Al-Azhar Journal of Agricultural Engineering 5 (2023) 31

Contents lists available at Egyptian knowledge Bank (EKB)

Al-Azhar Journal of Agricultural Engineering

journal homepage: https://azeng.journals.ekb.eg/

Full length article

Quality assessment of compost produced from cotton stalks and rice straw

M.R.M. Abd El-Moti [a, *], I.S.A. El-Soally [b], M.A.A. Shetawy [b], M.H. Abo Alghar [c], El Bassoumy R.R. [b]

[a] Graduate Student of Agricultural Structures and Environmental Control Engineering Department Faculty of Agricultural Engineering, Al-Azhar Universi-ty, Cairo, Egypt.

[b] Department of Agricultural Structures and Environmental Control Engineering, Faculty of Agricultural Engineering, Al-Azhar Universi-ty, Cairo, Egypt.

[c] Agricultural Engineering Research Institute (AENRI), Agricultural research Center (ARC), Dokki, Giza, Egypt.

ARTICLE INFO

Handling Editor - Dr. Mostafa H. Fayed

Keywords:
Compost
Cotton stalks
Rice straw
Waste treatment

Agricultural Structures and Environmental Control Engineering

ABSTRACT

It is necessary to exploit the organic waste, whether it is vegetable from the farm's waste that were plentiful and legume residues after harvesting the crop. As well as the use of animal waste represented in animal dung, whether solid or liquid. All these wastes are valuable to be used to produce organic fertilizers which could compensate for the depletion of nutrients by crops. Thus, it is possible to maintain soil fertility, maintaining the environment and its cleanliness. This research was done by making 54 piles (2×3×3×3 replicates) in several layers at site area of about 100 cm (width) × 70, 90, 110 cm (height) × 100 cm (length). Rice straw and cotton stalks were air dried and chopped to 0.5–5 cm by a chopping machine before compost preparation, in addition, animals' manure has been inoculants to rapid the compost process. The samples were collected in three periods, after 21, 42, and 63 days. The samples were prepared, and different characteristics were analyzed. The statistical analyses of the obtained results showed that the best treatment was compost produced from rice straw at 42 days from 110 cm covered piles, which has a C/N ratio of 20.

1. Introduction

In the environment, agricultural, animal and plant residues degrade slowly because of many natural biological and chemical processes known as decomposition. The compost process is considered as a way of accelerating natural deterioration or rapid decomposition by providing more controlled conditions. May (2022) refers to composting the purposeful accumulation of organic matter or biomass that is allowed to decompose in order to be used as an additive to improve soil properties. Mohamed et al., (2010) stated that Cotton is one of the important strategic crops in Egypt, and subsequently, Cotton stalks as a post-harvest by-product are in large quantities, reaching tens of thousands of tons annually. Therefore, that might cause many problems, such as storage on the roofs of houses, and disposal by burning which cause environmental pollution. In addition to the spread of many diseases as the stems contain eggs and larvae of cotton worms, which remain present until planting the next crop, causing great damage to the next crop.

Compost is the product of natural decomposition of organic waste. It occurs in nature slowly and may stop and start many times before decomposition is complete. On the other hand, this process can be accelerated by making some modifications to it in order to reach the required result. Thus, composting process is considered one of the strategic techniques used to recycle various wastes by means of biodegradation. Barakah et al., (2013) referred to the process of converting agricultural

* Corresponding authors.
E-mail address: engmr1973@gmail.com (M.R.M. Abd El-Moti.).

https://azeng.journals.ekb.eg/article_308714.html
Peer review under responsibility of Faculty of Agricultural Engineering, Al-Azhar University, Cairo, Egypt.
Received 11 January 2023; Received in revised form 6 February 2023; Accepted 07 February 2023
Available online 20 July 2023

waste into compost as economically beneficial, as it is a safe and attractive alternative to using chemical fertilizers to produce safe and healthy food.

Ghaly et al., (2006) defined composting as the process of controlled decomposition of organic matter by microorganisms. According to Kulcu and Yaldiz (2004), agricultural waste increases in the world day after day, and the process of converting it into compost is one of the most important ways to get rid of it and benefit from it. Where Hong and Park (2004) stated that organic materials are converted into compost, which is a product suitable for adding to the soil, as it produces some good and desirable properties as a result of adding this component. Accordingly, compost can be defined as a natural, vital process that occurs in aerobic conditions, the purpose of which is to convert organic waste into a dubale form suitable for addition to the soil. Abou Hussein and Sawan (2010) referred that the amount of agricultural waste in Egypt ranges between 30-35 million tons annually, of which only 7 million tons as animal feed and 4 million tons as manure are used. Some residues components after crop harvesting are leaves and stems which are considered as by-products with coarse and large sizes.

The composting was optimal at values of the carbon/nitrogen ratio (C/N) and moisture content of about 30 to 60% (Kubota and Hosono, 1977). Li et al. (2022) stated that composting food waste is difficult because it requires more agglomerating agents, and nitrogen loss is inevitable. To address these issues, composting of food waste with a proportionally lower C/N ratio of 15 with zeolite modification in the dosage range of 5-15% was performed. The effect of zeolite addition on nitrogen loss and NH_3 and N_2O emissions during the composting of food waste has been evaluated. The results showed that adding 10-15% zeolite can significantly reduce the phytotoxic nature of food waste digestate and the compost maturity level can be reached in 10-21 days. Furthermore, the total nitrogen loss can be reduced by 45% by mitigating NH_3 and N_2O emissions when 10 and 15% of the zeolite is modified. Such findings can be used as an effective food waste digestion composting strategy in any part of the world as the characteristics of food waste digestion are similar regardless of the type of food waste.

