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Bio Conversion and Recycling of *Zea Mays L* Waste Implementing Bulking Agents and Dry Leaves for Leachate Control

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Abstract: ***The agricultural recycling of Zea Mays L waste by the process of composting is the most promising sector in comparison to other disposal routes such as incineration and land filling. Indeed, the Zea Mays L compost is a good fertilizer that can increase crop harvests and improve the physicochemical and biological properties of the soil. In this regard, the present study aims to determine the agronomic value of Zea Mays L waste collected from Muhana village near Sanganer, Jaipur [1]. A pilot study was conducted to assess the feasibility of physio-chemical parameter of compost formed in five different trials (T1, T2, T3, T4 and T5) with the addition of 10 kg of dry leaves for proper aeration to control the leachate formation in drum composting. Mature compost is of brownish black in color obtained in third trial (T3) at the 20 day of composting [2]. Third trial composting gives the good quality compost having the characterized moisture 23.22%, pH 7.31, Electrical conductivity 3.3 dsm-1, BOD 402 mg/l, COD 668 mg/l, TOC 34.18,% Nitrogen 2.47%, Phosphorous 0.71%, Potassium 1.28%, C/N ratio 15.55:1. After that in trial 3 the compost starts to give a constant value of the determined parameters.***

Keyword: *Zea Mays L*, composting, physio-chemical properties, trial

1. Introduction

In the present day, major environment elements like air, water and soil are getting polluted due to the various natural and anthropogenic activities like dumping of solid waste without proper treatment, discharging waste water into the water bodies etc. In recent years, composting has been presented as an environmental friendly and sustainable alternative to manage and recycle agricultural solid wastes, with the aim of obtaining a quality organic product, known as compost [3]. Compost is used as organic soil amendment in agriculture within the threshold limit [4].

The *Zea Mays L* i.e. corn wastes was composted successfully, especially when mixed with adequate amount of water and implementation of bulking agents along with the addition of dry leaves for adequate aeration. The end products obtained contains large amounts of organic matter, usually combined with an increased EC value. The compost obtained is a highly nutritive 'organic fertilizer' and more powerful 'growth promoter' over the conventional composts and a 'protective' farm input (increasing the physical, chemical & biological properties of soil, restoring & improving its natural fertility) against the 'destructive' chemical fertilizers which have destroyed the soil properties and decreased its natural fertility over the years [5].

Corn compost is rich in NKP, micronutrients and beneficial soil microbes and also contains 'plant growth hormones & enzymes'. It is scientifically proving as 'miracle growth promoter & also plant protector' from pests and diseases [6]. Corn compost retains nutrients for long time and while the conventional compost fails to deliver the required amount of macro and micronutrients including the vital nitrogen (N), potash (K) and phosphorus (P) to plants in shorter time. The *Zea Mays L* (corn) agricultural waste has been characterized before and after the waste management using the method of composting.

A comparative analysis has been done in five different trials for producing compost. For each trial, corn waste has been mixed with two different bulking agents' cow dung and sawdust in 6:3:1 ratio. 10 kg of dry leaves added in each trial as dry leaves give proper aeration and control the leachate formation. The comparison is made to determine suitable proportion between corn compost and dry leaves with varying degree of water content to get the best quality of compost.

2. Materials and Methods

Feed-Stock Material

Zea Mays L. (corn) waste was collected from farm field of Muhana village near Sanganer, Jaipur Rajasthan and dry leaves from Central Park of Raja Bajar Jaipur, India. Prior to composting, the particle size of the waste was sieved to <1 cm in order to provide better aeration and moisture control. For preparing compost, *Zea Mays L* waste, cow dung and saw dust were mixed in 6:3:1 ratio. Five trials were conducted using this waste mix with different proportions of dry leaves.

Collection and Preservation of Sample

The sample of *Zea Mays L* waste was collected from Muhana village near Sanganer, Jaipur. The biodegradable organic waste of *Zea Mays L* has been mixed with cow dung and saw dust in 6:3:1 ratio, composting has done by mixing dry leaves in it in different proportion in five trials.

