considerably inhibited the germination percentage, were too low to inhibit the radical growth. Moreover, the immature composts would still improve soil properties and don't reduce plant growth.

As shown in Table (1), considerable increments in radical length could be detected when rice straw was composted for more than 30 days. This could be attributed to the elimination of the phenolic toxic compounds as the period of composting was increased, as previously mentioned. Meanwhile, slight fluctuations of radical length were observed in seeds treated with rice straw extracts of all composting times, which clearly indicate the absence of such toxic compounds in composted rice straw. Thus, it is clear that germination index did not adequately detect responses associated with the different C and N sources and it varied greatly during the composting period (Wilson, 1995).

Table (1) Radical length (L) and germination percentage (G%) of lettuce (*Lactuca sativa*) seeds treated with extracts of composted rice straw and sawdust at different periods of time.

Composting		*Extract dilutions*									
		Radical length (cm)					*Germination percentage*				
material	period	100%	75%	50%	25%	*Mean*	100%	75%	50%	25%	*Mean*
Sawdust	0	2.60	5.63	3.57	4.83	4.16	33.3	36.7	56.7	63.3	47.5
	15	3.57	4.07	2.87	4.23	3.69	53.3	56.7	56.7	63.3	57.5
	30	3.40	5.13	4.67	5.97	4.80	66.7	63.3	73.3	76.7	70.0
	45	5.63	5.67	5.07	4.53	5.23	96.7	96.7	100.0	100.0	98.4
	60	5.03	4.47	4.40	4.63	4.63	100.0	93.3	96.7	93.3	95.8
Mean		4.05	4.99	4.12	4.84	4.50	70.0	69.3	76.7	79.3	73.8
Rice straw	0	2.17	2.73	3.17	4.17	3.06	83.3	83.3	80.0	70.0	79.2
	15	2.07	1.57	2.83	3.83	2.58	93.3	90.0	90.0	83.3	89.2
	30	1.90	2.17	2.17	5.17	2.90	76.7	76.7	83.3	76.7	78.4
	45	1.63	2.00	3.00	4.67	2.83	90.0	93.3	90.0	90.0	90.8
	60	2.33	3.57	5.33	4.50	3.93	90.0	96.7	100.0	100.0	96.7
Mean		2.02	2.41	3.30	4.47	3.05	86.7	88.0	88.7	84.0	86.8
Water (control)				4.00					100.0		

Table (2) Changes in global germination index % (GI) of lettuce (*Lactuca sativa*) seeds treated with extracts of composted rice straw and sawdust at different periods of time.

Composted materials	Composting time (days)					
	0	15	30	45	60	Mean
Sawdust	51.417	49.127	83.587	131.667	105.047	84.169
Rice straw	60.212	49.503	43.750	57.083	109.710	64.052
Mean	55.814	49.315	63.668	94.375	107.378	
L.S.D.		0.05			0.01	
Media		4.410			10.171	
Composting time		11.996			16.529	
Interaction		16.966			23.376	

PLANT ASSAY:

Vegetative growth

Data on some chemical characteristics of sawdust, rice straw as affected by different composting times comparing to peat moss are shown in Table (3), which could be useful interpreting plant growth response. It could be deduced from the presented in Table (4) and (5) that the responses of both pothos and gardenia plants regarding most of the vegetative growth characteristics and chemical composition were in harmony with those obtained by the germination bioassay.

Slight increments could be detected in vegetative growth characteristics of pothos and gardenia plants grown in either rice straw or sawdust composted 30 days comparing to their control treatments (uncomposted materials). Meanwhile, growing plants in 45- or 60-day composted materials reflected significantly higher response on the vegetative growth characteristics of both plant species represented as plant height, number of leaves and internodes per plant, leaf area, fresh and dry weights of both shoots and roots per plant and shoot-root ratio. The good quality of plants grown in 45- or 60-day composted materials could be explained by the enhancements in fresh and dry weights of roots, which considerably increased both fresh and dry weight of shoots of both pothos and gardenia plants. It could be clearly noticed that composting process reduced the negative effects of the raw materials with increasing the time of composting and led to enhancement in compost end-product and subsequently better plant growth. Improvements in plant vegetative growth could be ascribed to the better physical and chemical statues of 45 or 60-day composted materials as shown in Table (3). At the higher concentrations of nitrogen in the growing media, there is a tendency to increase leaf cell number and cell size and consequently increase in leaf formation. These observations are in harmony with the well known fact that nitrogen is essential for protein biosynthesis in plants; Devlin and Witham, 1983 assumed that low nitrogen availability must cause a decrease in protein synthesis, which subsequently causes a decrease in cell size and especially cell division. This fact could be the reason of the poor growth of those plants grown in composted materials for up to 30 days which were characterized by high C/N ratio.