Zhang et al., (2020) studied the effect of the initial C/N ratio during the composting process of the chicken/corn manure mixture on the succession of the dominant bacteria in the mixture which reduced the total N and C losses in the composting process. Indicated that the succession of dominant bacteria was significantly affected by the temperature and initial C/N ratio during the composting process. Repeat analysis showed that higher C/N appears to enhance the relative abundance of nitrogen-fixing bacteria Thermoactinomyces, Planifilum, Flavobacterium, Bacillaceae, Pseudomonas, Sphingobacterium, Paenibacillus, Bacillus and Thermobifida, while compressing denitrifying bacteria, Pusillimonaseria, and Erysipeloth. The most significant result was a C/N ratio of 30:1 for the lowest C/N losses in the composting process, indicating that the modification to the initial C/N ratio could influence the nitrogen-converting bacteria to reduce overall N and C losses and improve compost quality. Thomas (2020) determined the effects of C/N and moisture content on the survival of extended-spectrum β-lactamase-producing Escherichia coli during in vitro composting of chicken manure. Nine different compost mixtures were enriched with a β-lactamase-producing extended-spectrum E. coli strain to an initial concentration of 7 log 10 CFU/g, and the number of Escherichia coli, temperature and chemical conditions during the composting process were determined. The fastest reduction in E. coli occurred for all mixtures with a C/N ratio of 10:1. In addition, dry mixtures with a moisture content (MC) of 20% and a C/N ratio of either 10:1 or 40:1 showed a faster decrease in E. coli than wet mixtures, Although the maximum temperatures inside the bioreactors are low. Decimal reduction times ranged from 0.27 days in a mixture of 10:1 C/N and 40% MC to 4.82 days in a mixture of 40:1 C/N and 40% MC. Both C/N and MC ratio had a significant effect on the number of E. coli bacteria producing extended-spectrum β-lactamase and on temperature development. The C/N ratio additionally affected the pH value and ammonia nitrogen content during chicken manure. The results of this study show a large set of mechanisms involved in the inactivation of Escherichia coli during chicken manure.

The agricultural wastes might cause environmental problems. Such raw materials are low in protein and fat, while contain a high percentage of lignin and cellulose contents. Moreover, that materials become accumulated in the fields after crop harvesting. While the farmers are in a hurry to replant their lands, therefore disposal of waste has the top priority. They usually do that by incineration with harmful effects of toxic gases into the air and the reduction of microbial activities in the soil. In addition, collecting and storing these wastes in the field may cause a suitable environment for reproduction and growth of pests and pathogens that attack new crops. So, the composting of agricultural wastes is very important and one of the environmentally approaches. Moreover, using the composted materials will help to re-fertilize the soil organically and reduce the production cost. And not only increase agricultural production, but also improve its quality.

Sullivan and Miller (2001) said that the arrival of compost to the stage of maturity is a relative stage that differs from one place to another according to the requirements of the place, and this is due to the fact that the term maturity is a general term that describes the suitability of compost from or not to the final use for which the agricultural waste was converted into compost (Linda and Dan , 2003). Alidadi et al. (2007) Has indicated the importance of using compost and adding it to the soil is due to the fact that it contains elements such as N, P, and K, and it also contains a percentage of C / N. They are all utilized based on existing requirements.

The current study aims at using cotton stalks and rice straw in compost production. These materials represent examples of agricultural wastes that are considered of large quantity and some of their disposal methods are highly polluted to the environment.

2. Materials and methods

The current experiment was done at Al-Hosayneya center, Al-Sharkeya Governorate, Egypt. The raw materials used in the compost experiment were rice straw, cotton stalks and animals' manure. The materials of each pile were in several layers at site area of about 100 cm (width) x 100 cm (length) x (70, 90, 110) cm (height).

2.1. *Raw components*

The raw materials were collected, prepared for piles construction, in addition some samples were taken for laboratory analysis (Table 1).

Table 1
The properties of the raw components used in compost piles.

Parameter	Value		
	rice straw	cotton stalks	animal's manure
pH	6.56	6.01	7.35
EC dS/m	4.63	4.51	4.40
Moisture Content (%)	13	9	63
Bulk Density (kg/m3)	0.64	143	0.74
Organic Carbon (%)	52.17	59. 98	13.12
Total Nitrogen (%)	0.57	0.43	0.98
C/N ratio	91.52	139.48	22.80
Organic Matter (%)	12.35	27.61	43.10
Ash (%)	0.50	5.5	56.90

- Rice straw: It was air dried and chopped to 0.5–5 cm by chopping machine before compost heap preparation.
- Cotton stalks: It has been inoculated to rapid the compost process.
- Animals' manure: Animals (Buffalo) manure has been inoculated to rapid the compost process.
- The chopper: local chopper attached with a tractor via PTO following the specification for both chopper and tractor to chop rice straw and cotton stalk into small pieces ranged between 0.5 to 5 cm.
- Agitation method: the pile was turned over every week by using a hand shovel.

2.2. *Measuring instruments*

- Thermometer/hygrometer sensor: A wired and waterproofed thermometer sensor (version DS18B20) was used to measure the temperature of the compost piles. And DHT11 was used to measure relative humidity. The temperature of the thermometer sensor ranged from – 25 ^{o}C to 125 ^{o}C with an accuracy of 0.1 ^{o}C and probed length of 30 cm. The relative humidity sensor ranged from 0% to 95% with an accuracy of 0.1%.
- Electric drying oven: The drying oven used in the drying process has the following specifications (VENTICELL55 model, 230V, 50/60 Hz, 1250w, Max 250 ^{o}C). Moisture content was evaluated at 70 ± 5 ^{0}C for a 24-hour drying time.
- Electronic balance: The weight of samples and blades was measured by a Sartorius electrical balance made in China (Tipriya Kitchen Household Weighing Scale TS-200 Up to 10 KG weight capacity, and 0.1 mg accuracy).
- pH meter: The pH values were measured by using a pH meter model YUV Digital Pocket Pen Portable pH Test Meter ± 0.1 pH High Accuracy with 0.00-14.00 pH with an accuracy of 0.1.
- Lab analyzer: The analyzation of elements like N, P and K were performed by JENWAY analyzer Model: PFP Flame Photometer
- Hot plate: The hot plate model: Corning Scholar Hot Plate SB45547 was used to preheat the samples for digestion process.
- Back spryer: The pack manually sprayer was used to wet the piles of compost model: IBS Pump Sprayers - Hand Operated/Manual Knapsack (16 LTR)
- Sizing unit: A wooden box was used, hollowed out from the top and bottom sides, with dimensions of (100 * 100 * 100) cm length, width, height.

2.3. *Experimental design*

The experiment was carried out to investigate some factors that affect the agriculture secondary products preparation (rice straws, cotton stalks, and a mixture of rice straw and cotton stalks with ratio 1:1 by Volume). The heights of piles were 70, 90, and 110 cm, and coverage treatments were covered and uncovered. Also, the experiment was carried out as a factorial design with three replicates [3(3×3×2)] resulting in 54 treatments, and the obtained results were statistically analyzed accordingly.

