EFFECT OF DIFFERENT DECOMPOSING CULTURE ON QUALITY OF COMPOST FROM WEED BIOMASS

THESIS

Submitted to
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
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DECLARATION OF STUDENT

I hereby declare that the experimental work and its interpretation of the thesis entitled “**EFFECT OF DIFFERENT DECOMPOSING CULTURE ON QUALITY OF COMPOST FROM WEED BIOMASS”** or part of thereof has neither been submitted for any other degree or diploma at any university, nor the data have been derived from any thesis/ publication of any university or scientific organization.

The source of materials used and all assistance received during the course of investigation have been duly acknowledged.

Place : Akola (PANDULE DNYANESHWAR SANJAY)

Date : / /2019 Enrolment No. PP/3388

CERTIFICATE

This is to certify that the thesis entitled "**EFFECT OF DIFFERENT DECOMPOSING CULTURE ON QUALITY OF COMPOST FROM WEED BIOMASS"** submitted in partial fulfilment of the requirements for the degree of ''**Master of Science in Agriculture (Agronomy)"** of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **PANDULE DNYANESHWAR SANJAY** under my guidance and supervision.

The subject of the thesis has been approved by the Student's Advisory Committee.

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Date: / /2019

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(D) List of Abbreviations

%	-	Per cent
^0C	-	Degree Celsius
/	-	Per
@	-	At the rate
CD	-	Critical difference
cfu	-	Colony forming unit
cm	-	Centimetre
cm^2	-	Square centimetre
CO_2	-	Carbon dioxide
DAF	-	Days after filling
DAT	-	Days after treatment
Dm^2	-	Square decimetre
e.g.	-	For example
et al.	-	et alia (and associates)
etc	-	Etcetera
Evap.	-	Evaporation
Fig.	-	Figure
FRBD	-	Factorial Randomized Block Design
g	-	Gram
GM	-	General mean
GMR	-	Gross monetary returns
ha	-	Hectare
i.e.	-	that is
K	-	Potassium
Kg	-	kilogram (s)
lit	-	Litre
LMT	-	Lakh million tonnes
m	-	Meter
m^2	-	Meter square
m^{-2}	-	per square meter
mm	-	Millimetre
MW	-	Meteorological week
N	-	Normal / Nitrogen
NMR	-	Net monetary reture

No.	-	Number
NS	-	Non significant
P	-	Phosphorus
pH	-	Hydrogen ion concentration
Q	-	Quintal
RF	-	Rainfall
RH	-	Relative humidity
Rs.	-	Rupees
SE(m)±	-	Standard error of mean
viz.,	-	Videlicet (Namely)
T	-	Treatment
T	-	Tones
T MAX	-	Temperature maximum
T MIN	-	Temperature minimum
WS	-	Wind speed

(E) Thesis Abstract

a)	**Title of the thesis**	**:**	**“Effect of different decomposing culture on quality of compost from weed biomass”**
b)	**Full name of student**	**:**	**Pandule Dnyaneshwar Sanjay**
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ABSTRACT

A field experiment entitled "Effect of different decomposing culture on quality of compost from weed biomass" was conducted at the Centre for Organic Agriculture Research and Training Farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) during the year 2018-19. The experiment was laid out in Factorial Randomized Block Design with four weed biomass at pre flowering stages i.e. *Cassia tora*, *Sorghum helepense*, Mix weed species and *Parthenium hysterophorus* with three cultures which comprised S-9, PDKV and control without culture. The combinations of twelve treatments

were replicated three times. The observations on changes in temperature, volume, weight of compost were recorded periodically. Similarly, samples were analysed for microbial dynamics and major nutrient. The end of decomposition was judged by changes in C:N ratio of these decomposing materials.

During composting process, the initial rise and early decline in temperature was more in *Parthenium hysterophorus* compost than *Cassia tora*, *Sorghum helepense* and Mix weed compost. In *Parthenium hysterophorus* compost pit, temperature raised maximum to 47.2°C and in Mix weed, *Sorghum helepense, Cassia tora* compost pit was 45.6°C, 45.1°C and 44.8°C respectively. Among the decomposing cultures, PDKV culture recorded higher temperature followed by S9 and control without culture.

During the process of composting all composts were acidic in nature and steadily pH was increased towards maturity. Initial lower EC of both composts was increased slowly as decomposition moved towards maturity of compost.

The reduction in volume was higher in *Sorghum helepense* than mix weed, *Parthenium hysterophorus* and *Cassia tora* compost. Among the three decomposing cultures, PDKV culture recorded higher decline in volume. In *Sorghum helepense* compost pit, the reduction in weight was more.

Mix weed compost recorded statistically higher bacterial, fungal and actinomycetes count than *Cassia tora, Sorghum helepense* and *Parthenium hysterophorus* compost. PDKV culture recorded higher microbial count followed by S9 and control without culture.

Mix weed compost recorded fast reduction in C:N ratio up to 90 days after filling and became stable than *Cassia tora, Sorghum helepense* and *Parthenium hysterophorus* compost. PDKV culture accelerated the speed of decomposition, decline C:N ratio early followed by S9 and control without culture.

After decomposition of mix weed biomass total nitrogen, phosphorus and potassium increased more when compared with *Cassia tora, Sorghum helepense* and *Parthenium hysterophorus* biomass. PDKV culture recorded higher increase in total nitrogen, phosphorus and potassium followed by S9 and control without culture.

CHAPTER I

INTRODUCTION

1.1 Background Information

Modern agriculture has gone through major changes during the last century. It has developed from more or less extensive subsistence farming to a highly intensive, often mechanized agricultural production. Modern agriculture depends upon the external application of plant nutrients needed year after year to harvest quantum of produce required for increased human population. Most cultivated soils in tropical climate are poor in organic matter. Recycling of organic matter in agriculture brings in the much needed organic matter to the soil. Since most recyclable wastes are organic and they directly add organic matter and the plant nutrient contained in them and improve soil physical, chemical and biological properties as well as overall soil productivity (Khan *et al*. 2005).

Due to green revolution, with the introduction of high yielding crop varieties and the adoption of intensive system of cropping, large quantities of crop residues such as straw, leaves, twigs and stubbles along with huge quantity of grasses and weeds are readily available on farms (Son and Ramaswami, 1997). All these organic wastes can not be applied or ploughed directly as such into the soil because of their wider C:N ratio. They are known to reduce the availability of important mineral nutrients to growing plants through immobilization into organic forms (Elliott *et al.* 1981) and also produced phytotoxic substances during their decomposition (Martin *et al.* 1978).

Bioconversion is a process in which heterotrophic microorganisms are the sole agents for the decomposition of carbonaceous material. Their activities are directly related to the availability of energy sources and inorganic nutrients required for their growth. There is a need to explore the possibility of bioconversion of organic wastes in order to augment the supply of organic matter for larger land coverage and to relieve the environment from various pollution problems and health hazards. Apart from crop residues available, plenty of green matter growing freely in vacant places, waste lands and weeds like *Parthenium hysterophorus*, *Cassia tora, Sorghum helepense and some other species* occupy larger areas with no economic use. In general, about 35 million hectare of land has been estimated to be infested with *Parthenium* currently (NRCWS, Jabalpur).

Generally weeds are heavy competitors for the crops. They have capacity to absorb water and nutrients three times more than crops. Since weeds contain lot of nutrient, using them as organic manure could be helpful in their management (De *et al*. 1988). Weeds are major deterrent to the development of more sustainable agricultural systems. They cause enormous losses and sufferings to human beings by way of reduction in crop yield and quality, wastage of human energy and resources and increased expenditure to alleviate the problems caused by them (Hosmani *et al*. 1979 and Tiwari and Bisen, 1982). In general, impact of weeds on crop yields varies from high input to low input crop production systems. The worldwide loss of attainable production caused by weeds (particularly due to *Parthenium*) in principal food and cash crops like rice, wheat, barley, maize, potato, soybean, cotton, and coffee has been reported to be more (Mukhopadhyay, 1997).

