The Effect of Particle Size and Composting Period on (C/N) Ratio of Date-Palm Waste

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ABSTRACT:

Solid wastes generated from agricultural activities such as crop residues require special attention for its disposal. Applications of these wastes into soilless systems as culture media after bio-processing not only supplies nutrients to the plants, but also improve the physical, chemical and biological properties. For improving conditions of planting substrate could be used from composting process for different particle sizes. This research was carried out using a completely randomized design with two treatments and three replications. Date-palm wastes crushed by a combine and then they were sieved in two sizes with mesh (sieve). The treatments were particle of date palm wastes with two sizes including 0-5 and 10-20 mm**.** The incubation time for composting process was 180 days. Sampling was done once every two weeks. Temperature of samples was measured once every week during the period of composting. The results showed that organic carbon content in date palm wastes reduced in both particle size with increasing in incubation time and had significant differences ($p<0.05$). With increasing in incubation time, total nitrogen increased and at the most samples, in the particle size of 10-20 mm was more than 0-5 mm. With increasing in incubation time, C/N ratio reduced in both sizes.

KEY WORDS: Date palm waste, Composting, Particle Size, C/N ratio, Temperature

1. INTRODUCTION:

Use of suitable growing media or substrates is essential for production of qualifying horticultural crops. It has directly affects on the development and later maintenance of the extensive functional rooting system. A good growing medium would provides sufficient anchorage or support to the plant, serves as reservoir for nutrients and water, allow oxygen diffusion to the roots and permit gaseous exchange between the roots and atmosphere outside the root substrate.

The origin of date palm tree is in the south of Iran and Iraq, however, today it is cultivated in many areas of world. It is estimated that about 3% of agricultural lands in the world is under date palm cultivation. Currently, appropriate management and optimized procedure is not in use for this material (Borji et al, 2010).

In composting, the industry needs to analyze the physical, chemical and biological properties of compost to determine the completing degree of composting process with assessing the different changes in physicochemical and biological properties of raw compost (Levanon and Pluda, 2002). During the composting process, microorganisms transform organic raw materials into compost by breaking them down to simple compounds and reforming them into new complex compounds

(Mohammad et al., 2008). Among these, the properties can point to C/N ratio, CEC, pH, porosity, bulk density and salinity of compost. Immature compost has high C/N ratio that can cause deficiency of N in plant. The falling value of C/N ratio is a sign of fermentation and the performance of the composting process during maintenance period. Microorganisms supply their primary energy from C of compost, while the N of compost is used by microorganisms to develop their colonies for breaking down the organic matters. Microorganisms use the 30/1 ratio of C/N. If this ratio increases up to 30, the rate of compost breakdown will decrease. Of course, this ratio decreases in the composting process for a long period of time. As such, attention must be paid to this ratio, because the extra N changes to $NH4^{+}$ when it decreases below 25, (Barrington et al., 2002).

Nitrogen is used for the synthesis of cellular material, amino acids, and proteins and is continuously recycled through the cellular material of the micro-organisms.

Any nitrogen that is incorporated into the cells becomes available again when the micro-organism dies. Because a large part of the carbon is continuously released while the majority of the nitrogen is recycled, the C: N ratio decreases over the composting period. If, however, the system experiences large nitrogen losses, the C: N ratio can increase (Graves et al.2000).

A convenient and meaningful compost parameter to monitor is temperature. Temperature is an indicator of microbial activity. By recording temperatures daily, a normal pattern of temperature development can be established. Deviation from the normal pattern of temperature increase indicates a slowing of or unexpected change in microbial activity. The temperature should begin to rise steadily as the microbial population begins to develop. If it does not begin to rise within the first several days, adjustments must be made in the compost mix.