2.4. *Raw material preparation*

a. Domestic shredder attached to a tractor according to the required specifications was used in cutting rice straw as shown in Fig. 1A and cotton stalks as shown in Fig. 1B into small pieces (length 0.5 - 5 cm).

b. The animal manure was added and homogenized with each of the chopped rice straw and the chopped cotton stacks, each separately, in the ratio of chopped: animal mature as 2:1 by volume.

c. The piles were divided into 18 piles of equal sizes (1 cubic meter) as shown in Fig. 2 according to the experimental design.

d. Temperature was measured every 7 days at specific places and at a fixed height and distributed on the sides of an equilateral triangle for all piles in the same way.

e. The initial wetting and stirring was done at the beginning of the experiment for each pile manually with a trowel until almost a constant relative humidity was reached at (%60-50) for each pile. The process of stirring and aerating for 10 minutes was repeated manually for each pile, with wetting every 7 days and fixing the relative humidity at (%60-50) for all piles.

f. Fresh samples and 3 replicates were taken from each pile regularly every 21 days from the beginning to the end of the experiments. These samples were analyzed to determine nitrogen, phosphorous, potassium, organic matter, organic carbon, carbon to nitrogen ratio, relative humidity, bulk density, electrical conductivity and pH.

g. The best result was taken from the piles according to the laboratory analysis.

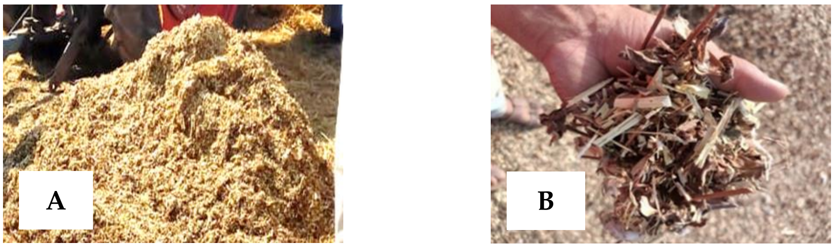

Fig. 1. Rice straw and cotton stalks cut into small pieces.

Fig. 2. 18 piles of rice straw, cotton stalks mixed with animal manure.

2.5. *Statistical analysis*

Main and interaction effects of experimental factors were determined through analysis of variance a 3 (21, 42, and 63 days) × 2 (covered and uncovered) × 3 (CS, RS, and CS+RS mixture) × 3 (70, 90, and 110 cm heights) factorial experiment in completely randomized design with three replications using the statistical program InfoStat Software (Di Rienzo et al. 2013). Differences between means were compared using Duncan's multiple range test at the 5% level ($p \leq 0.05$).

3. Results and discussions

The collected samples at different composting times (21, 42, and 63 days) were analyzed in order to evaluate the differences between applied treatments, in addition to defining the optimum conditions for compost production using similar components of the current study.

Results in Figures 3 and 4 show that sampling time had a significant effect on all studied traits except pH. The highest values of WC (514.6 kg), MC (54.9%), P (0.83%), and ash content (52.5%) for 63 days from composting (DFC), macro-elements (i.e., N; 4.41% and K; 1.76%), OC (36.8%), OM (63.4%), and EC (10.22 dS m^{-1}) for 21 DFC, and C/N (17.9) for 42 DFC were obtained. These results are in harmony with **Xie et al. (2022).** They reported that C/N Ratio After 30 days, the 25:1 C/N ratio ranked second in terms of lignocellulose degradation rate. 30:1 C/N Ratio These results confirm that the C/N ratio is the primary for the substrate.

For pile covering, the results in Figs. 3 and 4 reveal that the compost produced from the covered piles has higher values of WC, MC, K, OC, OM, C/N, EC, and ash content, which were, respectively, 6.0%, 2.0%, 1.2%, 2.1%, 1.6%, 7.1%, 0.9%, and 11.8% greater than the compost produced from the uncovered piles. However, the N and P content in compost produced from the uncovered piles was 6.1% and 6.5% greater than covered piles.

On the other hand, concerning the composted material, the results in Figs. 3 and 4 reveal that the compost produced from Rice straw has higher values of WC, MC, N, K, OC, OM, and EC which were, respectively, 462.2, 49.6, 2.84, 1.78, 34.1, 58.8 and 10.40. However, the highest P content (0.53) was in the compost produced from Cotton stalks.

For the height factor, the results in Figs. 3 and 4 reveal that the highest values of P, K, OC, OM, and EC were in piles with 90 cm height with values of 0.52, 1.74, 34.4, 59.2, and 9.37, respectively. While the highest values of WC and Ash were, respectively, 437.4, and 51.3 in the case of piles height of 110 cm. However, the highest C/N was (14.67) in the compost piles of 70 cm in height.

Results in Table 2 show that the highest values of WC (603 kg), ash content (73.0%), P (0.71%), K (1.94%), and MC (21.1%) were observed when the T42 × C × RS × H110, T21 × C × CS × H90, T21 × U × M × H90, T63 × U × RS × H90, and T63 × C × M × H90 interactions, respectively, were applied. Furthermore, the T21 × U × RS × H110 interaction recorded the highest N (5.33%), OC (38.6%), OM (66.5%), pH (8.3), and EC (5.33 dS/m-1).

The overall interaction of all treatments reveals that the optimum combination was compost produced from Rice straw at 42 days from 110 cm covered piles. The C/N ratio is one of the most basic values on the basis of which it describes the process of compost ripening and its arrival to the form suitable for use, and it is within 1: 20-22 (Fahad et al. 2013). The C:N ratio can be taken as an indicator of the decomposition of rice straw (Zayed and Abdel-Motaal, 2004).

4. Conclusions

The current study aims to evaluate compost produced from cotton stalks and rice straw. Which will share in supplying the agriculture sector with organic matter, in an environmentally friendly approach of composting the agriculture wastes. The experiment was carried out so that the treatments include plant waste (rice straw, cotton firewood, and a mixture of 1:1 ratio). These materials were prepared where cutting and chopping in appropriate sizes were applied. The dimensions of each pile were 100 cm wide x 100 cm long x 70, 90 or 110 cm height. Moreover, pile coverage (2 treatments) including covered and un-covered piles was applied. All treatments combinations were applied in three replicates. Animal waste was added to all piles with ratio of 2:1. Stirring is done every week and the pile moisture is controlled. Samples were taken at 21, 42 and 63 days from the beginning of the experiment to conduct various chemical and physical analyses.