Performance of compost by analyzing different physio-chemical quality of compost. The physical and chemical analysis of Zea Mays L waste was conducted at Sri Balaji College campus, Jhotwara, Jaipur and C/N ratio test and NPK test at Agricultural Research Institute Durgapur, Jaipur.

Rotary Drum Composter

To study the compost stability, a rotary drum composter of 550 L capacity was used. The drum is of 1.07 m length and 0.76 m diameter, made up of a 0.3cm thick metal sheet. The inner side of the drum is covered by anti-corrosive coating. The drum is mounted on four rubber rollers attached to metal stand and the drum is rotated manually. In order to provide the appropriate mixing of wastes, 40 mm angles are welded longitudinally inside the drum. Drum was rotated manually once in every 24 hours for proper mixing and aerobic conditions are maintained by opening up both half-side doors of the drum after rotation.

Physio-Chemical Analysis of Compost

Compositing is a natural process, it will eventually occur, however slowly. The primary objective is to create an optimum environment for the microorganisms doing the decomposing. Although there is no one "right" way to compost, the process of composting can be accelerated and made more efficient. The microorganisms in the compost pile require the same basic essentials of most living organisms: nutrients, air, and water. If the microbes are abundant, the compost pile will decompose rapidly. Table 1 shows the Physio-chemical characteristics of collected of waste mixture just after the start of composting.

Table 1: Physio-Chemical characteristics of collected waste mixture just after the start of composting

Physio Chemical Character	*Ratio (6:3:1)*				
	Trial 1	*Trial 2*	*Trial*	*Trial 4*	*Trial 5*
Zea Mays L (Kg)	30	42	54	72	90
Cattle Dung (Kg)	15	21	27	36	45
Saw Dust (Kg)	5	7	9	12	15
Waste Mixture (Kg)	50	70	90	120	150
Added Leaves (Kg)	10	10	10	10	10
Raw Mixture (Kg)	60	80	100	130	160
Temperature (^{0}C)	28	29	30	25	24
Moisture (%)	21.7	21.02	18.67	18.37	18.65
pH	6.2	6.3	6.5	5.9	5.7
Electrical Conductivity (dS/m)	2.2	3.1	2.6	2.8	2.6
BOD (mg/l)	931	842	858	848	874
COD (mg/l)	1184	1143	1045	1152	1160
TOC (%)	47.12	45.17	40.01	43.33	45.01
Nitrogen (%)	1.02	1.67	1.34	1.81	1.92
Phosphorus (%)	0.52	0.42	0.27	0.42	0.67
Potassium (%)	0.62	0.28	0.38	0.48	0.51
C:N Ration	16.01:1	19.12:1	22.7:1	22.34:1	19.32:1

3. Result and Discussion

Physio-chemical Parameters

3.1 Temperature 3.3 pH

High temperature of compost pile, in conjunction with satisfactory levels of other important composting factors, indicates the likelihood of successful composting. While low temperatures retard composting, and may even halt the process. Trial-3 shows the appropriate temperature among all the trial temperature. Fig.1 shows the temperature variation for all the trials of composting.

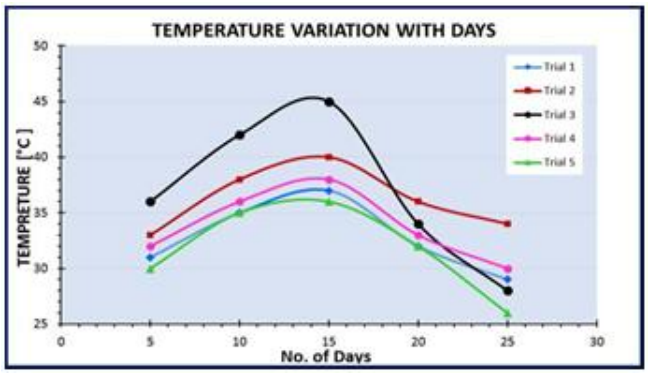

Figure 1: Temperature variation with days in composting in all the five trials

3.2 Moisture

Moisture loss during the composting process can be viewed as an indicator of the extent of decomposition. Due to readily degradable organic content, rise in temperature was observed within few days and no leachate was observed during the composting period. Fig.2 shows moisture variation with days for all the trials.