1.2 Importance of study

In India, weed biomass like *Parthenium hysterophorus*, *Cassia tora*, *Sorghum helepense* and some other species of weed like like *Celosia argentina, Euphorbia hirta, Alteranthera triandra, Commelina benghalensis, Tridex procumbens* and *Digera arvensis* are available in huge quantity. Obnoxious weed *Parthenium hysterophorus* is a prolific seed producer with having long storage life and can quickly disperse through wind. Vegetative generation occurs from the crown. The weed reaches 50 per cent seed setting during flowering. The weed left as such in the same area acts as a seed bank because of its higher seed production capacity and extended dormancy period. The concept of ‘one year seeding and seven years weeding' is true for *Parthenium*. It produces about 25000 seeds per plant, which are viable even at immature stage. In dry months *Parthenium* appears in a rosette form. But during rainy season it grows up to 90 cm height with profuse flowering and green foliage. It flowers throughout the years.

Various methods are employed to control the weeds. Of the available methods of control such as mechanical, chemical, biological and cultural, none offers complete eradication due to various factors (Tripati *et al.* 1991). The natural weed killer *Zygogramma bicolorata* has number of limitations and its use is limited to very small area. Managing *Parthenium* is a great challenge before researchers. The problematic weeds are manually collected and then disposed off or burnt. Studies to utilize problematic weeds efficiently for human welfare are lacking (Thimmaiah and Bhatnagar, 1997). Hence composting is recommended, as the seeds lose their viability due to the higher temperature during composting (Nishida *et al.* 1998 and Eghball *et al*. 2000). Organic recycling of this weed not only manages the weed but provides returns in the form of compost.

Keeping in view of the above facts, different scientists and researchers working on the line of composting are keenly interested to use such wild plants, weeds and other natural biomasses as source of substrate for compost making. Composting is one of the best methods of recycling to improve soil fertility as well as disposal of organic wastes to check environmental pollution and health hazards to human beings and soils. Organic wastes like wild plants and weeds have large potential for the production of organic manures either by innovative composting technology or by vermicomposting (Bhaiday, 1994). The utilization of obnoxious weed like *Parthenium* by direct *in-situ* incorporation requires pre sowing decomposition period of 20-30 days and decomposition processes are dependent on many factors, any one lacking leads to partial decomposition, which may causes its toxic effects on soil as well as growing crops (Martin *et al.* 1978 and Downer *et al*. 2003).

The traditional method of composting is a slow process and takes more than six months. Also the product thus prepared contains very low quantity of nutrients. Moreover, because of their wide C:N ratio, these agricultural wastes and weed biomass are known to reduce the availability of important mineral nutrients to growing plants through immobilization in to organic form during their decomposition. Hence it necessary to speed up the process of decomposition and to test feasibility of different weed biomass and decomposing culture, a field experiment was carried out at Agronomy farm, Dr. PDKV, Akola during year 2018-2019 entitled " Effect of different decomposing culture on quality of compost from weed biomass " with following objectives

OBJECTIVES

1. To explore the feasibility of different weed biomass and decomposing culture.
2. To study the rate of decomposition of different weed biomass under pit method.
3. To analyze the biological and chemical properties of compost.

1.3 Scope of composting

In conventional agriculture production system, chemical fertilizers are main nutrient source for higher productivity. Farmers are using these fertilizers alone with higher quantity which increase demand in market. Most of fertilizers are imported from westerns countries. The country consumes 55 million tonne of fertilizers annually, of which 72 per cent is domestically produced while the rest is imported, India Rating and Research (Ind-Ra) said in a report (2018-2019). Of the 15.5 million tonne of fertilizers imported, urea, DAP and MOP constituted 6 million tonne (39 per cent), 4.3 million tonne (28 per cent) and 4.7 million tonne (31 per cent), respectively. It clearly indicates that there is a huge gap between production and consumption of fertilizer.

Recent studies have focus on traditional fertilization practices to enhance soil fertility by amendment of crop residues, green manure and farm yard manure, which may be major source of nutrients combating gap between import and demand of agriculture production. In India some of weed biomass used as a fodder and thatching roof. That weed biomass can be utilized as composting material. Hence composting of weed biomasses is best option to help fulfilling fertilizer requirement and supply gap.

Composting is a controlled microbiological conversion process leading to complete decomposition of organic materials to a stable humus form. (Mathur, 1998). The toxic effect of *Parthenium* can be eliminated after 60- 65 days of its decomposition in compost pile. As it is rich source of macro and micronutrients, supplements high nutritional value to mature compost (More *et al*. 2005). Composting is one of the best method for recycling of organic waste to improve soil fertility as well as disposal of organic wastes to check environmental pollution and health hazards to human beings and soils. Bulky nature of *Cassia tora, Sorghum helepense, Parthenium hysterophorus* and other weed biomass can be recycled as valuable compost by using locally available bio-inoculants. Composting also can reduce viability of seeds. So composting of *Cassia tora, Sorghum helepense and Parthenium* gives dual benefit for the agricultural production and maintain the fertility of soil. The compost prepared from *P. hysterophorous* has high level of macro and micronutrient it contains two times more nitrogen, phosphorous and potassium than Farm Yard Manure (Angiras, 2008).

1.4 Limitations

Large volume of compost or weed biomass are required for land application due to low contents of nutrients, in comparison with chemical fertilizers. Compost products have high variable concentration of nutrients due to type, size and C:N ratio of weed biomass used. Generally farmers keeps FYM and weed biomass in open space without moisture which deteriorate the quality of compost prepared. Composting is laborious and time consuming method to get final product.

1.3 Hypothesis

External inputs in farming system not only deteriorate soil health but also increase the cost of inputs. Use of organic source of fertilizer assumed as costly inputs, not easily available in market and heavy transport cost mislead the concept of organic farming. In field, weed biomass like *Parthenium hysterophorus*, mixed weed, *Cassia tora*, *and Sorghum helepense* are available in huge quantity. Available weed biomass should be utilized as a source of organic fertilizer. By converting this biomass into valuable compost with proper and easy composting technique are to be verified for the use of farmers on their field. Thus, the hypothesis is to utilize available weed biomass in appropriate decomposing method with active microbial cultures to harvest quality compost in the field itself and helpful to organic growers and marginal farmers.

CHAPTER II

REVIEW OF LITERATURE

The available literature pertaining to the present investigation has been reviewed and presented under the following headings

2.1 Compost

2.2 Reduction in weight during decomposition process

2.3 Changes in physical and chemical properties of compost

2.3.1 Temperature

2.3.2 pH

2.3.3 Electrical conductivity

2.3.4 Total nitrogen content

2.3.5 Total phosphorus and potassium content

2.3.6 C:N ratio

2.4 Biological properties

2.4.1 Microbial population during decomposition

2.5 Maturity period for composting

2.1 Compost

Acharya (1946) reported that Bangalore hot fermentation method of composting gives higher yield of manure and better conservation of nutrients as compared to aerobic heap method and Indore method of composting.

Gopal (1987) reported that compost from water hyacinth has also been prepared by using the dry plants and mixing them with wood ash, soil, farmyard manure and vegetable refuse.

Perumal (1994) studied the composting of *Eichornia* and recorded that compost contained 2.10 % N, 1.20 % P_2O_5 and 2.30 % K_20.

Churchill *et al*. (1996) studied the survival of some weed seeds affected by composting and reported that survival of weed seeds and pathogen propagules were decreased with number of turns, but was not related to straw collection method used and depth of packet placement or method of turning.