The statistical analysis was carried out, and the results showed that the highest value of weight per cubic meter and moisture content was at the age of 63 days, the highest values for nitrogen, phosphorous, potassium, organic carbon and organic matter at the age of 21 days, and the highest ratio of carbon to nitrogen was 17.90 at the age of 42 days. The highest value of ash percentage was 52.5 at the age of 63 days. On the other hand, using coverage produced the cubic meter weight, potassium, organic carbon, organic matter, carbon to nitrogen ratio, electrical conductivity, and ash percentage. While uncovered piles increased the Nitrogen and phosphorous content. The rice straw produced the highest weight of the square meter, relative humidity, nitrogen, potassium, organic carbon, organic matter, and electrical conductivity. While cotton stalks produced the highest phosphorous value (0.53). The pile height had different effects as phosphorus, potassium, organic carbon, organic matter, and electrical conductivity had the highest values at 90 cm height. The highest values for the weight of a cubic meter and ash were at height 110 cm. The highest value of carbon to nitrogen ratio was 14.67 at 70 cm height. The all-combinations effect reveals that the best result was rice straw at the age of 42 days and a height of 110 cm using mulching.

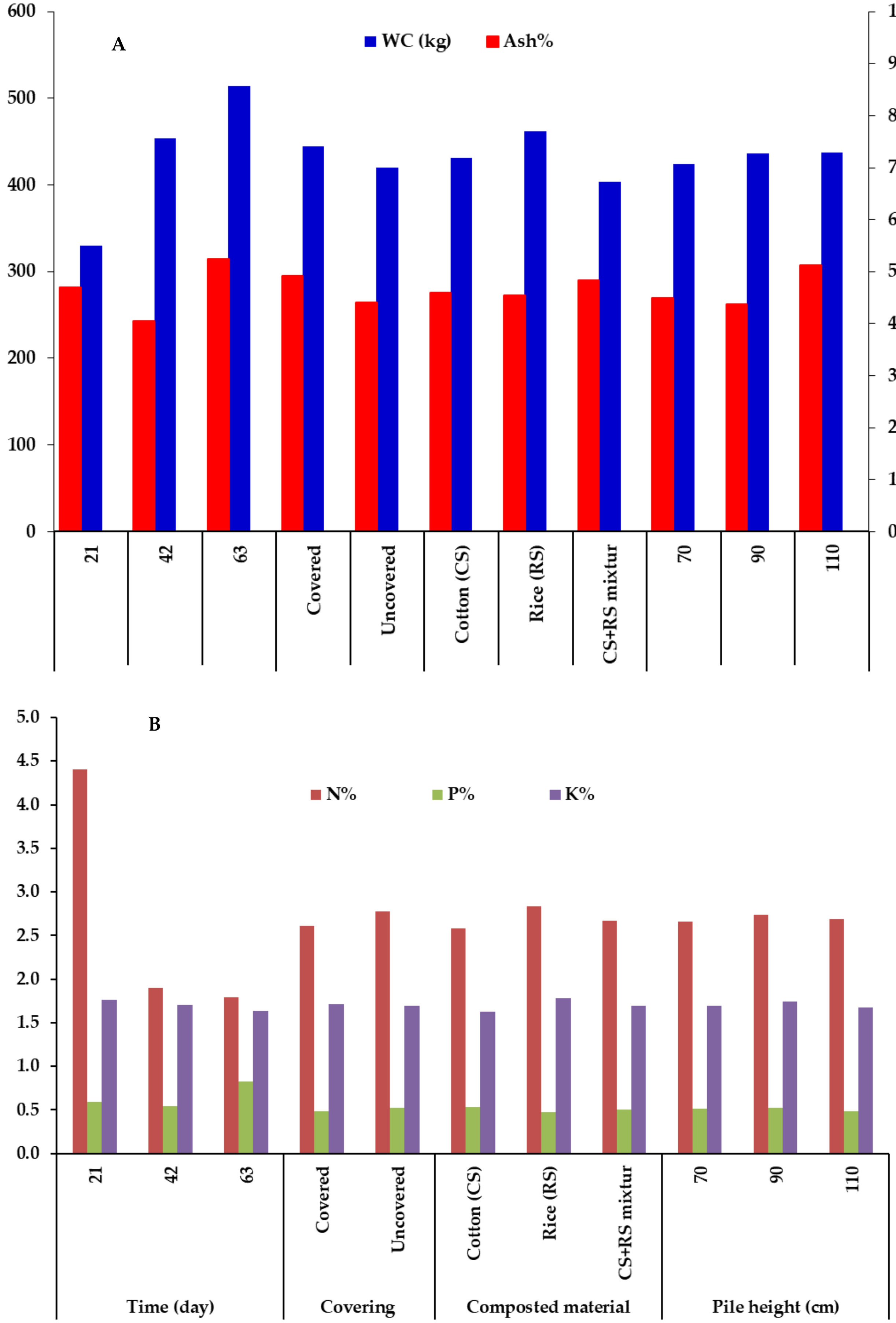

Fig. 3. Effect of sampling time, covering, composted material, and pile height on compost properties i.e., (A) weight of cubic meter; WC and ash content and (B) nutrients (nitrogen; N, phosphorus; P, and potassium; K).