The pH of the growing medium is an important factor indirectly influencing plant growth through its effects on mineral nutrients availability and microbial activity. The pH ranges from 5.5 to 6.5 or 5.0 to 6.5 were recommended for most foliage crops grown in soil or artificial media, respectively. Gardenia plant prefers a rich, moist, well-drained, acidic soil (pH 4.5-5.5). On the other hand, Pothos is a semi-shade, humid atmosphere-like plant and prefers pH 5.5 to 6.5 (Davidson, 1989). The present investigation indicated that the lower pH value of 45- or 60-day composted materials enhanced the vegetative growth of pothos and gardenia plants, which could be attributed to the preferable effects of acidic soil conditions. Comparing with peat moss, rice straw composted for 45 days or more seemed to reach peat standard effects in most cases, especially in leaf area, number of internodes, shoots fresh weight, fresh and dry weight of roots, and shoot-root ratio of pothos plants.

The priority of rice straw in relation to sawdust in most cases could be explained according to the findings of JongMyung *et al*., 2000, who postulated that the air space of sawdust was low (4%) indicating that aeration could be a problem for container-grown plants in this substrate. However; its electrical conductivity and cation exchange capacity were higher than some other organic substrates. Several researchers such as Solvia *et al*., 1984 and Chen *et al*., 1999 and 2003 concluded that sawdust might be better if used as growing media in mixtures with other materials to grow other indoor plants.

Flowering characteristics of gardenia plant:

Flowering of gardenia plant in the present study was strongly influenced by the absorbed amounts of the nutrient elements. As the composting time increased the amount of the nutrient element increased in the composted material and subsequently in plant leaves. This obviously correlated with flower quality of gardenia plants grown in those materials, as shown in Table (5), where flower diameter, and flower number and weight per plant slightly increased in plants grown in composted materials for up to 30 days then significantly increased in 45- or 60-day composted ones. In addition, peat moss-grown plants showed the best flowering characteristics.

Leaf pigmentation and chemical composition

The obtained results on both pothos and gardenia plants revealed that there is a positive relationship between the increment in leaf pigment content and the increment in leaf content of nitrogen and magnesium of both plant species grown in composted materials due to increments in the time of composting (Tables 6 and 7). The best results concerning leaf pigmentation and chemical composition were noticed in peat-grown plants followed by those grown in 45- 60-day composted materials, which strongly correlates with the previously discussed vegetative characteristics in both pothos and gardenia plants. The high nitrogen and magnesium content of peat moss were proved to increase chlorophylls content as indicated by Edwards *et al*., 1990 on *pinus teada* and Mansour *et al.*, 1994 on *Syngonium podophyllum*. The preferable increments in pigment content with increasing composting time were observed by Gariglio *et al.*, 2002 on calendula grown in composted sawdust.

Table 3. Some characteristics of sawdust, rice straw as affected by different composting times comparing to peat moss.

Growing media	*Composting time (days)*	*N%*	*P%*	*K%*	*pH*
Peat moss	General check	1.23	0.303	0.514	4.2
Sawdust	0	0.18	0.151	0.642	7.79
	15	0.32	0.210	0.621	7.50
	30	0.34	0.200	0.567	7.83
	45	0.35	0.168	0.599	7.95
	60	0.43	0.185	0.642	7.61
Rice straw	0	0.33	0.210	0.631	8.22
	15	0.32	0.294	0.514	8.15
	30	0.42	0.202	0.631	8.25
	45	0.47	0.269	0.535	8.00
	60	0.98	0.219	0.621	8.20

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كمبوست من قش الأرز ونشارة الخشب كبيئات لزراعة نباتات الأصص

نعيم عيسي القلتاوي ، عزة عبد العزيز توفيق ،
جمال عبد الحفيظ أحمد وعمر حسني محمد
قسم البساتين، كلية الزراعة، جامعة أسيوط، أسيوط 71562، مصر.

