Vermicompost: An Eco-Friendly Technology for Crop Residue
Management in Organic Agriculture

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Abstract

Vermicompost production was carried out under laboratory and field condition during 2015 at Shahid chamran University, Ahvaz, Iran. The experimental design was factorial with 4 replications. First factor included 4 different crop residues (e.g. rice, corn, wheat and sugarcane) and second factor included 3 weight ratios (e.g. 30, 40 and 50%). The highest total earthworm weight (352/3 gr) belonged to vermicompost produced by wheat residue with 50% weight ratio. The highest total earthworm numbers (7193) belonged to vermicompost produced by rice residue with 30% weight ratio. The highest vermicompost fertilizer (3288.6 gr) produced from used wheat residue with 50% weight ratio, which this treatment had the best converting factor (83/2%). The highest (188.5 g/m²) Mung bean grain yield belonged to vermicompost produced by rice residue with 40% weight ratio. We concluded that vermicompost produced from crop residues had better biological situation than produced from manure or directly use of crop residue. Also, different crop residues as a base substrate had different effects on final vermicompost fertilizer

1. Introduction

Organic agriculture aimed at reducing the dependence on chemical fertilizers need to incorporate crop residues or other forms of organic material thus providing nutrients thereby improving soil structure while maintaining soil fertility. It is difficult to increase soil organic matter or even maintain it in the sub-tropics as organic matter turnover is high and crop residues are removed from the field used as fodder by roaming animals or burned [8]. It is interesting that a great proportion of the crop nutrient input during cultivation returned in the form of the plant residues. Estimation showed that 30–35% of applied N & P and 70–80% for K is remained in the crop residues of food crops. Such nutrient rich crop residues must be ‘prepared’ before they are used as a fertilizer, and earthworms are suitable candidates for the same [13]. Vermicomposting is the non-thermophilic biodegradation of organic material through the interaction between earthworms and microorganisms, whereby organic material residuals are fragmented rapidly into much finer particles by passing them through a grinding gizzard while maintaining nutrients

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Earthworms thereby reduce numbers of human pathogens, an effect obtained in traditional composting by increases in temperature, but vermicomposting is generally faster [12]. Compared to conventional composting system (as commonly used in country to manage crop residues and other related wastes), vermicomposting often results in mass reduction, shorter time for processing, high levels of humus with reduced phytotoxicity [9]. Reference [2] have stated that organic matter transferred differently in compost and vermicompost, and it can be partly explained by the mutualistic relationship between ingested microorganisms and intestinal mucus. It is also important that inoculation of earthworms in to waste material can accelerate the microbial composition and activities in substrates, which in turn enhances the nutrient transformation and its biological properties. However, traditional methods of composting results in losses of 55% of OM and from 30 to 50% of N. Vermicomposting, utilizing earthworms, has been recognized as an eco-biotechnological process that transforms complex organic substances into a stabilized humus-like product [4]. The cause of this fall in C/N ratio during vermicomposting processes could be regarded as being caused by microbial respiration due to which carbon is lost as CO$_2$ leading concomitantly to an increase in the proportion of total nitrogen of the medium[11]. Earthworms accelerate the mineralization rate and convert the manures into casts with higher nutritional value and degree of humification than traditional method of composting [9]. The increased mineralization and conservation of nutrients is due to the activity of earthworms in the decomposition and conservation mechanism. The application of vermicompost soil is considered a good management practice in any agricultural production system because stimulate soil microbial growth and activity, with subsequent mineralization of plant nutrients, and therefore produce an increase soil fertility and quality [1]. The objective of this study was to evaluate the effect of different crop residues as basic agent on biological properties of vermicompost fertilizer and its effects on Mung bean grain yield.

2. Material and method

The study was carried out at two parts from Feb. to Sep. 2015 in laboratory and field of Agricultural Faculty of Shahid Chamran University, Ahvaz, Iran. The experimental design was factorial based on RCB with 4 replications. First factor included 4 crop residues (e.g. rice, corn, wheat and sugarcane) and second factor included 3 weight ratios (e.g. 30, 40 and 50%). At the laboratory condition, crop residues were vermicomposted on a bed consisting of a wooden frame. Each bed was filled 5 kg of substrate and included with 200 adult epigamic earthworms ($Eisenia$ $fetida$). The worms were introduced in the material at the beginning of vermicomposting process. The moisture level of beds was maintained at about 60-70% during the vermicomposting period by periodically sprinkling with water. The vermicomposting process lasted 90 days. After the production of vermicompost, we tested the effect of different vermicompost fertilizers on grain yield of Mung bean in pod at greenhouse condition. Earthworm characters and Mung bean grain and biological yield were determined. Proliferation ratio is total earthworm numbers at the end of process to total earthworm numbers at the beginning of process. Efficiency ratio is total earthworm weight at the end of process to total earthworm weight at the beginning of process. Converting factor is total organic Mather weight at the end of process to total organic Mather weight at the beginning of process. The SAS software was used to analysis data and statistical significant for all samples was determined by analysis of variance (ANOVA). Different in means were compared by Duncan multiple- ranged test.

3. Result and discussion

3.1. Vermicompost production

Both crop residue and weight ratio had significant effect on vermicompost fertilizers. The highest (3274.8 gr) and lowest (2553.4 gr) of total organic matter was belonged to when we used wheat and corn residue for production vermicompost, respectively (Table 1). Also, we found a different between weight of vermicomposted and non-vermicomposted material. At this situation, highest (3244.8 gr) vermicomposted matter belonged to use of wheat residue treatment. While apply a sugarcane residue for producing vermicompost fertilizer, had a highest non-vermicomposted matter (62.7 gr).
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