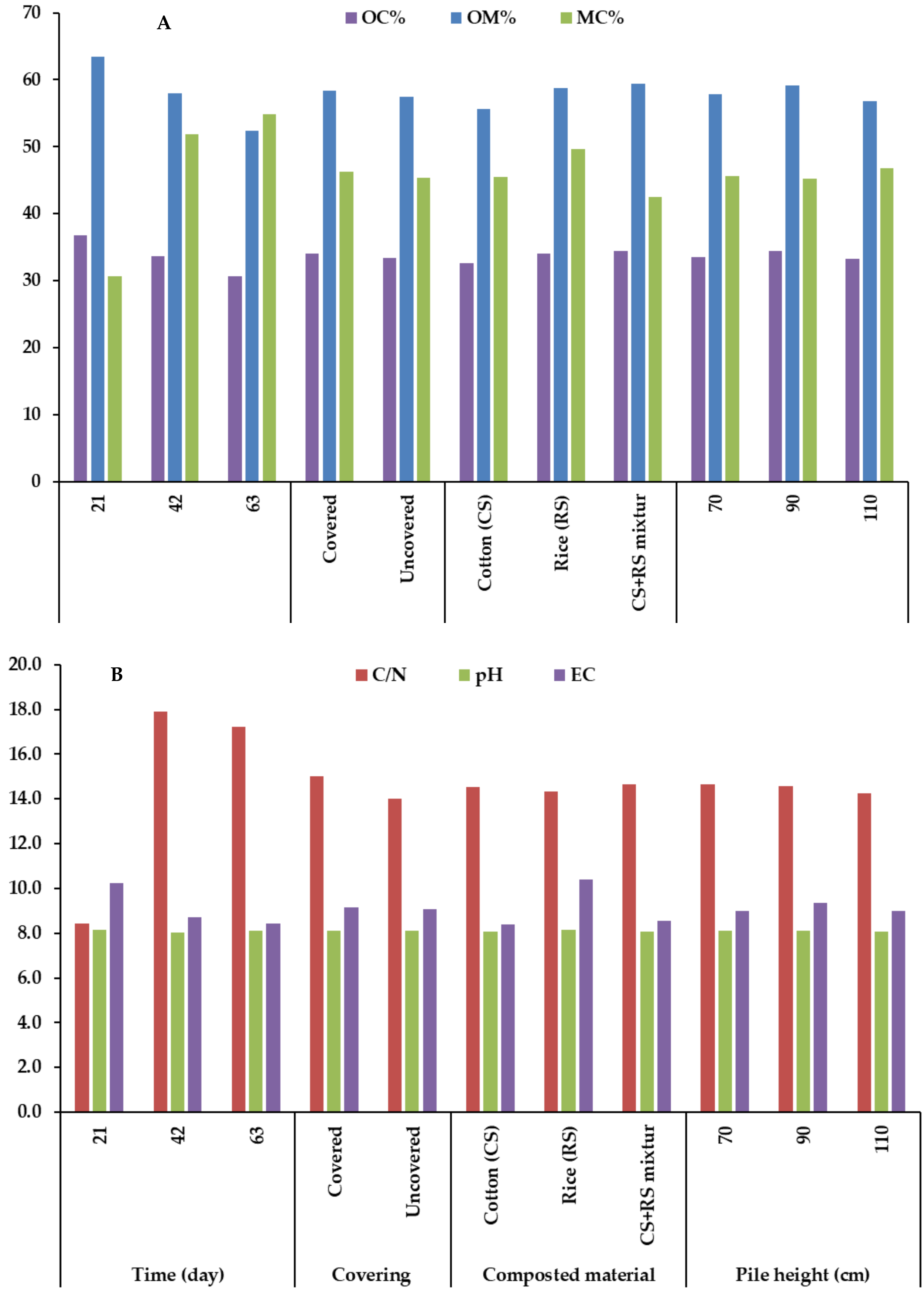

Fig. 4. Effect of sampling time, covering, composted material, and pile height on compost properties i.e., (A) organic carbon; OC, organic matter; OM and moisture content; MC and (B) Carbon/nitrogen; C/N, pH, and electrical conductivity; EC.

Table 2
The interactive effect of sampling time (T; day), covering (Cov), composted material (CM), and pile height (H; cm) on compost properties.