Eisele (1997) studied the influence of composting on seeds of *Vicia hirsuta* and reported that between 10 and 30 per cent of weed seeds were germinated again after 5 weeks and 0-5 per cent of seeds germinated spontaneously, but more than 90 per cent after scarification. He also concluded that to avoid the dispersal of weed seeds careful composting of manure should be followed.

Sreenivasa and Majjigudda (1997) an experiment was conducted to study the possibility of utilizing common weeds such as *Parthenium, cassia* and water hyacinth in various combinations along with cattle dung for biogas generation. The results revealed that the highest biogas yield was obtained with the conventional control (cattle dung alone). Among different weeds, water hyacinth was found to be superior when used in combination with cattle dung in equal proportion. However, *Cassia* or *Parthenium* in combination with cattle dung at 25:75 (w/w) proportions found to be superior in biogas production.

Verma *et al.* (1999) inferred that the *Parthenium* weed and *kharif* weeds can be composted easily by *Chimney* method to obtain good quality compost. They used soybean trash, paddy straw, *Parthenium* weed and *kharif* weeds as composting substrates. Highest Zn content was observed in the compost prepared from *Parthenium.* They also concluded that *Chimney* method was superior than wall technique and single turning methods.

Singh *et al*. (2000) studied the composting of different wild weeds including *Parthenium* in Berkeley method and reported that compost prepared from wild weeds contains higher nutrients and even better than FYM in terms of nutrient content. It was found that Berkeley method was superior than other common methods which are used by farmers.

Shivani (2003) while studying the comparative performance of application of *lantana* biomass directly as well as through compost observed that compost application recorded significantly higher grain and straw yield of wheat than its direct application. Thus practice of composting is more profitable keeping in view the quality and convenience of handling the material.

More *et al*. (2005) reported that the heavy distribution of *Parthenium* in Parbhani and other areas of Marathwada as a menace to agricultural production and human population. They also concluded that to check its dispersal composting technique can be used and compost can be prepared from *Parthenium* with locally available inoculants without any additional cost.

2.2 Reduction in weight during decomposition process

Attayee *et al.* (2017) revealed that compost prepared from *Parthenium* + cow dung (3:1) yielded 52.2 % recovery at maturity and also observed that compost contains 1.54% N, 1.18% P and 1.72% K.

2.3 Changes in physical and chemical properties of compost

2.3.1 Temperature

Mustin (1987) reported that the temperature within a composting mass determines the rate at which many of the biological processes takes place and plays a selective role on the evolution and the succession of the microbiological communities.

Thompson *et al*. (1997) conducted the laboratory experiment to know the germination of 10 common problematic weed seeds inhibited by different range of temperature and reported that germination of weed seeds were very lower which were treated in 56°C than 31°C or 42°C and temperature required to reduce or eliminate the germination of weed species was differ among weed seeds.

Nishida *et al*. (1998) studied the germination of 15 weed seeds affected by composting process and inferred that seeds were germinated before when compost pits were not reached 46°C. Thereafter there was a rapid decline in the percentage of germinable seeds and none of the species germinated when the temperature was above 57°C.

Eghball *et al.* (2000) studied the viability of different weed seeds affected by composting process and reported that all weed seeds lost their viability in dairy manure composting except velvet leaf seeds. Compost pit temperature never reached 60°C, which is considered for the most of the weed seeds destruction. They also concluded that composting are moist for most of composting period, the viability of weed seeds can be reduced even though critical temperature is not achieved possibly because of compost phytotoxins.

Sandler *et al*. (2003) studied the composting of temperate weed cranberry residues and reported that thermophillic temperature (43-66°C) generated during composting process destroyed the weed seeds and pathogens. They also reported that mixed piles of cranberry composting generate thermophillic temperature than without mixture (cranberry leaves only).

Sharma *et al.* (2004) studied the recycling of obnoxious weed plants lantana and *Parthenium* through vermicomposting and reported that high content of macro and micronutrients and reduced C:N ratio, pH, temperature during composting process. Recorded values of nutrients are higher than FYM and C:N ratio of final compost was half of C:N ratio of FYM.

2.3.2 pH

Dick and McCoy (1993) stated that pH generally gives an approximate index of compost maturation.

Nakasaki and Ohtaki (2002) stated that changes in pH have been found to occur during the composting period and therefore, have been considered as a possible indicator of biological activity. Microorganisms tend to modify their movement and the products of decomposition may alter pH over time. The range of pH values suitable for bacterial development is 6.0-7.5, while fungi prefer an environment in the range of pH 5.5-8.0.

Sharma *et al*. (2004) studied the recycling of obnoxious weed plants lantana and *Parthenium* through vermicomposting and reported that high content of macro and micronutrients and reduced C:N ratio, pH, temperature during composting process. Recorded values of nutrients are higher than FYM and C:N ratio of final compost was half of C:N ratio of FYM.

Preethu *et al*. (2005) studied the preparation of quality compost from coffee wastes and reported that the reduced levels of toxic constituents, pH, phenol and salt content in matured compost than fresh leaves. They also reported higher amount of macro and micronutrients than fresh leaves even than FYM.

Sangwan *et al*. (2010) reported decrease in pH of *Parthenium* compost prepared along with sugar mill sludge and biogas plant slurry by employing *E. fetida* as compared to compost prepared from *Parthenium* alone.

Yadav and Garg (2011) also reported decrease in pH for compost of *Parthenium* mixed with cow dung using *E. fetida*.

2.3.3 Electrical conductivity

Rajiv *et al.* (2013) prepared *Parthenium* compost along with cow dung in the ratio of 1:4 and 1:3. According to experiments conducted on the quality of compost, the pH, EC and moisture content (%) recorded for *Parthenium* and cow dung (in the ratio 3:1) was 6.52, 0.20 (dSm-1) and 42.54%, respectively, as compared to 6.50, 0.20 (dSm-1) and 41.25% for *Parthenium* alone. They further studied the allelopathic effect on germination and growth of *Arachis hypogeae* L. Highest concentration of cow dung mixed *Parthenium* [*Parthenium*: Cow dung (1:4 and 1:3)] compost, respectively showed similar soil physical properties along with 96% of seed germination, highest growth level of radicles (87.2 and 85.3 mm) and plumule length (22 and 21.8 mm) when compared to other treatments and control.

Sasidharan *et al.* (2013) reported that compost prepared from *Eichhornia* contains electrical conductivity at maturity was 0.02 dS/m, pH 6.8 and nitrogen, phosphorus, potassium content was 2.9, 2.72 and 1.4 respectively.

2.3.4 Total nitrogen content

Mathur and Debnath (1980) reported that quality of compost prepared from mixture of paddy straw, weeds and *Eichornia* improved when rock phosphate was applied to it with or without pyrite. The results showed that low dose of rock phosphate (5 per cent) increased the nitrogen content by 30 per cent of the compost over the control.

Nallathambi and Marimuthu (1993) found that the increase in the nitrogen content of agrowaste during decomposition may be due to lignolytic activity of *Aspergillus spp.*, *Trichoderma spp* and *Pleurotus* spp.

Gaur and Geetha (1995) recorded that green weeds and *Eichornia* contained 2.45 and 2.38 % N, respectively. The weed sample of *Chromolaena odorata*, which was harvested before flowering, contains 2.8, 0.48 and 1.56 per cent N, P and K, respectively. Whereas, *Parthenium hysterophorus* contains 2.16, 0.55 and 1.68 per cent N, P and K, respectively.

Chauhan and Joshi (2010) prepared compost from Congress grass (*P.* *hysterophorus* Linn.), water hyacinth (*Eichhornia crassipes*) and bhang (*Cannabis sativa* Linn.) using worms. High increase in nitrogen, potassium, phosphorus and a high decrease in organic carbon, C/N, C/P ratio in the experiment having *Eisenia foetida* was observed.