تهدف هذه الدراسه إلى محاوله إيجاد بيئات محليه بدلاً من البيت موس المستوره والمستخدم بكثره فى مشاتل نباتات الزينه لزراعه نباتات الأصص. تم زراعة نبات من البوتس والجاردينيا في بيئات من قش الأرز ونشارة الخشب المرطب لفترات مختلفة (صفر، 15، 30، 45، 60 يوماً) وذلك مقارنة ببيئة البيتموس. وقد أثبتت النتائج المتحصل عليها إمكانية استخدام كل من البيئتين بعد عمليه الترطيب إلا أن قش الأرز كان الأفضل كبيئه أصص بعد البيت موس مباشره لنمو نباتات البوتس والجاردنيا. وقد وجد أن زياده فتره الترطيب لمده 45 يوما أو أكثر أدت إلى تحسين صفات النمو الخضري ومحتوي الأوراق من الصبغات والعناصر الغذائيه لنبات البوتس وتحسين النمو الخضرى والزهرى لنباتات الجاردينيا. ولم تلاحظ أية فروق معنوية بين الترطيب لمدة 45 و 60 يوماً في معظم القياسات. وبالرغم من التفوق الملحوظ للمعاملة بالترطيب لمدة 45 أو 60 يوماً، إلا أن مجهوداً أكبر يجب أن يبذل لتقليل درجة الـ pH لهذه البيئات وكذلك تحسين محتواها من العناصر الغذائية الضرورية. ويمكن أيضاً أن ننصح منتجي نباتات الأصص الورقية أو المزهرة باستخدام خلطات مختلفة من مخلفات المزرعة في محاولة لتحسين خواصها الفيزيائية.

Table (4): Vegetative growth characteristics of pothos plants grown on composted rice straw, sawdust and peat moss wetted at different periods

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Media	Composting time (days)	Plant height cm	No. leaves/ plant	Leaf area cm^2	No internodes/ plant	Internode length cm	Shoot fwt. g/plant	Shoot dwt. g/plant	Root fwt. g/plant	Root dwt. g/plant
Sawdust	0	15.43	6.63	20.06	8.03	1.92	9.47	1.16	3.67	0.59
	15	16.67	7.17	20.19	8.17	2.05	10.30	1.17	4.00	0.59
	30	17.70	8.10	21.52	8.10	2.19	11.40	1.22	4.03	0.76
	45	21.13	9.10	27.50	9.83	2.15	12.26	1.24	5.63	1.00
	60	25.37	8.40	27.39	9.00	2.83	11.83	1.26	5.73	1.07
Mean		19.26	7.88	23.33	8.63	2.23	11.05	1.21	4.61	0.80
Rice straw	0	16.03	7.53	23.42	9.60	1.67	9.07	1.31	4.57	0.59
	15	25.35	8.23	24.17	9.77	2.61	10.93	1.50	4.60	0.62
	30	29.90	8.73	28.83	10.47	2.86	14.10	1.74	4.61	0.99
	45	33.24	12.13	48.83	12.70	2.62	25.17	2.46	9.00	1.92
	60	33.41	11.37	48.67	12.30	2.72	24.70	2.54	10.10	2.00
Mean		27.59	9.60	34.78	10.97	2.50	16.79	1.91	6.58	1.22
Peat moss	0	40.91	14.02	50.83	15.07	2.71	29.30	2.74	10.07	2.35
	15	41.43	15.26	50.33	16.11	2.57	29.00	2.79	10.14	2.33
	30	40.89	15.09	51.52	16.30	2.51	29.00	2.81	10.47	2.33
	45	42.29	14.92	50.77	16.27	2.60	29.20	2.83	10.58	2.34
	60	42.10	14.83	51.53	15.56	2.71	29.20	2.81	10.49	2.35
Mean		41.52	14.82	51.00	15.86	2.62	27.14	2.80	10.35	2.34
Means of Composting time	0	24.12	9.39	31.44	10.90	2.10	15.95	1.74	6.10	1.18
	15	27.82	10.22	31.56	11.35	2.41	16.74	1.82	6.25	1.18
	30	29.50	10.64	33.96	11.62	2.51	18.17	1.92	6.37	1.36
	45	32.22	12.05	42.37	12.93	2.46	22.21	2.18	8.40	1.75
	60	33.43	11.53	42.53	12.29	2.75	21.91	2.20	8.77	1.81
L.S.D. 5%	Media	2.11	0.41	4.02	0.23	0.16	0.35	0.07	0.15	0.05
	Time	1.09	0.56	2.52	0.74	0.18	0.49	0.09	0.21	0.04
	Interaction	1.53	0.79	3.56	1.04	0.26	0.69	0.13	0.30	0.05

Table (5): Vegetative growth and flowering characteristics of gardenia plants grown on composted rice straw, sawdust and peat moss wetted at different periods.