T × Cov × CM × H				WC (kg)	Ash	N	P	K	OC	OM	MC	C/N	pH	EC (dS/m⁻¹)
					(%)									
		CS	H_{70}	327C-E	42.5n-q	4.37b-e	0.65b	1.66i-n	34.2b-h	59.0c-g	7.8q-r	10.0h-i	8.10a	4.37b-e
			H_{90}	330B-E	73.0a	4.01f-g	0.62b-e	1.68h-m	36.4a-e	62.8a-c	9.1p-q	9.8i-j	8.10a	4.01f-g
			H_{110}	356x-C	52.0h-i	4.03f-g	0.57f-i	1.60l-p	36.4a-e	62.8a-c	9.0p-q	8.7l-m	8.00a	4.03f-g
		RS	H_{70}	398p-t	37.0s-w	4.34b-f	0.50l-n	1.84a-f	38.2a	65.9a	8.8p-q	11.7d	8.20a	4.34b-f
	C		H_{90}	294F-G	43.5m-q	4.26c-f	0.50l-n	1.90a-b	37.4a-b	64.5a-b	8.8p-q	9.4k	8.20a	4.26c-f
			H_{110}	369t-z	46.0k-n	4.56b-c	0.51j-n	1.76e-i	38.6a	66.5a	8.5p-r	9.3k	8.20a	4.56b-c
		M	H_{70}	383r-x	43.5m-q	3.56h	0.53i-m	1.88a-c	37.4a-b	64.5a-b	10.5o	11.3d	8.10a	3.56h
			H_{90}	296F-G	43.5m-q	4.50b-d	0.61b-f	1.88a-d	37.6a	64.8a-b	8.4p-r	10.6e-f	8.10a	4.50b-d
T_{21}			H_{110}	282G	67.5b-c	4.52b-c	0.58e-h	1.84a-e	37.8a	65.2a-b	8.4p-r	9.5j-k	8.10a	4.52b-c
		CS	H_{70}	314D-F	36.5t-w	4.17d-f	0.65b	1.66i-n	34.0c-h	58.6d-g	8.1q-r	8.1o-q	8.10a	4.17d-f
			H_{90}	374s-y	31.0y	4.10e-g	0.65b-c	1.54o-q	33.6e-i	57.9d-g	8.2q-r	7.7r-t	8.20a	4.10e-g
			H_{110}	342z-D	52.0h-i	4.09e-g	0.63b-d	1.70g-l	33.6e-i	57.9d-g	8.2q-r	9.5j-k	8.00a	4.09e-g
		RS	H_{70}	333A-D	44.5l-p	5.29a	0.58e-h	1.90a-b	38.4a	66.2a	7.3r	13.2b	8.40a	5.29a
	U		H_{90}	344y-D	40.0q-t	5.33a	0.57f-i	1.92a	38.4a	66.2a	7.2r	12.4c	8.40a	5.33a
			H_{110}	290F-G	54.5g-h	5.33a	0.60c-g	1.90a-c	38.6a	66.5a	7.2r	14.0a	8.30a	5.33a
		M	H_{70}	284F-G	40.5p-t	4.49b-d	0.66b	1.78d-h	37.2a-c	64.1a-b	8.3q-r	10.1h-i	8.10a	4.49b-d
			H_{90}	302E-G	40.5p-t	4.61b	0.71a	1.70g-l	37.2a-c	64.1a-b	8.1q-r	9.8i-j	8.10a	4.61b
			H_{110}	314D-F	57.0f-g	3.82g-h	0.52j-m	1.52p-q	37.4a-b	64.5a-b	9.8o-p	8.9l	8.00a	3.82g-h
		CS	H_{70}	459j-m	39.5q-u	2.00i-n	0.60d-g	1.74f-j	34.2b-h	58.9c-g	17.1f-l	8.5l-n	8.06a	2.00i-n
			H_{90}	419n-q	47.0j-m	1.89i-p	0.56g-j	1.66i-n	33.8d-i	58.3d-g	17.9e-j	10.1h-i	7.94a	1.89i-p
			H_{110}	403p-s	38.0r-w	1.77j-q	0.56g-j	1.76e-i	30.5i-n	52.6i-k	17.3e-k	9.5j-k	8.06a	1.77j-q
		RS	H_{70}	565b-c	42.0n-r	1.68m-q	0.53i-m	1.58m-p	34.0c-h	58.6d-g	20.2a	8.0p-r	8.19a	1.68m-q
	C		H_{90}	541c-e	35.5u-w	1.63o-q	0.47n-o	1.74f-j	32.1g-m	55.3f-j	19.7a-c	9.4j-k	8.06a	1.63o-q
			H_{110}	603a	43.m-q	1.61p-q	0.50l-n	1.64j-o	33.4e-i	57.6d-g	20.8a	9.9h-i	8.08a	1.61p-q
		M	H_{70}	364u-A	56.5f-g	1.99i-o	0.56g-j	1.56n-q	35.7a-f	61.6b-d	17.9e-i	6.8x	8.01a	1.99i-o
			H_{90}	389q-w	40.5p-t	1.90i-p	0.52j-m	1.58m-p	35.5a-f	61.2b-e	18.7b-e	7.6s-t	7.98a	1.90i-p
T_{42}			H_{110}	488g-j	69.0b	1.95i-p	0.53i-m	1.58m-p	34.0c-h	58.6d-g	17.4e-k	7.3t-w	8.08a	1.95i-p
		CS	H_{70}	360w-B	35.0w-x	1.66n-q	0.57f-i	1.48q-r	32.6f-k	56.3f-i	19.7a-d	7.0w-x	8.06a	1.66n-q
			H_{90}	504f-g	27.5y	1.68m-q	0.55h-k	1.58m-p	33.6e-i	57.9d-g	20.0a-b	8.6l-m	8.01a	1.68m-q
			H_{110}	472h-l	46.0k-n	1.83i-q	0.57f-i	1.34s	32.5f-l	55.9f-i	17.7e-j	6.2y	8.00a	1.83i-q
		RS	H_{70}	468i-m	37.5s-w	1.94i-p	0.49m-o	1.62k-p	34.2b-h	58.9c-g	17.6e-j	10.5e-g	8.13a	1.94i-p
	U		H_{90}	454k-m	30.5y	2.13i-j	0.58e-h	1.80c-g	33.0f-j	56.9f-h	15.5m-n	10.3g-h	8.14a	2.13i-j
			H_{110}	507f-g	48.5i-l	2.14i	0.58e-h	1.80b-g	34.4b-g	59.3c-f	16.1k-n	11.6d	8.15a	2.14i
		M	H_{70}	362w-A	31.5x-y	2.11i-k	0.54h-l	1.62k-p	35.5a-f	61.2b-e	16.8g-m	8.4m-p	7.97a	2.11i-k
			H_{90}	410o-r	31.0y	2.14i	0.50l-n	1.66i-n	33.0f-j	56.9f-h	15.4m-n	8.7l-m	8.04a	2.14i
			H_{110}	394p-u	30.0y	2.07i-l	0.51k-n	1.76e-i	34.0c-h	58.6d-g	16.4i-m	8.5l-o	7.97a	2.07i-l
		CS	H_{70}	559b-d	41.0o-s	1.60p-q	0.38q-s	1.52p-q	29.6k-n	51.0k-l	18.5c-f	6.8x	8.23a	1.60p-q
			H_{90}	558b-d	52.0h-i	1.83i-q	0.39q-s	1.66i-n	33.4e-i	57.6d-g	18.3d-g	8.8l	8.08a	1.83i-q
			H_{110}	531d-f	59.5e-f	1.71l-q	0.38q-s	1.78d-h	28.0n	38.3n	16.4j-m	8.9l	8.04a	1.71l-q
		RS	H_{70}	539c-e	61.5d-e	2.00i-n	0.45o-p	1.88a-d	30.9h-n	53.3h-k	15.5m-n	11.5d	8.14a	2.00i-n
	C		H_{90}	579a-b	42.5n-q	1.92i-p	0.45o-p	1.86a-e	33.8e-i	58.3d-g	17.6e-j	10.8e	8.18a	1.92i-p
			H_{110}	423n-p	52.0h-i	1.62p-q	0.24t	1.70g-l	29.2m-n	50.3k-l	18.0e-h	8.7l-m	8.07a	1.62p-q
		M	H_{70}	438m-o	46.0k-n	1.88i-p	0.39q-s	1.72g-k	33.2e-i	57.3e-h	17.7e-j	8.2n-q	8.13a	1.88i-p
			H_{90}	585a-b	56.5f-g	1.84i-q	0.39q-s	1.74f-j	37.1a-d	63.9a-b	20.1a	9.3k	8.08a	1.84i-q
T_{63}			H_{110}	538c-e	59.0e-f	1.62p-q	0.25t-t	1.42r-s	28.0n	48.3l	17.3e-k	6.9x	8.08a	1.62p-q
		CS	H_{70}	421n-p	60.0e-f	1.71l-q	0.37r-s	1.72g-k	29.4l-n	50.6k-l	17.2e-k	8.1p-q	8.16a	1.71l-q
			H_{90}	500g-h	45.0l-o	1.86i-p	0.45o-p	1.70g-l	30.9h-n	53.3h-k	16.6h-m	7.9q-s	8.02a	1.86i-p
			H_{110}	539c-e	50.5h-j	2.11i-k	0.47n-o	1.62k-p	30.9h-n	53.3h-k	14.7n	7.0u-x	8.12a	2.11i-k
		RS	H_{70}	540c-e	64.0c-d	1.48q	0.26t	1.40r-s	24.8o	42.7m	16.7g-m	5.6z	8.11a	1.48q
	U		H_{90}	494g-i	49.5i-k	2.04i-m	0.45o-p	1.94a	31.9g-m	54.9g-j	15.6l-n	10.5e-g	8.07a	2.04i-m
			H_{110}	578a-b	47.0j-m	1.90i-p	0.40q-r	1.78d-h	32.4f-l	55.9f-i	17.1f-l	10.3f-h	8.06a	1.90i-p
		M	H_{70}	514e-g	48.5i-l	1.63o-q	0.39q-s	1.80b-g	30.0j-n	51.6j-l	18.4c-f	8.2n-q	8.14a	1.63o-q
			H_{90}	483g-k	59.0e-f	1.70m-q	0.42p-q	1.78e-h	30.0j-n	51.6j-l	17.6e-j	7.0u-x	8.11a	1.70m-q
			H_{110}	444l-n	51.5h-i	1.75k-q	0.35s	1.56n-q	29.4l-n	50.6k-l	16.8g-m	7.3t-u	8.07a	1.75k-q
Significance				**	**	**	**	**	NS	*	**	*	NS	**