Kumar *et al.* (2012) conducted an experiment consisted five different treatments viz. N1 (Dry cutting of *Parthenium*), N2 (Green cutting of *Parthenium*), N3 (Dry cutting of *Cannabis*), N4 (Green cutting of *Cannabis*) and N5 (Normal NADEP-Control). The result obtained from the experiment indicated that the treatment N2 contained highest level of N (2.37%), P (0.53%) and K (1.79%).

Bhoyar (2013) assessed the manurial and composting value of *Parthenium,* as compared to FYM, *Parthenium* compost contained 1.05, 0.84, 1.11 and 12.68 per cent N, P, K and OC, respectively as compared to 0.5, 0.2, 0.5, and 3-5 per cent in FYM. Besides burning or destruction of the weed, composting served dual purpose of eradication of the weed for better utilization as compost, for better crop production and could be a good source of employment and income for villagers.

Ameta *et al*. (2016) reported that *Parthenium* compost is a good source of nitrogen as it consist 3 times more nitrogen than simple farm yard manure.

2.3.5 Total phosphorus and potassium content

Son and Ramaswami (1997) studied the bioconversion of *Parthenium* for sustainable agriculture and reported that the increase in nitrogen content in fungal culture treated pile was 1.70 folds over control. Final nitrogen content in *Parthenium* compost was 2.90 per cent. Composted *Parthenium* recorded higher phosphorus content. The higher percentage of reduction (41.4%) in phenol content was observed with *Parthenium* (even though the phenol content was higher in *Parthenium* residue) at the end of composting.

Gajanan *et al*. (2000) reported that the nutrient potential viz., N, P and K of weeds like *Eupatorium*, *Parthenium* and *Eichornia* ranged from 2.86 to 3.15 per cent, 0.50 to 0.98 per cent and 1.56 to 2.13 per cent respectively.

Priyasankar *et al*. (2001) studied the conversion of aquatic weed *Trapa bispinosa* into valuable compost and reported that vermicompost from aquatic weed has higher concentration of total N, available P, K, Ca and Mg than without worms. They also concluded that nutrients locked up in organic matter were mobilized into plant available forms in the cast during passage of the plant material through the gut of worms.

Mathakiya and Meisheri (2003) found that the nutrient potential viz., N, P, K, Fe, Mn, Zn, and Cu in the range of 1.45%, 2.80%, 1.45%, 7280 mg kg'1, 305 mg kg'1, 58 mg kg'1 and 120 mg kg'1 respectively in bio compost which was prepared by using different crop residues and weeds.

Saravanane *et al*. (2005) reported that there is a possibility of saving 25 per cent of inorganic fertilizer by utilizing *Parthenium* as compost and *Chromolaena* or *Lantana* as green manure incorporation to potato crop under eastern dry zone of Karnataka.

Khaket *et al.* (2012) composted *Parthenium* along with *Eichhornia* which is also an uncontrolled weed. The combined composting of *Parthenium* and *Erichhornia* reduced the allelopathic effect and increased the nutrient quality thus, making the compost promising for organic farming and bioremediation. The biochemical and enzymatic analysis of the compost indicate significant increase in N, P, K and polyphenol oxidase in combined compost.

Bhoyar (2013) also reported high compositing value of *Parthenium* (1.05, 0.84, 1.11 per cent N,P,K content), as compared to FYM alone (0.5, 0.2, 0.5 per cent N,P,K content). Compost mixtures *Parthenium* + cow dung + earthworms and *Parthenium* + cow dung + agriculture waste + earthworms recorded low values for organic carbon and C/N ratio.

2.3.6 C:N ratio

Ameta *et al*. (2016) C/N ratios for all the recipes were determined using standard methods. Carbon to nitrogen ratio of *Parthenium hysterophorus* weed found in this locality was 10:1, while other combinations gave results ranging from 7.1 to 11.8. Because both; carbon and nitrogen are available in organic wastes and hence, one cannot distinguish any waste as a source of single material alone e.g. Carbon or nitrogen.

Harada *et al*. (1981) reported that the total carbon content, C:N ratio, the contents of cellulose and hemicellulose and the ratio of carbon in reducing sugar to the total carbon decreased whereas relative contents of total nitrogen, ash and lignin increased with maturity of compost.

Mehta and Daftardar (1984) found that the N content of the compost prepared from wheat straw with cattle dung and urea increased and C:N ratio decreased with increase in the bone meal used for composting.

Bhriguvanshi (1988) reported that organic manures prepared from cattle shed wastes, kudzu vine, kharif weeds and pine needles by mixing with fertilizers contains the higher percentage of total nitrogen in all manures and C:N ratio of the composting mixture was narrowed down considerably.

Rajbhansi *et al.* (1998) studied the composting of allelopathic plants like *Lantana* and *Eupatorium* reported that the reduced C:N ratio and increased nitrogen contents by 43 per cent and 29 per cent in eupatorium and *Lantana* respectively in composting. Complete elimination of allelopathic potential of both plants was achieved in matured compost which is used for germination of bioassays with Chinese cabbage seeds. However, the germination index of Dia sorghum indicated that eupatorium, not lantana, still retained a significant inhibitory potential.

According to Ameta *et al*. (2016) different combinations were prepared by using different organic wastes such as *Parthenium*, cow dung, wheat straw, charcoal powder, sawdust, etc. in different proportions. C/N ratio of the different organic wastes such as *Parthenium* as well as different combinations has been reported. The results of this study are helpful in maintaining the desired C/N ratio of the feedstock while preparing the compost. Carbon to nitrogen ratio of *Parthenium hysterophorus* weed found in this locality was 10:1, while other combinations gave results ranging from 7.1 to 11.8.

2.4 Biological properties

2.4.1 Microbial population during decomposition

Gaur *et al*. (1971). Noted the increase trend of bacterial and actinomycetes population at 30 and 90 days period, followed by decline in trend of their population at 60 and 120 days. However, again an increasing trend was observed after 120 days of incubation.

Kapoor *et al*. (1983) reported that inoculation of cellulolytic microorganisms helps to enhance the decomposition. Inoculation of *Trichorus spiralis* and *Paecilomyces fusisporus* helped to produce compost with lower C:N ratio from sugarcane trash and rice straw. The inoculation of

N_2 fixing bacteria, phosphate solubilizing fungus and cellulolytic fungus coupled with the addition of rock phosphate helped to produce compost from plant residues in short period and with high N and P_20_5 content.

Shinde and Rote (1983) reported that the enrichment of sugarcane trash with different phosphate level and microbial cultures took five months for decomposition while composting without phosphate and microbial enrichment was found to be not ready even after six months.

Talashilkar (1987) studied the effect of microbial culture on humification and enrichment of mechanized compost. He observed that the enrichment of compost produced in a machanised plant by addition of urea followed by inoculation for upto 90 days improved the quality of compost by lowering the C:N ratio. Addition of phosphorus and microbial culture with or without urea improved the quality of compost.

Pore *et al.* (1992) reported that an inoculation of fungal culture with farm waste has reduced the period of composting and improved the quality of compost.

Bhanavase *et al.* (1995) found that an improvement in quality of compost when it was enriched with microbial culture and 1 per cent and 5 per cent of rock phosphate in chopped, sugarcane trash over the unchopped one. Microbial culture used were *Trichoderma viride, Trichorus spiralis, Aspergillus awamori, Paecilomyces fusisporus and Penicillium sp.* with rock phosphate, urea and biofertilizers. They also recorded higher population of fungi, bacteria, actinomycetes and PSB in compost prepared from chopped trash than unchopped trash and also reported that an improvement in quality of compost and increased decomposition rate of sugarcane trash due to frequent turning and application of suitable decomposers.

2.5 Maturity period for composting

Biruk and Jabir (2017) conducted the experiment with the objective of evaluating different methods of composting in terms of date of compost maturity and observed that non turned pit method required about 87days for the maturity.