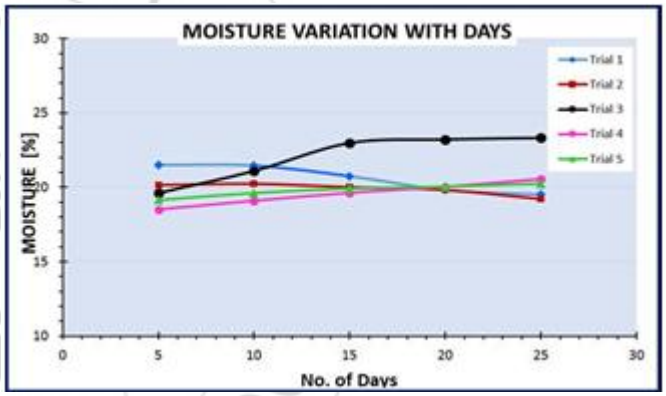

Figure 2: Moisture variation with days in composting in all the five trials

3.3 pH

For all the trials, pH of the corn compost varies between 6 to 8. But Trial-3 gives the most optimum range of pH after the 15th day of composting. After 20th day of compost variation in Trial-3 is very minimal. So best compost was obtained from Trial-3 after 20th day of composting.

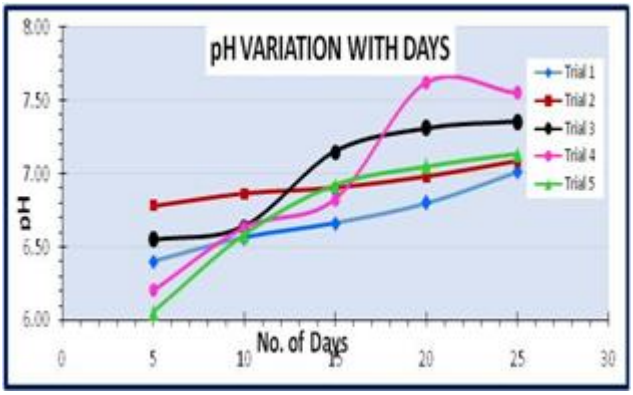

Figure 3: pH variation with days in composting in all the five trials

3.4 Electrical Conductivity

Increase in EC was observed in the present study which shows the better quality of compost rich in mineral nutrient. EC values of all the trials were found to be increasing because of degradation of organic matter during composting process. The range of EC variation lies between 2.0 to 4.6.

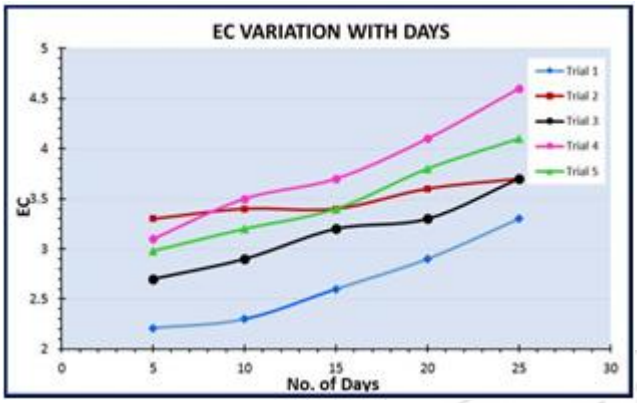

Figure 4: EC variation with days in composting in all the five trials

3.5 Total Organic Carbon

The initial concentration of Organic Carbon of *Zea Mays L* waste was for mixture of T1 - 47.12, T2 – 45.17, T3 – 40.01, T4 – 43.33 and T5 – 45.01. The Organic Carbon concentrations of compost during composting vary as the days of composting passes. In all the trials after some days the value become stable shows the matured form of compost. The graph of Fig.5 shows that Trial-3 after 15 day gives approx. TOC of the compost is in desirable limit.