Media	Composting time (days)	Plant height cm	No. leaves/ plant	Leaf area cm^2	No internodes/ plant	Internode length cm	Shoot fwt. g/plant	Shoot dwt. g/plant	Root fwt. g/plant	Root dwt. g/plant	No flowers / plant	Flower diameter cm	Flower weight g
Sawdust	0	17.40	8.03	6.44	5.03	3.46	12.30	3.91	7.75	3.18	1.00	1.99	1.11
	15	18.15	8.17	7.44	5.07	3.58	14.33	3.99	8.47	3.99	0.99	2.66	1.15
	30	19.10	12.03	10.57	6.23	3.06	15.63	4.17	8.99	4.12	1.08	3.77	1.64
	45	21.66	14.47	12.57	36.33	3.42	20.90	5.07	13.60	5.15	1.51	4.52	1.93
	60	23.00	13.03	14.07	6.77	3.40	21.07	5.10	14.23	6.92	1.50	4.60	1.90
Mean		19.86	10.75	10.22	5.89	3.38	16.85	4.45	10.61	4.67	1.22	3.51	1.55
Rice straw	0	18.06	8.07	6.33	4.53	3.98	13.69	3.14	6.85	3.12	1.03	3.10	1.21
	15	18.18	8.17	8.40	4.67	3.90	15.62	3.95	9.53	4.13	0.99	3.17	1.51
	30	19.47	12.10	1.19	6.67	2.92	15.76	3.98	10.04	4.51	0.98	4.43	1.90
	45	23.30	13.43	15.06	6.87	3.25	21.80	4.51	16.57	7.03	0.97	4.99	1.97
	60	23.66	13.70	15.37	6.93	.41	23.46	5.18	15.80	7.07	0.95	5.02	1.98
Mean		20.33	11.09	11.27	5.93	3.49	18.06	4.15	1.76	5.17	0.98	4.14	1.71
Peat moss	0	24.07	12.63	18.19	6.61	3.64	31.24	10.05	23.73	9.23	1.56	6.08	2.38
	15	24.16	12.60	18.05	6.58	3.67	31.01	10.05	23.83	9.22	1.55	6.07	1.37
	30	23.95	12.53	17.52	6.59	3.64	31.15	10.12	23.90	9.22	1.56	6.04	1.38
	45	23.33	12.60	18.20	6.58	3.55	31.21	10.08	23.93	9.25	1.58	6.12	1.39
	60	23.74	12.57	18.12	6.57	3.61	30.98	10.01	23.66	9.26	1.58	6.12	1.39
Mean		23.85	12.59	18.02	6.58	3.62	31.12	10.06	23.81	9.24	1.56	6.08	1.38
Means of Composting time	0	19.84	9.58	10.32	5.39	3.69	19.08	5.70	12.78	5.18	1.20	3.72	1.56
	15	20.16	9.64	11.30	5.44	3.72	20.32	6.00	13.94	5.78	1.18	3.97	1.68
	30	21.41	12.22	13.09	6.50	3.21	20.85	6.09	14.31	5.95	1.20	4.75	1.97
	45	21.49	12.83	15.28	6.59	3.41	24.64	6.55	18.03	7.14	1.35	5.21	2.10
	60	23.53	13.10	15.85	6.76	3.47	25.17	6.76	17.90	7.75	1.34	5.25	2.09
L.S.D. 5%	Media	0.38	0.11	0.57	0.07	0.09	0.57	0.08	0.22	0.05	0.06	0.02	0.01
	Time	0.42	0.07	1.08	0.06	0.07	0.74	0.07	0.46	0.06	0.03	0.09	0.03
	Interaction	0.59	0.09	1.52	0.09	0.10	1.05	0.10	0.64	0.09	0.04	0.13	0.04

Table (6): Leaf pigmentation and chemical composition of pothos plants grown on composted rice straw, sawdust and peat moss wetted at different periods