CHAPTER III

MATERIALS AND METHOD

3.1.1 Experimental site

An experiment was carried out to study the "Effect of different decomposing culture on quality of compost from weed biomass" at Centre for Organic Agriculture Research and Training Farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2018-19. The details of materials used and method adopted during the course of investigation is described below under appropriate heads.

3.1 Experiment details

3.2 Treatment details

3.3 Decomposing culture

3.4 Methodology for preparation of compost

3.5 Weed biomass

3.6 Observations

3.7 Methods of analysis

3.8 Statistical analysis

3.1 Experiment details:

1) **Location** : Centre for Organic Agriculture Research and Training Farm, Department of Agronomy, Dr. PDKV, Akola.
2) **Composting method** : Pit method
3) **Weed biomasses** : 1) *Cassia tora*
   2) *Sorghum halepense*
   3) Mix weed species
   4) *Parthenium hysterophorus*
4) **Decomposing culture** : 1) S–9 Culture
   2) PDKV Culture
   3) Without culture (Only dung slurry)
5) **Experimental design** : Factorial Randomized Block Design
6) **Number of replications** : 3 (Three)

7) **Number of treatments** : 12

8) **Number of compost pits** : 36

9) **Size of compost pit** : 0.5 m^3

10) **Experimental Period** : August 2018 to November 2018

3.2 Treatment details:

Factor A – Weed biomass

W_1 : Cassia tora

W_2 : *Sorghum halepense*

W_3 : *Mix weed species*

W_4 : *Parthenium hysterophorus*

Factor B – Decomposing Cultures

C_1 : S-9 culture

C_2 : PDKV culture

C_3 : Without culture (Dung slurry)

Treatment combinations:

Treatment	Symbol	Treatment combination
T_1	W_1C_1	*Cassia tora*+ S-9 culture
T_2	W_1C_2	*Cassia tora*+ PDKV culture
T_3	W_1C_3	*Cassia tora*+ Dung slurry
T_4	W_2C_1	*Sorghum halepense*+ S-9 culture
T_5	W_2C_2	*Sorghum halepense*+ PDKV culture
T_6	W_2C_3	*Sorghum halepense*+ Dung slurry
T_7	W_3C_1	Mix weed+ S-9 culture
T_8	W_3C_2	Mix weed+ PDKV culture
T_9	W_3C_3	Mix weed+ Dung slurry
T_{10}	W_4C_1	*Parthenium hysterophorus*+ S-9 culture
T_{11}	W_4C_2	*Parthenium hysterophorus*+ PDKV culture
T_{12}	W_4C_3	*Parthenium hysterophorus*+ Dung slurry

3.3 Decomposing culture

3.3.1 S9 culture

It was collected from Supa Biotech Pvt. Ltd., Akola. This culture is distributed by State Agriculture department under organic

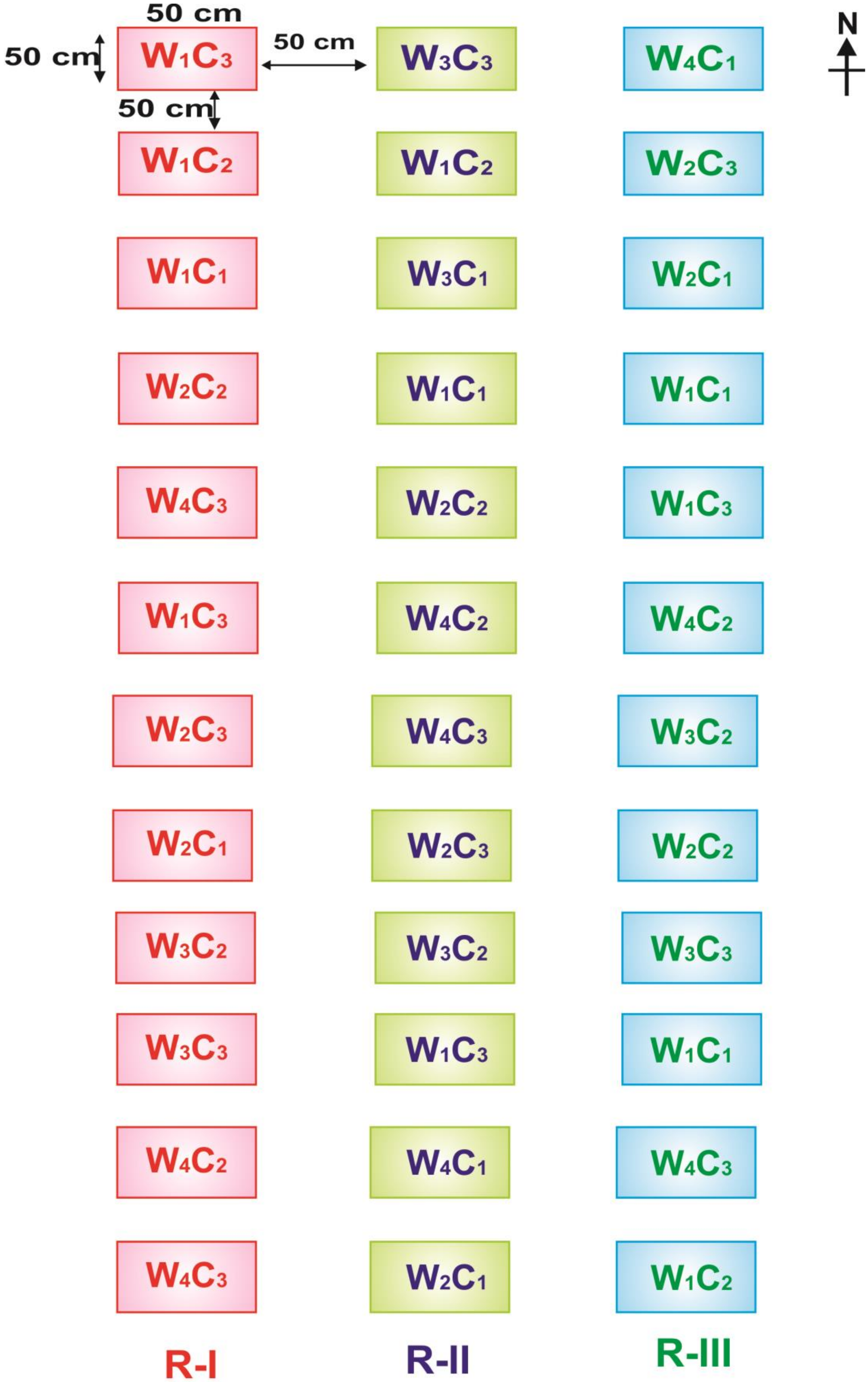


Fig. 1. Plan of compost pit layout

scheme. The recommended quantity of decomposing culture was @1 kg ton^{-1} of weed biomass.

3.3.2 PDKV decomposing culture

The decomposing culture were collected from Department of Plant Pathology, Dr. PDKV, Akola which contains 80 per cent *Trichodemia viridae* and 20 per cent other microorganisms species in closed formula. The recommended quantity of this culture is @ 1 kg ton^{-1} was used for decomposing of weed biomass.

3.3.3 Dung Slurry

The deshi cow dung were collected from Centre for Organic Agriculture Research and Training Farm, Department of Agronomy. Dr. PDKV Akola. The dung slurry was prepared from mixing of 5 kg fresh dung and 10 litre of water for single pit.

3.4 Methodology for preparation of compost

3.4.1 Preparation of mother culture

Water of 10 litre was taken in plastic bucket, the slurry was made by thoroughly mixing 5 kg dung and 50 gram decomposing culture.