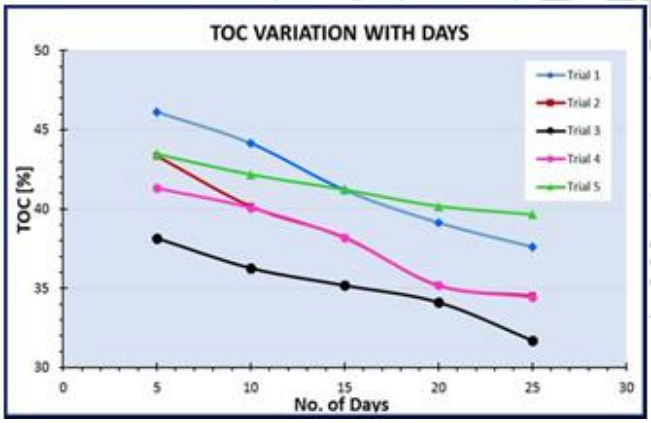

Figure 5: TOC variation with days in composting in all the five trials Fig 7 Phosphorous variation with days in composting in all the five trials

3.6 Nitrogen

The total Nitrogen present in the *Zea Mays L* waste was increasing in composting process. In all five trials, the total Nitrogen is increasing due to the recycling of Nitrogen in the composting process. The increase of Total Nitrogen shows the good quality of bio-compost.. Nitrogen fixing bacteria might also contribute to the increase in TN. The Fig.6 shows the gradual increment in the nitrogen and after 20 days a stable value of nitrogen.

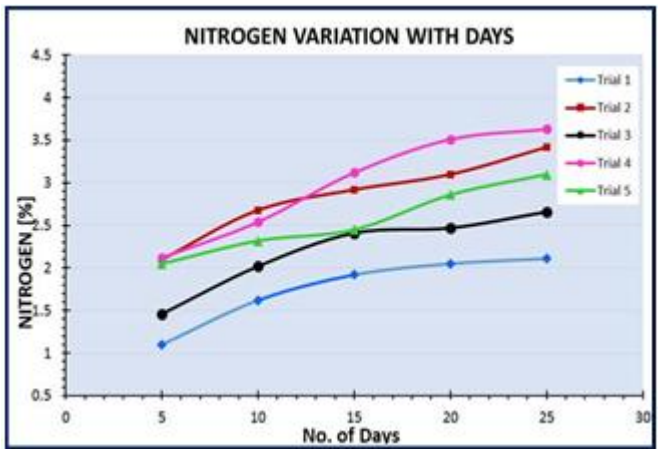

Figure 6: Nitrogen variation with days in composting in all the five trials

3.7 Phosphorous

Trial-3 gives the best possible result after 20th day as per BIS standards. In later stages change in phosphorous is very minimal. This indicates the stability of the compost. The increase in phosphorous content is due to mineralization of organic material. The phosphorous is the main nutrient for soil fertility

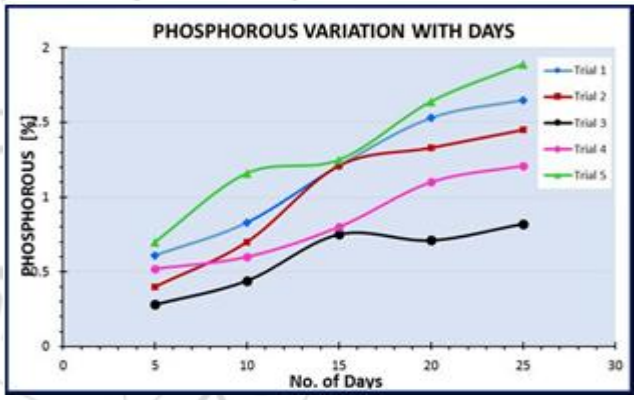

Figure 7: Phosphorous variation with days in composting in all the five trials

3.8 Potassium

The initial concentration of Potassium in the *Zea Mays L* waste was found to be T1 - 0.62%, T2 – 0.28%, T3 – 0.43%, T4 – 0.38% and T5 – 0.51%. For all trials amount of potassium is increasing with each passing day. Trial-3 gives the best possible result after 20th day as per BIS standards.

