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STUDIES ON BIOCONVERSION
Part V. Conversion of Cotton Waste into Compost

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Cotton waste with 83-84% organic matter was degraded using Chinese method of composting. Compost thus produced had 76% yield, a pH of 7.5; organic matter 65%; ash 35% nitrogen 2.87%, potassium 1.62%, phosphorous 1.07% and a C/N value of 13/1. This compost was chemically compared with cow dung manure, and it was observed that it had 1.18%, 0.527% and 1.1% more nitrogen, phosphates, and potassium respectively. Microbiological evaluation of compost showed presence of 4.9 billion microorganisms per gram of compost; 2.6 billion bacteria, 2.0 billion fungi and 0.3 billion actinomycetes.

Key words: Cotton waste, Biodegradation, Compost.

INTRODUCTION

During studies on utilization of agrowaste for fuel, fodder and fertilizer, several types of materials were analyzed. It was observed that cotton waste (in the form of leaves, stalks, dust and lint) contain 83-84% organic matter and this waste having significantly high ratio of decomposstable material can therefore, be taken up for further studies. Cotton is one of the major crop of Pakistan with large number of cotton processing factories which generate huge bulk of cotton waste annually. According to Bhide [1] possibilities exist for conversion of cotton waste into compost. Based on this possibility and authors experience [2] on composting garbage, present study was initiated to determine chemical constituents of cotton waste and its subsequent utilization as material for composting. Compost thus produced was analysed and compared with cow dung manure for its nutritive value.

MATERIAL AND METHODS

Cotton waste from Fazililahi cotton waste processing factory and fresh cow-dung collected from farm - yard, were separately analyzed. Organic matter and ash were determined by igniting dried mass at 650^{o} in furnace for 2 hours [3]. Nitrogen determined by semi micro-kjeldhal technique [4]; carbon assessed as described in ENSIC review [5]; potassium and phosphate were estimated employing the techniques described in [6] and [7]. The pH of the homogenized material was determined and adjusted as required.

Preparation of feed. The most essential requirement of aerobic fermentation process is the appropriate carbon/nitrogen balance, which is reported between 25/1-35/1 [8]. As C/N ratio of cotton waste was higher (42. 2/1) than optimum, cotton waste was supplemented with cow dung to bring it to required ratio. Thus 100 kg. cotton waste and 50 kg cow dung were mixed and appropriate amount of water was added to obtain feed with 70% moisture content, 80% organic matter, and C/N 35/1.

Method of composting. Two hundred and fifty kg. feed (based on wet weight) prepared as above was piled to a height of 1 meter on horizontally and vertically arranged bamboos and covered with moist earth. On the third day when earth cover had completely dried, bamboos were drawn out leaving holes for aeration. Details on composting have already been described in an earlier communication [2]. A thermocouple was burried in the centre of composting unit during erection of mound for recording temperature (Fig. 1). The entire process remained in operation for four weeks. Compost thus obtained was microbiologically evaluated after appropriate dilutions of sample using pour plate technique [9]. Total bacterial count was made on nutrient agar, fungi and actinomycetes

Fig. 1. Chinese composting unit showing thermocouple

were estimated on Czapeck's Dox and Jennson's agar media respectively.

RESULTS AND DISCUSSIONS

Since waste under investigation had 42/1 C/N ratio, Table 1 not suitable for fermenting alone, (as it would have prolonged duration of composting processes requiring extra time both for oxidation of CO_2 and for lowering the C/N value to required optimum range) 50% cow dung was added for preparing feed to achieve a C/N ratio of 35/1, the desired optimum range. Besides, cow-dung provided much needed microbial population for fermentation process, On analysis, it was observed that feed had a pH of 6.7, 80% organic matter, 20% ash, 46% carbon, 1.25% nitrogen and 35/1 C/N ratio and 70% moisture content Table 2.

During the fermentation process, temperature of composting mass increased from 37° to 46-48° within two days an remained so till 4th day. Since oxygen present in the mass had been consumed, bamboos were removed creating passage for aeration. Temperature then increased gradually and reached thermogenic phase. A maximum peak of 60-62° was reached between (Fig 2) 10-17th day, thereafter temperature declined to 46.5° till 25th day. Mass was left for a week to mature, and then sun dried, sieved to separate undigested material and finally analyzed. Compost thus produced had an yield of 76% (based on dry weight). Twenty four percent material remained undigested which can be reused for composting after mixing with fresh raw materials. Compost had 14% moisture 7.5pH, 65% organic matter, 35% ash; 37% carbon, 2.87% nitrogen, 1.62% potassium 1.07% phosphate and C/N value of 13/1. (The analysis mentioned above is based on dry wt. basis). Organic matter in compost had reduced from 80% to 65%, whereas ash content increased from 20% to 35%, an increase of 15%. Initial nitrogen content (waste) of 1.25% increased to 2.87% in composted mass, and C/N ratio stabilized at 13/1. It appears that all complex materials present in the waste feed had been degraded into simpler forms making them available as soluble nutrients for plant growth.