3.4.2 Filling of compost pit and management

The compost was prepared by Bangalore (Pit) method. All side of the pit were wetted by sprinkling thin slurry of dung, water and decomposing culture. At bottom, 10 cm thick layer of fresh weed biomass was spread evenly. Then spread thick slurry of 3 kg prepared from mixture of dung, water and decomposing culture. After that the thin layer of 1 kg soil from the field spread over the layer uniformly. Likewise four layers were filled up to ground level. Last 5^{th} layer of 20cm was filled with same procedure in dome shape. This layer was plastered with thick slurry of 7 kg dung, 4 kg soil and four litre water. Temperature was monitored at 7 days of interval. Compost was watered when required to maintain moisture content up to 60- 70%. Total 45 kg initial weed biomass was added in per compost pit.

FLOW CHART OF COMPOST

The 0.5 m^3 of compost pit was prepared

Mother culture was made by thoroughly mixing 5 kg dung, 10 litre water and 50 gram decomposing culture.

All side of the pit were wetted by sprinkling thin slurry of dung, water and decomposing culture

At bottom, 10 cm thick layer of weed biomass was spread evenly

Then spread thick slurry of prepared from mixture of dung, water and decomposing culture

Likewise four layers were filled up to ground level

Last 5^{th} layer of 20cm was filled with same procedure in dome shaped

This layer was plastered with thick slurry of 7 kg dung, 4 kg soil and four litre water

Temperature was monitored at 7 days of interval

Final compost

(Total initial weed biomass 45 kg per pit)

Plate 1. Layout of compost pit

Plate 2. Preparation of mother culture

Plate 3. Filling of compost pit

Plate 4. Plastering of compost pit

Plate 5. Recording temperature of compost pit

Plate 6. Volume of compost

Plate 7. ***Parthenium hysterophorus*** **compost**

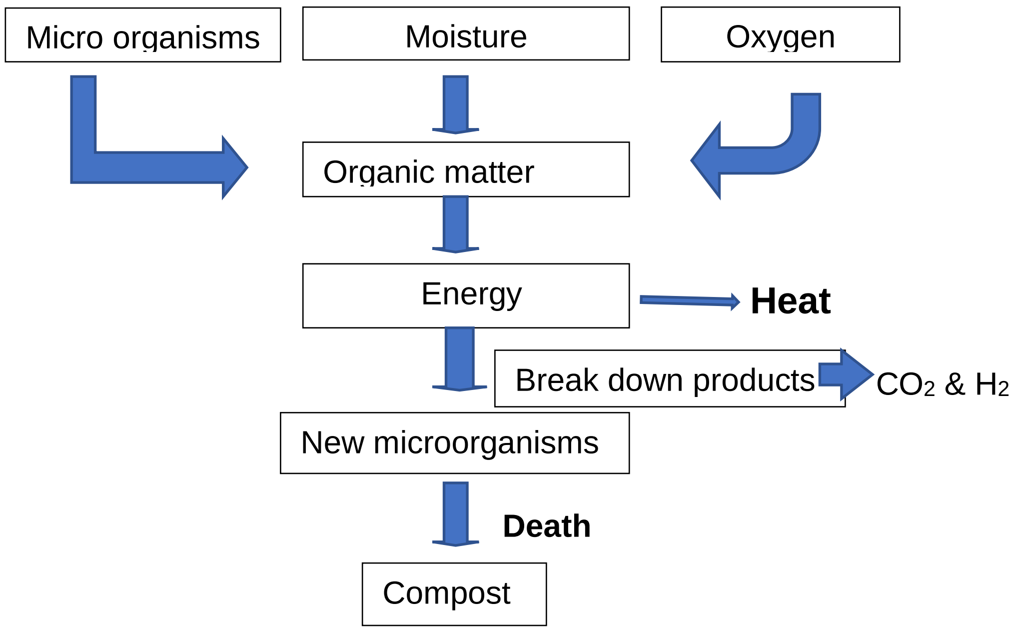
Plate 8. Mix weed compost

Plate 9. ***Sorghum helepense*** **compost**

Plate 10. ***Cassia tora*** **compost**

3.4.3 Process of decomposition of organic matter

Maheshwari *et al*. (2013)



3.5 Weed biomass

The weed biomass of *Parthenium hysterophorus*, Cassia tora, *Sorghum helepense* and some other weeds like *Celosia argentina, Euphorbia hirta, Alteranthera triandra, Commelina benghalensis, Tridex procumbens* and *Digera arvensis* was used in mix weed (At pre-flowering stage). These were available at Agronomy farm.

Chemical composition of weed biomass (Initial):

Sr. no.	Particular	*Cassia tora*	*Sorghum halepense*	Mix weed species	*Parthenium hysterophorus*
1)	Nitrogen (%)	1.58	1.08	1.42	1.88
2)	Phosphorus(%)	0.36	0.28	0.42	0.34
3)	Potassium(%)	0.44	0.38	0.52	0.44
4)	Total carbon (%)	41.6	40.2	48.8	46.6
5)	C:N ratio	26.3:1	37.2:1	34.3:1	24.7:1

3.6 Observations recorded :

Sr. No.	Particulars	Frequency	Days after filling
A. Physical properties			
1.	Temperature (^{0}C) (At middle of the pit)	7 days	Upto 90 days
2.	Volume of compost (m^3)	2	Initial and Final
3.	Weight of compost (kg)	2	Initial and Final
B. Chemical analysis			
4.	pH	3	30,60,90 DAF
5.	EC (dS/m)	3	30,60,90 DAF
6.	Total carbon content (%)	3	30,60,90 DAF
7.	Total N,P,K (%)	2	Initial and Final
8.	C:N Ratio	2	Initial and Final
C. Microbial studies			
9.	Microbial count for Fungi ($x10^4$ cfu g^{-1})	3	30,60,90 DAF
10.	Microbial count for Bacteria ($x10^6$ cfu g^{-1})	3	30,60,90 DAF
11.	Microbial count for Actinomycetes ($x10^4$ cfu g^{-1})	3	30,60,90 DAF

A) PHYSICAL PROPERTIES

3.6.1 Temperature (^{0}C)

Temperature of compost was recorded at 7 days interval by portable digital thermometer. Probe of the thermometer was placed 30 cm depth in the compost pit for 10 minute to stabilize the reading.

3.6.2 Weight of compost (kg)

Initial total weight of weed biomass, dung and soil was recorded at the time of filling of compost pit and final total weight of decomposed compost was recorded after confirming complete composting.

3.6.3 Volume of compost (m^3)

The initial volume of compost pit was 0.15 m^3. Final volume of decomposed compost was recorded at the time of removal from compost pit.

B) CHEMICAL ANALYSIS

3.7 Method of Analysis

3.7.1 pH

The pH was estimated at 30, 60, and 90 days after filling of compost pit. It was determined by pH meter using 1:4 to 1:5 compost to water ratio (Jackson, 1973).

3.7.2 EC (dS/m)

The EC was estimated at 30, 60 and 90 days after filling of compost pit. It was determined by using supernatant liquid obtained from 1:4 to 1:5 compost to water suspensions on conductivity meter (Jackson, 1973).

3.7.3 Total organic carbon

The organic carbon was estimated at 30, 90 and 90 days of decomposition. Organic carbon was determined by modified method of Walkely and Black (1934).

3.7.4 Total Nitrogen

Total nitrogen of compost was determined by Kjeldahl method (Jackson, 1973)

3.7.5 Total Phosphorus

Total phosphorous of vermicompost was determined by vanadomolybdate phosphoric acid, yellow colour method using spectrophotometer (Jackson, 1973).

3.7.6 Total Potassium

It was determined by neutral normal ammonium acetate using flame photometer (Jackson, 1973).

3.7.7 C: N ratio

The extent of decomposition of organic substrate was determined by its CN ratio. Undecomposed substrates have wider C:N ratio and on decomposition the C: N ratio was reduced. With this view the over dried samples were analyzed for their organic carbon and nitrogen content by using ignition method (Jackson, 1973) and micro Kjeidahl method (Jackson, 1973) respectively.