T_{21}, T_{42}, and T_{63}= 21, 42, and 63 days from composting, respectively. C and U= covered and uncovered compost piles, respectively. CS, RS, and M= cotton straw, rice straw, and both in mixture, respectively. H_{70}, H_{90}, and H_{110}= pile height of 70, 90, 110 cm, respectively. Means in each column followed by the same letter do not differ significantly according to Duncan's test at $p \leq 0.05$. (* = $p \leq 0.05$; ** = $p \leq 0.01$, and NS= non-significant). weight of cubic meter; WC, nitrogen; N, phosphorus; P, and potassium; K, organic carbon; OC, organic matter; OM and moisture content; MC, Carbon/nitrogen; C/N, pH, and electrical conductivity; EC.

References

Abou Hussein, S D., Sawan, O.M., 2010. The utilization of agricultural waste as one of the environmental issues in Egypt (a case study). Journal of Applied Sciences Research, 6(8), 1116-1124.

Al-Barakah, F.N., Radwan, S.M.A., Abdel-Aziz, R.A., 2013. Using biotechnology in recycling agricultural waste for sustainable agriculture and environmental protection. Int. J. Curr. Microbiol. App. Sci, 2(12), 446-459.

Alidadi, H., Najafpoor, A.A., Parvaresh, A., 2007. Determination of carbon/nitrogen ratio and heavy metals in bulking agents used for sewage composting. Pakistan Journal of Biological Sciences: PJBS, 10(22), 4180-4182. DOI: 10.3923/pjbs.2007.4180.4182.

Di Rienzo, J.A., Casanoves, F., Balzarini, M.G., Gonzalez, L., Tablada, M., Robledo, C.W., 2013. InfoStat versión. URL. Grupo InfoStat, FCA, Universidad Nacional de Córdoba, Argentina. http://www.infostat.com.ar.

Ghaly, A.E., Alkoaik, F., Snow, A., 2006. Thermal balance of invessel composting of tomato plant residues. Canadian Biosystems Engineering, 48, 6.

Hong, J.H., K.J. Park. 2004. Compost Biofiltration of Ammonia Gas from Bin Composting. Sunchon National University, Sunchon 540-742.

Kubota, H., Hosono, Y., 1977. Composting. Kagakukogaku, 41 (7), 364-368.

Kulcu, R., Yaldiz, O., 2004. Determination of aeration rate and kinetics of composting some agricultural wastes. Bioresource technology, 93(1), 49-57. https://doi.org/10.1016/j.biortech.2003.10.007.

Li, D., Manu, M.K., Varjani, S., Wong, J.W. 2022. Mitigation of NH_3 and N_2O emissions during food waste digestate composting at C/N ratio 15 using zeolite amendment. Bioresource Technology, 359, 127465.

Linda J. Brewer, Dan M. Sullivan, 2003 Maturity and Stability Evaluation of Composted Yard Trimmings, Compost Science & Utilization, 11:2, 96-112. DOI: 10.1080/1065657X.2003.10702117.

May, C.M., 2022. Composting Meaning, Stages, Process, and Environmental Impacts.https://www.felsics.com/composting-meaning-stages-process-and-environmental-impacts/

Mohamed, A.S., Abdel Wahab, A.F., El-Etr, W.M., 2010. Recycling of Cotton Stalks with Rice Straw to Compost as Friendly Technology to The Environment. Journal of Agricultural Chemistry and Biotechnology, 1(1), 41-52. https://dx.doi.org/10.21608/jacb.2010.88782.

Petra Loro , Livestock Environment Developing a Recipe for Composting Livestock Manure Specialist, Animal Industry Branch, Manitoba Agriculture, Food and Rural Initiatives,

Sullivan, D. M., & Miller, R. O. (2001). Compost quality attributes, measurements and variability. https://ir.library.oregonstate.edu/downloads/xw42ng202?locale=en.

Thomas, C., Idler, C., Ammon, C., Amon, T., 2020. Effects of the C/N ratio and moisture content on the survival of ESBL-producing Escherichia coli during chicken manure composting. Waste Management, 105, 110-118.

Winnipeg, MB, R3T 5S6. E-mail: ploro@gov.mb.ca (2004)

Xie, Yuqing, Liuyan Zhou, Jinping Dai, Jing Chen, Xinping Yang, Xiaowu Wang, Zhifang Wang, Lei Feng, 2022. Effects of the C/N ratio on the microbial community and lignocellulose degradation, during branch waste composting. Bioprocess and Biosystems Engineering, 45(7), 1163-1174. https://doi.org/10.1007/s00449-022-02732-w

Zayed, G., Abdel-Motaal, H., 2004. Bio-active composts from rice straw enriched with rock phosphate and their effect on the phosphorous nutrition and microbial community in rhizosphere of cowpea. Bioresource Technology, 96(8), 929-935. https://doi.org/10.1016/j.biortech.2004.08.002.

Zhang, W., Yu, C., Wang, X., Hai, L., 2020. Increased abundance of nitrogen transforming bacteria by higher C/N ratio reduces the total losses of N and C in chicken manure and corn stover mix composting. Bioresource Technology, 297, 122410. https://doi.org/10.1016/j.biortech.2019.122410.