2. MATERIALS AND METHODS:

This research was carried out in a research greenhouse of Islamic Azad University, khorasgan branch, using a completely randomized design with two treatments and tree replications. Date-palm wastes crushed by a combine and then they were sieved in two sizes with mesh (sieve). The treatments were particle of date palm wastes with two sizes including 0-5 and 10-20 mm**.** The incubation time for composting process was 180 days. The moisture content of wastes at beginning of composting period increased to 70-60 percent (w/w)**.** They were kept in the 1 m^3 plastic bags for controlling the moisture and temperature. Some amounts of N and P fertilizers were added to them as a fermentation starter, and these bags were placed in hot (25 to 30°C) condition. For respiration, some air holes were made on the bags. Every week, these materials were mixed together and put into the bags again and their moisture was adjusted to 65%. Every two weeks samples took up from treatments and analyzed for determination of C/N ratio. Organic C was determined according to the combustion method (McKeague, 1976). Total nitrogen was determined using kjedahl, and then C/N ratio was calculated. Data were analyzed using Statistical Program for Social Sciences (SPSS).

3. RESULTS AND DISCUSSION:

The effect of composting period on organic matter percentage in treatments illustrated in fig 1. The results showed that organic carbon content in date palm wastes reduced in both particle size with increasing in incubation time and had significant differences ($p<0.05$) so the treatment with 10-20 mm size had have more organic carbon content in every time. Carbon is used both as a source of energy and for growth of microbes. In aerobic decomposition, part of the carbon is released as CO2 while the rest is combined with nitrogen for microbial growth.

As a result, the carbon content of a compost pile is continuously decreasing (Graves et al.2000).

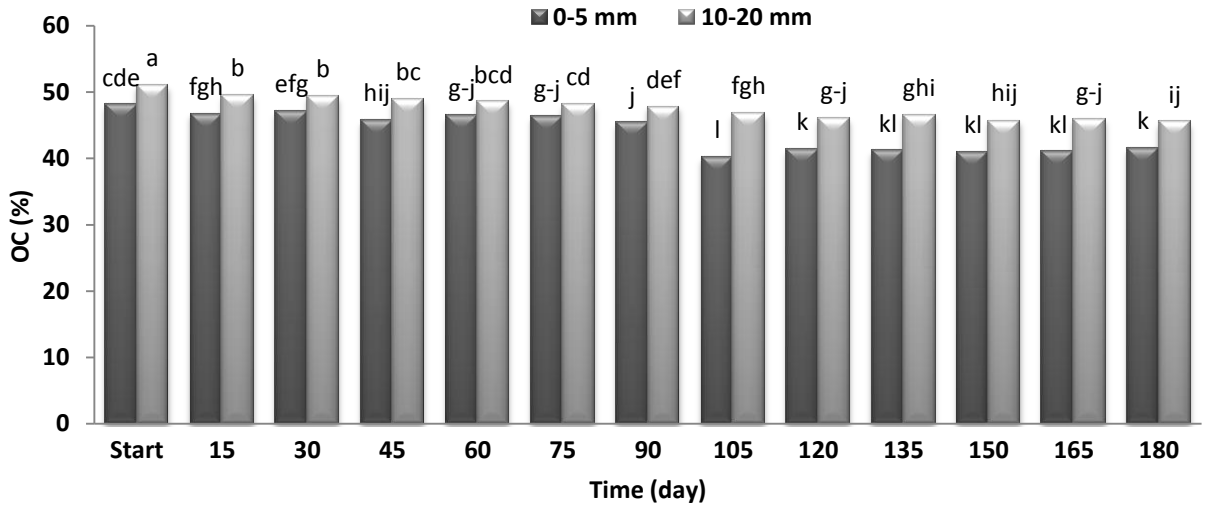

Figure1. Changes in organic carbon of the composting with different size of date- palm wastes.

Fig. 2, showed that with increasing composting time, total nitrogen increased and at the most samples, amount of total nitrogen in the particle size of 10-20 mm were more than 0-5 mm. Nitrogen is used for the synthesis of cellular material, amino acids, and proteins and is continuously recycled through the cellular material of the micro-organisms (Graves et al.2000).