C) BIOLOGICAL PROPERTIES

3.8. Microbial count

The compost samples from each pit were collected at 30, 60 and 90 days of composting and used for estimating fungi, bacteria and actinomycetes population using serial dilutions technique. The media were prepared and sterilized in autoclave. 1g compost sample were taken in 10 ml sterilized water in the test tube, stirred well and serial dilutions were made up to 10^{-8}.

3.8.1 Fungal count

The serially diluted supernatant (1ml) of 10^{-4} was taken with pipette and spread over into petri plate then poured the PDA medium. Check the growth or colony of fungus.

3.8.2 Bacterial count

The serially diluted supernatant (1ml) of 10^{-6} was taken with pipette and spread over into petri plate then poured the NA medium. Check the growth or colony of bacteria.

3.8.3 Actinomycetes count

The serially diluted supernatant (1ml) of 10^{-4} was taken with pipette and spread over into petri plate then poured the NA medium. Check the growth or colony of actinomycetes.

3.9 Statistical analysis

The experimental data collected during the course of investigation were statistically analyzed with factorial randomized block design programmed on computer by adopting standard statistical techniques of analysis of differences (CD) were worked out at 5 % level of probability for comparison of treatment means. The data on treatment effects are presented suitably in appropriate tables and graphically depicted in figures.

CHAPTER IV

RESULTS AND DISCUSSION

The summarized data of the result of field investigation in kharif season of year 2018-2019 entitled “Effect of different decomposing culture on quality of compost from weed biomass” along with statistical parameters of all main effects and important significant interactions are presented and discussed in this chapter. The investigational data have been arranged in the sequential order starting from initial temperature of compost to till the mature compost prepared. The finding during composting of weed biomass the activity of microorganisms play important role.

4.0 Studies on composting of weed biomass

4.1 Change in the temperature of compost during composting

Temperature is one of the most important environmental factor determining how rapidly natural material are metabolized. A great deal of exothermic energy is released during the oxidation of carbon dioxide. A change in temperature will alter the species composition of the active flora and at the same time have direct influence on microbial population. Composting may begin as soon as the raw materials are mix together with moisture. During the initial stage of the process, oxygen and the easily degradable components of the raw material are rapidly consumed by the microorganisms. The temperature of the compost pit or heap is directly related to the microorganisms activity and is a good indicator of what is going on inside.

A mark change in compost temperature was recorded during the period of experimentation as revealed from the data presented in Table 1. The readings of temperature were taken by digital thermometer in weekly interval up to optimum decomposition i.e. up to 90 DAF of compost pit. Temperature was varied across the decomposition process.

Table 1. Change in temperature (°C) during composting process as influenced by different treatment

Treatments	Temperature (°C) Weeks after filling												
	1	2	3	4	5	6	7	8	9	10	11	12	13
W_1C_1 - *Cassia tora* + S9	41.1	42.5	44.3	43.6	41.2	38.8	36.6	35.1	34.4	33.2	32.1	30.9	29.4
W_1C_2 - *Cassia tora* + PDKV	42.4	43.2	44.8	44.2	42.5	40.4	38.4	36.6	35.8	34.2	33.7	31.6	30.6
W_1C_3 - *Cassia tora* + WC	40.2	41.4	43.2	42.4	40.8	38.8	36.2	34.4	32.8	32.1	31.5	30.2	28.8
W_2C_1 - *Sorghum helepense* + S9	41.8	43.2	44.8	43.7	41.6	40.2	38.4	36.6	34.8	34.2	32.6	31.2	29.8
W_2C_2 - *Sorghum helepense* + PDKV	42.8	43.6	45.1	44.6	42.8	40.6	39.1	38.2	36.1	34.8	34.2	32.4	31.1
W_2C_3 - *Sorghum helepense* + WC	40.6	42.1	43.8	43.1	41.2	39.4	38.1	36.2	34.4	32.8	31.8	30.8	29.4
W_3C_1 - Mix weed + S9	42.4	44.2	45.4	44.6	42.2	41.1	38.8	37.2	36.4	34.8	33.4	32.2	30.8
W_3C_2 - Mix weed + PDKV	42.8	44.6	45.6	44.8	43.6	42.4	40.4	39.1	38.2	36.4	34.1	33.6	31.8
W_3C_3 - Mix weed + WC	41.1	42.6	44.2	43.6	42.5	40.4	38.8	36.8	35.2	34.8	32.6	31.4	30.1
W_4C_1 - *Parthenium hysterophorus* + S9	44.4	45.8	46.4	45.1	44.4	42.8	42.6	40.8	39.6	38.4	36.6	35.2	33.8
W_4C_2 - *Parthenium hysterophorus* + PDKV	45.2	46.4	47.2	46.4	45.6	44.2	43.1	41.6	40.8	40.1	39.2	36.4	35.2
W_4C_3 - *Parthenium hysterophorus* + WC	43.2	44.8	46.6	44.8	44.1	42.6	40.8	38.8	38.2	36.1	33.8	32.6	33.2

It is noteworthy that, *Parthenium hysterophorus* compost pit showed high temperature than other weed biomass compost pit during span of decomposition.

It is evident from the table 1 that during the year 2018- 2019, in *Parthenium hysterophorus* compost pit, higher temperature was noticed followed by Mix weeds, *Sorghum helepense* and *Cassia tora* compost pit throughout composting period. Increase in temperature was observed from just 7^{th} DAF with an average of about 44.26°C in *Parthenium hysterophorus* , 41.23°C in *Cassia tora*, 42.1°C in Mix weed and 41.73°C in *Sorghum helepense* compost pit at 30 cm depth. During second week after filing of compost pit, higher hike in temperature was recorded in *Parthenium hysterophorus* compost (47.2°C) than other weeds when treated with PDKV decomposing culture. S9 decomposing culture recorded lesser increase in temperature as compared to PDKV culture in all weed biomass. However, compost pit without decomposing culture were recorded lower increase in temperature in all weed biomass. Then it was started decline up to 30 DAF.

The active composting temperature slows down with time and gradually drops to ambient air temperature. Accruing period usually follows the active composting period. In these phase, the materials would continue to decompose slowly and continue to breakdown the last easily decompose form i.e. humus. Whatever raw materials are undigested, consumed by the remaining microorganisms at this point, the compost becomes relatively stable and easy to handle.

A short mesophilic phase was followed by a relatively long thermophiles phase indicating the quick establishment of microbial activities in the composting process. The microorganisms consumed the soluble organic matter and ambient nutrients and then underwent aerobic degradation to generate heat, biomass and carbon dioxides. The evolution of temperature revealed a usual thermal effect accompanying organic matter biodegradation as was explained by Mustin (1987). Acharya (1939) stated that the raise of temperature is proportional to the amount of decomposable organic matter present. The maximum temperature (65-70

°C) was usually reached in about 3-5 DAF which the temperature slowly fell.

4.2 Changes in weight (kg)

During composting of crop residues, weed biomass, urban waste, manure, the activity of microorganisms plays important role. This is very natural process occurred in heaps of bio-degradable organic matter. The activity of microorganisms in decomposition can be visibly observed by loss in volume and weight of organic matter. It is mainly depends on the Loss of cellulose during decomposition.