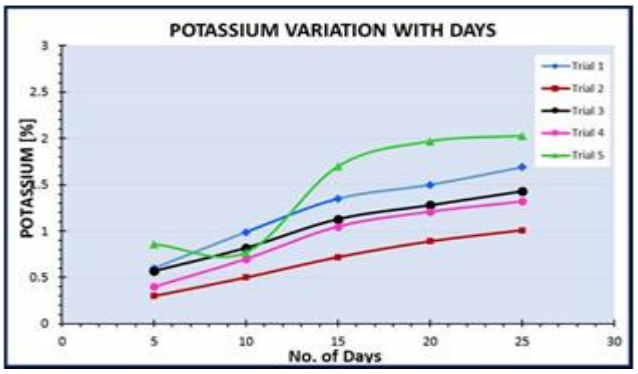

Figure 8: Potassium variation with days in composting in all the five trials

3.9 Carbon/Nitrogen Ratio

The carbon content present in the organics was utilized as source of energy for worms and simultaneously, the Nitrogen is being recycled in the compost. During this process, the casting of worms in turn enriches the macronutrients such as N, P, and K and hence bio compost will become as an organic fertilizer. The C/N ratio of *Zea Mays L* waste was decreasing. The Fig.9 shows the changes in C/N ratio during composting period. Microorganisms utilize carbon as a source of energy and the nitrogen for building cell structures, thereby reducing the C/N ratio.

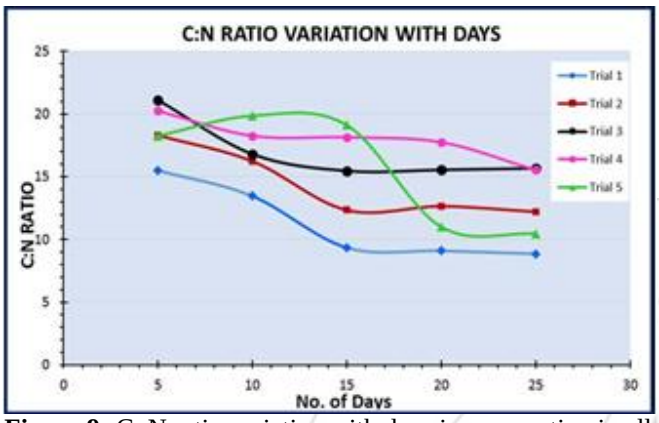

Figure 9: C: N ratio variation with days in composting in all the five trial.

3.10 Color

This is the primitive qualitative characteristics of waste that shows condition of waste before and after composting .The degree of composting seen after putting the waste into the process. The matured compost can be shown by the change in color from light yellow to blackish. The blackish color of compost with no odor gives the good quality matured. Other parameters are also essential to determine the quality of waste.

4. Conclusion

Composting is one of the environment friendly methods for the management of organic waste. To evaluate environmental and economic impacts of *Zea Mays L* waste compost formation trials have been conducted with the use of different bulking agents. By the implementation of appropriate quantity of bulking agent and addition of dry leaves for aeration a proper combination of waste materials in trial 3 (6:3:1) is formed. Longer thermophilic phase was observed due to active microorganisms by providing proper carbon and nitrogen ratio. With higher reduction in organic fractions, in Trial-3 at 15th to20th day of composting the stable compost was obtained. Approximately standard value of physio-chemical parameters observed in C/N ratio, pH, and the NPK value along with total organic carbon by the compost obtained in Trial-3.Finally it can be concluded from the observed results that implementation of bulking agent along with the addition of dry leaves in *Zea Mays L* waste form a good quality bio compost in a composting of 15 – 20 days period.

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