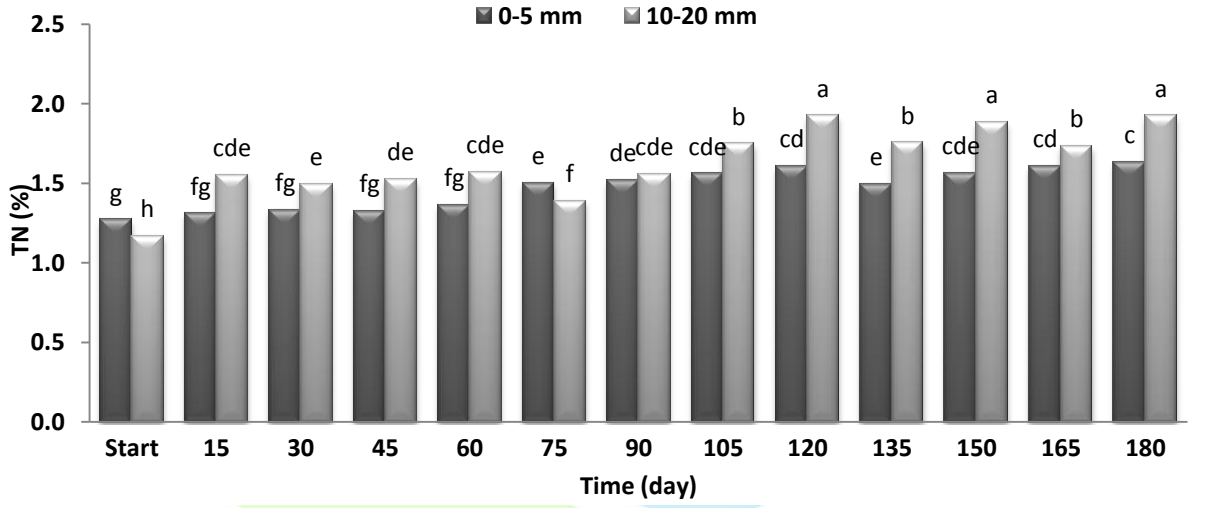

Figure2. Changes in total nitrogen of the composting with different size of date- palm wastes.

Fig. 3, showed that with increasing and at the most time of this study, C/N ratio in the particle composting time, C/N reduced in both size of 0-5 mm was more than 10-20 mm. Any nitrogen that is incorporated into the cells becomes available again when the micro-organism dies. Because a large part of the carbon is continuously released while the majority of the nitrogen is recycled, the C: N ratio decreases over the composting period. If, however, the system experiences large nitrogen losses, the C: N ratio can increase (Graves et al.2000).