تقييم جودة الكمبوست الناتج من حطب القطن وقش الأرز

محمد رمضان محمد عبد المعطى [١]، إبراهيم سيف السؤالي [٢]، محمد أحمد شتيوي [٢]، محمد حمزة أبوالغار [٣]، رزق ربيع كامل البسومى [٢]

[١] طالب دراسات عليا، قسم هندسة المنشآت الزراعية والتحكم البيئي، كلية الهندسة الزراعية، جامعة الأزهر، القاهرة، مصر.
[٢] قسم هندسة المنشآت الزراعية والتحكم البيئي، كلية الهندسة الزراعية، جامعة الأزهر، القاهرة، مصر.
[٣] معهد بحوث الهندسة الزراعية، مركز البحوث الزراعية، الدقي، الجيزة، مصر.

الملخص العربي

تهدف هذه الدراسة إلى تقييم الكمبوست الناتج من حطب القطن وقش الارز. حيث إنه في السنوات الأخيرة انتشرت ظاهرة تدهور الأراضي الزراعية بأنواعها المختلفة من الرملية إلى الطينية، ومن أسباب ذلك عدم توافر المواد العضوية. وللتغلب على هذه المشكلة يتم زيادة المادة العضوية عن طريق تحويل بعض المخلفات الزراعية المتوفرة في مصر إلى صورة وسطية يمكن إضافتها إلى التربة الزراعية ومن هذه المخلفات المستخدمة حطب القطن وقش الأرز.

وتهدف الدراسة الحالية إلى تقييم وتحليل صور وحالة الكمبوست الناتج على فترات مختلفة. وقد تم تنفيذ التجربة بحيث تشتمل المعاملات على مخلفات نباتية (قش الارز، حطب القطن، وخليط منهما بنسبة ١:١) وقد تم عمل اعداد وتهيئه لكل مخلف من حيث التقطيع والفرم بمقاسات ملائمة للمرحلة التالية. بالإضافة لمعاملة ارتفاع الكومة (٣ مستويات) حيث كانت أبعاد كل كومة هي ١م عرض × ١م طول × ارتفاع ٧٠ سم أو ٩٠ أو ١١٠ سم. كما تشتمل المعاملات على (٢) معاملة تغطية للكومات حيث يتم إجراء تغطية للكومات أو بدون تغطية، وتم عمل ثلاث مكررات لهذه المعاملات. وقد تم اضافة مخلف حيواني إلى جميع الكومات بنسبة ٢:١ من مكونات كل كومة. ويتم التقليب كل أسبوع وضبط رطوبة الكومة، وتم أخذ عينات على الفترات التالية ٢١ و٤٢ و٦٣ يوم من بداية التجربة لإجراء التحليلات الكيميائية والفيزيائية المختلفة. حيث اشتملت القياسات والتحليلات على وزن المتر المكعب، النيتروجين، الفسفور، البوتاسيوم، المادة العضوية، الكربون العضوي، نسبة الكربون إلى النيتروجين، المحتوى الرطوبي، الكثافة الظاهرية، التوصيل الكهربي في معلق ١:١٠، الأس الهيدروجيني في معلق ١:١٠، ونسبة الرماد.

وبعد الحصول على نتائج التحليلات تم عمل تحليل احصائي لدراسة التأثيرات المختلفة للمعاملات وتفاعلاتها. وقد أوضحت النتائج أنه بالنسبة لتأثير عامل الوقت على خصائص الكمبوست فإن أعلى قيمة لوزن المتر المكعب والمحتوى الرطوبي كانت عند عمر ٦٣ يوم حيث بلغت ٥١٤,٦ كجم، ٥٤,٩ ٪ على الترتيب. وكانت أعلى قيم لكل من النيتروجين والفسفور والبوتاسيوم والكربون العضوي

والمادة العضوية عند عمر ٢١ يوم كما يلي على الترتيب ٤,٤١ ، ٠,٨٣ ، ١,٧٦ ، ٣٦,٨، ٦٣,٤. أما أعلى نسبة للكربون إلى النتروجين كانت ١٧,٩٠ عند عمر ٤٢ يوم. وكانت أعلى قيمة لنسبة الرماد ٥٢,٥ عند عمر ٦٣ يوم.

أما تأثير معاملة التغطية فقد اتضح أن وزن المتر المكعب والبوتاسيوم والكربون العضوي والمادة العضوية ونسبة الكربون للنيتروجين والتوصيل الكهربي ونسبة الرماد كانت على الترتيب ١,٧١ ، ٣٤,١ ، ٥٨,٤ ، ١٥,٤ ، ٩,١٦ ، ٤٩,٢ عند استخدام التغطية. وكان النيتروجين والفوسفور ٢,٧٨ ، ٠,٥٢ في حالة عدم التغطية.

أما تأثير نوع المخلفات النباتية فقد كان لكل من وزن المتر المربع والمحتوى الرطوبي والنيتروجين والبوتاسيوم والكربون العضوي والمادة العضوية والتوصيل الكهربي أعلى قيم عند استخدام قش الأرز وهي على الترتيب ٤٦٢,٢ ، ٤٩,٦ ، ٢,٨٤، ١,٧٨ ، ٣٤,١ ، ٥٨,٨ ، ١٠,٤٠. بينما كان للفوسفور اعلى قيمة (٠,٥٣) عند استخدام حطب القطن.

وبالنسبة لعامل ارتفاع الكومة فقد كان لكل من الفوسفور والبوتاسيوم والكربون العضوي والمادة العضوية والتوصيل الكهربي اعلى قيم عند ارتفاع ٩٠ سم حيث بلغت ٠,٥٢ ، ١,٧٤ ، ٣٤,٤ ، ٥٩,٢ ، ٩,٣٧ على الترتيب. وكان أعلى قيم لوزن المتر المكعب والرماد عند ارتفاع ١١٠ بقيم ٤٣٧,٤ ، ٥١,٣ على الترتيب. وأعلى قيمة لنسبة الكربون للنيتروجين كانت ١٤,٦٧ عند ارتفاع ٧٠ سم.

أما عند دراسة جميع العوامل مجتمعة فكانت أفضل نتيجة هي قش الارز عند عمر ٤٢ يوم وارتفاع ١١٠ سم باستخدام التغطية.