Media	Composting time (days)	Chlrophyll a (mg/g)	Chlrophyl b (mg/g)	Carotenoids (mg/g)	N %	P %	K %	Ca %	Mg %
Sawdust	0	0.75	0.34	0.19	1.30	0.238	0.552	0.60	1.44
	15	0.98	0.43	0.19	1.40	0.318	0.562	0.80	1.68
	30	1.00	0.67	0.18	1.41	0.318	0.583	0.80	1.68
	45	1.12	0.97	0.24	1.83	0.338	0.573	0.60	2.40
	60	1.14	1.06	0.23	1.73	0.332	0.531	0.60	1.68
Mean		1.00	0.70	0.21	1.53	0.309	0.560	0.68	1.77
Rice straw	0	0.89	0.47	0.18	1.20	0.277	0.501	0.40	1.56
	15	0.97	0.50	0.19	1.50	0.270	0.522	0.80	1.68
	30	1.14	0.68	0.22	1.60	0.287	0.521	1.20	1.68
	45	1.72	1.12	0.23	1.99	0.307	0.499	1.00	2.52
	60	1.68	1.17	0.22	1.98	0.297	0.496	1.00	1.20
Mean		1.28	0.79	0.21	1.65	0.287	0.508	0.88	1.73
Peat moss	0	1.74	1.17	0.34	2.00	0.342	0.800	1.20	1.68
	15	1.72	1.16	0.34	2.04	0.345	0.801	1.19	1.67
	30	1.71	1.16	0.34	2.04	0.364	0.803	1.18	1.67
	45	1.74	1.16	0.35	2.04	0.342	0.802	1.16	1.68
	60	1.73	1.17	0.35	2.00	0.344	0.800	1.21	1.68
Mean		1.73	1.16	0.35	2.03	0.347	0.801	1.19	1.68
Means of Composting time	0	1.13	0.66	0.24	1.50	0.286	0.618	0.73	1.56
	15	1.22	0.70	0.24	1.65	0.311	0.628	0.93	1.68
	30	1.28	0.84	0.25	1.68	0.323	0.636	1.06	1.68
	45	1.53	1.08	0.27	1.95	0.329	0.625	0.92	2.20
	60	1.52	1.13	0.27	1.90	0.324	0.609	0.94	1.52
L.S.D. 5%	Media	0.10	0.03	0.03	0.04	0.010	0.002	0.01	0.01
	Time	0.09	0.03	0.01	0.02	0.012	0.002	0.01	0.01
	Interaction	0.12	0.04	0.02	0.03	0.018	0.002	0.01	0.01

Table (7): Leaf pigmentation and chemical composition of gardenia plants grown on composted rice straw, sawdust and peat moss wetted at different periods.

Media	Composting time (days)	Chlrophyll a (mg/g)	Chlrophyl b (mg/g)	Carotenoids (mg/g)	N %	P %	K %	Ca %	Mg %
Sawdust	0	0.444	0.207	0.217	1.53	0.207	0.512	1.54	1.18
	15	0.464	0.215	0.259	1.91	0.214	0.513	1.44	1.17
	30	0.571	0.276	0.253	1.98	0.286	0.537	1.45	1.42
	45	0.718	0.281	0.215	2.05	0.298	0.499	1.98	1.62
	60	0.748	0.254	0.215	2.04	0.290	0.497	1.97	1.63
Mean		0.578	0.246	0.215	1.90	0.259	0.512	1.68	1.41
Rice straw	0	0.457	0.221	0.208	1.80	0.222	0.411	0.92	1.21
	15	0.467	0.252	0.202	1.91	0.242	0.498	1.06	1.63
	30	0.531	0.346	0.207	1.93	0.249	0.499	1.25	1.75
	45	0.910	0.475	0.298	2.08	0.251	0.476	1.99	2.33
	60	0.924	0.481	0.312	2.06	0.256	0.446	2.00	2.37
Mean		0.658	0.355	0.246	1.96	0.244	0.466	1.44	1.86
Peat moss	0	1.002	0.523	0.300	2.37	0.302	0.399	1.11	2.14
	15	1.003	0.522	0.300	2.36	0.301	0.403	1.12	2.17
	30	1.001	0.523	0.301	2.37	0.301	0.402	1.13	2.18
	45	1.003	0.525	0.299	2.37	0.303	0.399	1.13	2.16
	60	1.002	0.522	0.301	2.35	0.303	0.403	1.14	2.15
Mean		1.002	0.523	0.300	2.36	0.302	0.401	1.13	2.16
Means of Composting time	0	0.634	0.317	0.242	1.90	0.243	0.441	1.19	1.51
	15	0.645	0.329	0.254	2.06	0.253	0.472	1.21	1.66
	30	0.683	0.382	0.254	2.09	0.278	0.479	1.28	1.78
	45	0.877	0.427	0.271	2.17	0.284	0.458	1.70	2.04
	60	0.891	0.419	0.276	2.15	0.283	0.449	1.70	2.05
L.S.D. 5%	Media	0.005	0.003	0.006	0.04	0.005	0.011	0.06	0.02
	Time	0.006	0.006	0.014	0.05	0.005	0.014	0.03	0.02
	Interaction	0.009	0.008	0.019	0.07	0.006	0.020	0.04	0.02