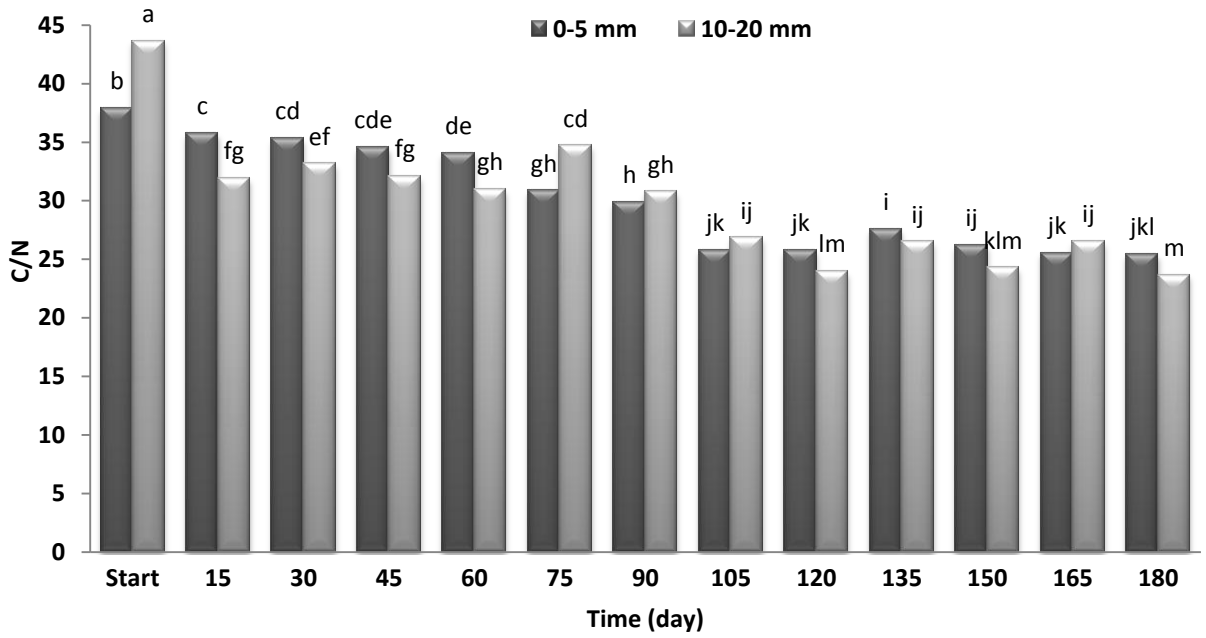

Figure3. Changes in C/N ratio of the composting with different size of date- palm wastes.

The temperature changes in the wastes mass during the composting process of are shown in Figure 4. The temperature of wastes mass was decreased with increasing in incubation time. The results showed a maximum temperature (49 ^{o}C) for particle size of 10-20mm at 14 days. Finally, the temperature of mass decreased and stabilized at 18 ^{o}C after 161 days, therefore composting process by micro organism in this time was finished and date palm wastes were maturated. The temperature pattern shows the microbial activity and the occurrence of the composting process (Bernal *et al*. 2009). The optimum temperature range for composting is 40–65^{o}C (De Bertoldi et al. 1983); temperatures above 55^{o}C are required to kill pathogenic microorganisms.

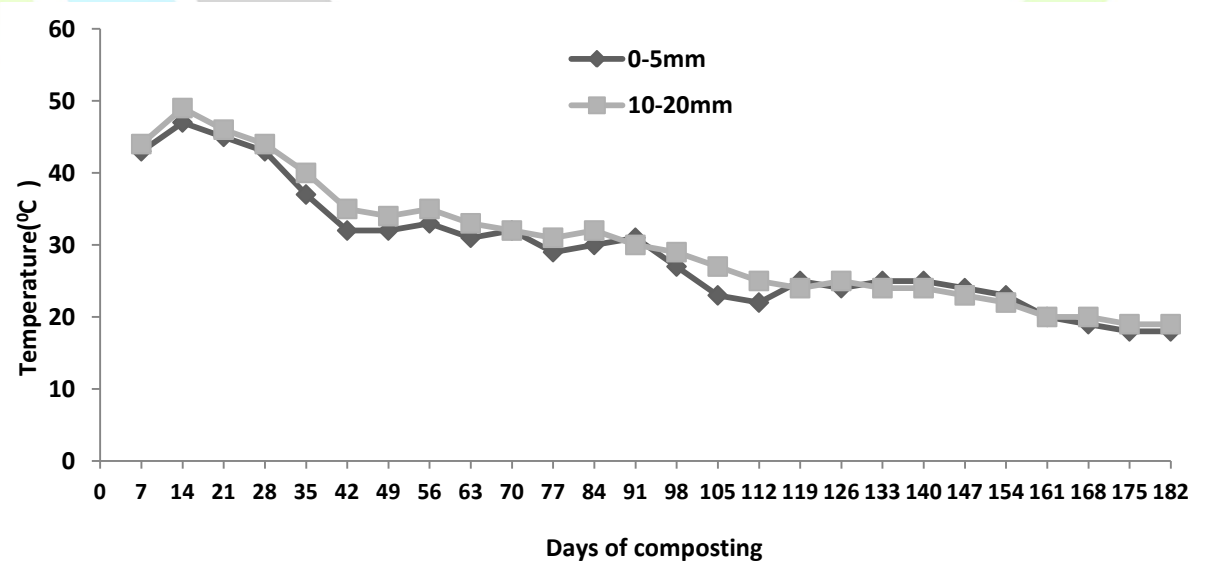

Figure 4. Temperature changes during composting process in different size of date- palm wastes.

4. CONCLUSIONS:

The results showed that organic carbon content in date palm wastes reduced in both particle size with increasing in incubation time and had significant differences ($p<0.05$). With increasing in incubation time, total nitrogen increased and at the most samples, in the particle size of 10-20 mm was more than 0-5 mm. With increasing in incubation time, C/N ratio reduced in both sizes.

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