Table 1. Analysis of cotton waste and cowdung

	Cotton waste	Cowdung
Moisture	10%	21.63%
Dry weight	90%	78.37%
pH	6.5	7.4
Organic matter	83.7%	75.8
Ash	16.2%	24.1%
Carbon	48.6%	45.35%
Nitrogen	1.15%	1.68%
C/N ratio	42.2	26.8

Table 2 Analysis of feed and compost

	Feed	Compost
Moisture	70%	14%
Dry weight	30%	86%
pH	6.7	7.52
Organic matter	80%	65%
Ash	20%	35.0%
Carbon	46%	37.0%
Nitrogen	1.25%	2.87%
Potassium	–	1.62%
Phosphate	–	1.07%
C/N ratio	35/1	13/1

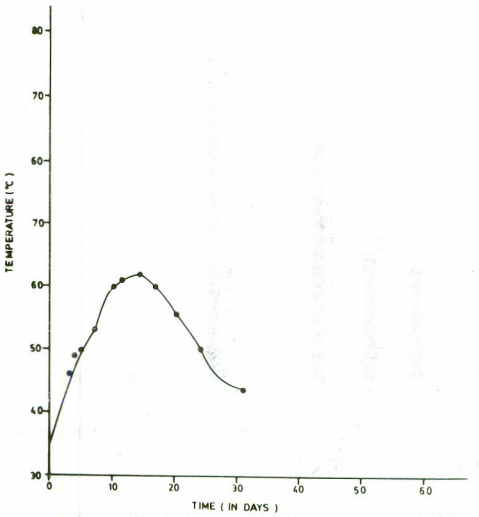

Fig. 2. Thermogenesis in cotton waste composting process.

Chemical composition of this compost and cow dung manure Fig 3 was compared to assess nutritive value as soil fertilizer. Chemical analysis of compost and cowdung manure demonstrated that cowdung manure had 2.05% nitrogen, 0.543% phosphorous, 0.5% potassium and 24.14% ash with 26.81% CN value, whereas compost obtained from waste had 1.18%, 0.527% and 1.1% more nitrogen, phosphorous and potassium respectively and a stabilized C/N ratio. All these values show that this compost had a better nutritive profile than cowdung manure.

Microbiological evaluation of compost showed presence of 4.9 billion total microbial count per gram compost, with 2.6 billion bacteria count, 2 billion fungi count

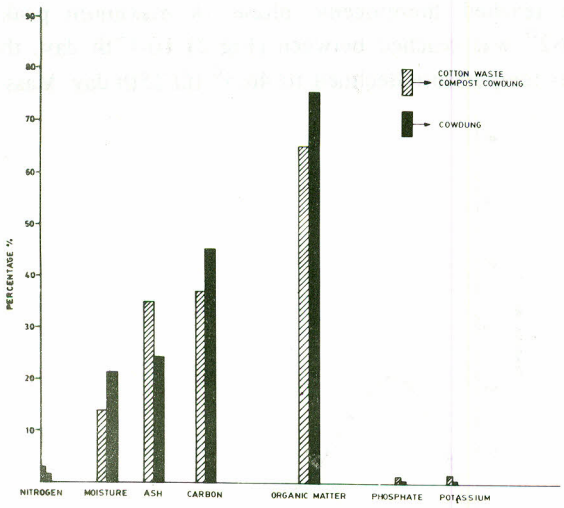

Fig. 3. Chemical composition of cowdung manure and cotton waste compost – a comparison.

and 0.3 billion actinomyceta count/gm. compost sample. Surviving microorganisms are thermophilic Table 3.

Humus is known to possess some physical qualities like it has buffering capacity, water retention property and providing soil structure etc. [10]. To determine the above qualities of cotton waste compost over cowdung manure and to assess its nutritive value, it is being used on sunflower plants results of which will be reported later.

Table 3. Micro-biological evaluation of cotton wast compost.

S. No.	Type of micro-organism	Count/gm material
1.	Bacterial	2,600,000,000
2.	Fungi	2,000,000,000
3.	Actinomycetes	300,000,000
4.	Total micro-organisms	4,900,000,000

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