Table 2. Change in weight of compost during decomposition process

Treatment	Change in weight			
	Initial (kg)	Final (kg)	Reduction in wt. (kg)	Reduction in wt. (%)
A) Source of compost (weed biomass)				
W1- *Cassia tora*	60	30.87	29.13	48.55
W2- *Sorghum helepense*	60	27.31	32.69	54.48
W3- Mix weeds	60	28.02	31.8	53.00
W4-*Parthenium hysterophorus*	60	29.00	31	51.66
SE (m) ±		0.71		
CD at 5%		**2.09**		
B) Decomposing culture				
C1- S9 culture	60	28.90	31.10	51.83
C2- PDKV culture	60	27.20	32.80	54.66
C3- Without culture	60	30.30	29.70	49.50
SE (m) ±		0.62		
CD at 5%		**1.81**		
Interaction A x B				
SE (m) ±		1.23		
CD at 5%		**NS**		
GM		28.8	31.17	51.95

During present investigation, the changes in weight were measured at the time of filling the compost pit and after maturation. The

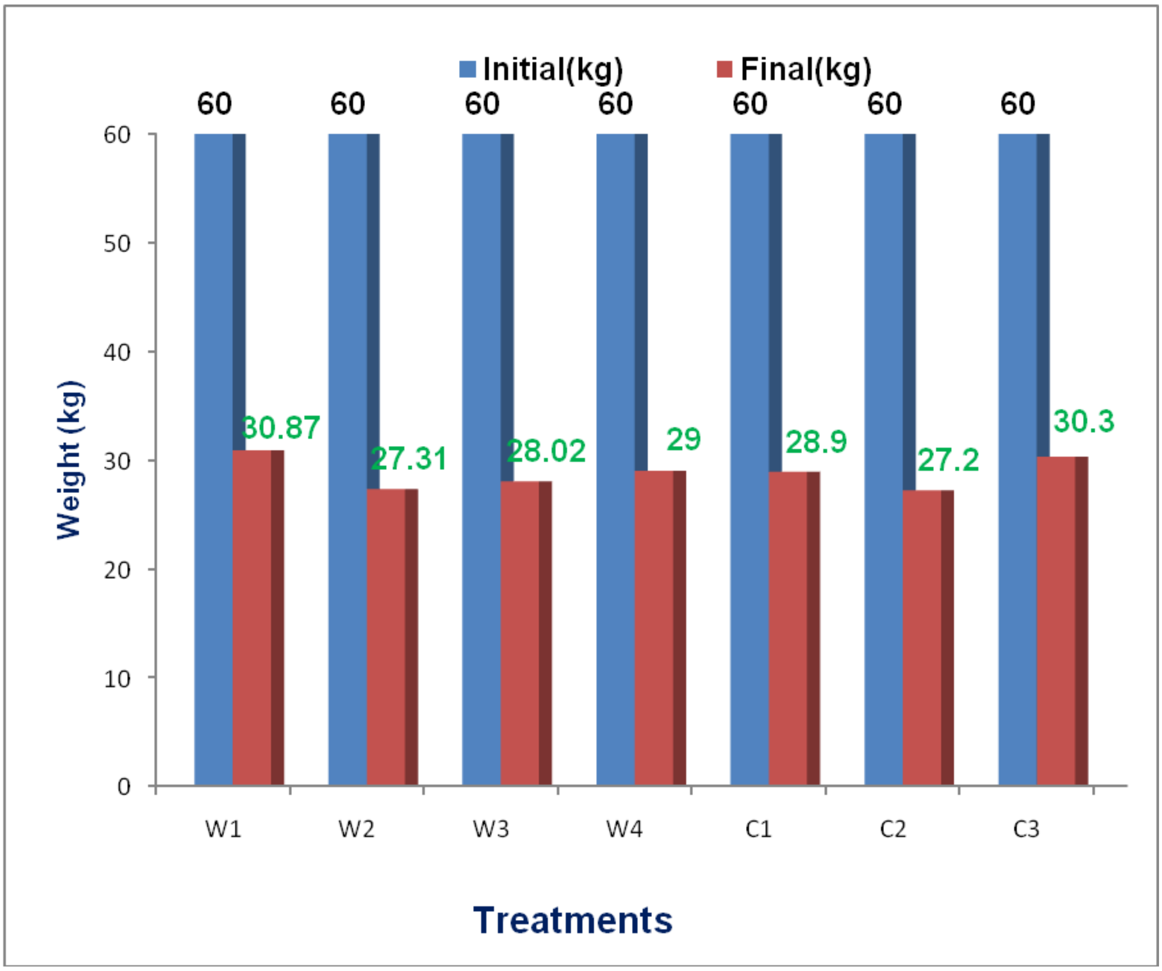


Fig. 2 Change in weight of compost during decomposition process

W1 – Cassia tora
W2 – Sorghum helepense
W3 – Mix weeds
W4 – Parthenium hysterophorus

C1 – S9 culture
C2 – PDKV culture
C3 – Without culture

observed values are presented in Table 2 and illustrated in Fig. 2. The initial weights of filled *Cassia tora*, *Sorghum helepense*, Mix weed and *Parthenium hysterophorus* compost pit material were 60 kg respectively.

4.2.1 Source of compost

The data presented in Table 2 and depicted in Fig. 2. revealed that *Sorghum helepense* weed biomass indicated statistically higher reduction of about 32.69 kg over initial weight added in compost pit of 60 kg at start of filling of compost pit. However, *Cassia tora* recorded less reduction in weight of about 29.13 kg. Mix weed recorded reduction in weight of about 31.80 kg and *Parthenium hysterophorus* recorded reduction in weight of about 31 kg over initial weight of material added in compost pit of 60 kg. The reduction of weight in compost made from *Sorghum helepense* was significantly higher than other weeds. Attayee *et al.* (2017) reported that recovery yield of compost obtained from *Parthenium* + cow dung (3:1) was 52.2% .

4.2.2 Decomposing culture

Decomposing cultures were recorded significant difference in reduction weight of compost material during composting period. Among the three decomposing culture PDKV decomposing culture recorded significantly higher reduction in weight about 32.80 kg during decomposition span followed by S9 decomposing culture and without culture. These cultures were found less efficient than PDKV decomposing culture. However, all these two decomposing cultures were found significantly effective over compost pit without microbial culture.

It indicated that decomposition rate of PDKV decomposing culture was significantly higher than other decomposing culture used in experiment. The reduction in the weight of weed biomass added in compost pit or heap due to active microbial population digest carbohydrates and two-thirds of the carbon is respired and the remaining one third combined with nitrogen in the living cells. Similar result were in agreement with findings by Anonymous (1977), Pande (1978), Somani *et al.* (1982), Potdukhe (1990), Gouri Kakad (2005) and Terdal (2005).

4.2.3 Interaction effect

Interaction effect regarding change in weight (kg) between sources of compost application and decomposing cultures were not found significant.

4.3 Changes in volume (m^3)

Any weed biomass has more volume because of complex cell structure, sponginess and vacuoles in cell. Vegetative part to be used in composting methodology should be small in size and chopped to enhance the decomposition process with help of moisture, cow dung, soil and decomposing inoculums. It creates congenial humid environment proliferate fungal and bacterial population in the substrate. These active microbial populations digest carbohydrates and two-thirds of the carbon is respired or evolved as CO_2 and the remaining one third combined with nitrogen in the living cells. These causes decrease in volume filled with weed biomass along with decomposing cultures and growth mediums. Initially it was at lower rate and then increases with time and decomposition complex material in to simpler form i.e. breakdown of cellulose, hemicellulose and lignin content of weed biomass.

During present experimentation, the changes in compost volume were measured at the time of filling of compost pit and after its maturation. The observed values are presented in Table 3 and depicted in Fig 3. The initial volume of compost was 0.15 m^3.

4.3.1 Source of compost

Type of weed biomass used, size, C:N ratio and moisture during composting process determines the rate of change of volume of compost material in the pit. The data presented in Table 3 and depicted in Fig. 3 revealed that *Sorghum helepense* indicated statistically higher reduction in volume of about 0.08 m^3 over initial volume added in compost pit of 0.15 m^3 at start of filling of compost pit. However, *Cassia tora* recorded less reduction in volume of about 0.073 m^3 over initial volume of material added in compost pit. Mix weed and *Parthenium hysterophorus* recorded reduction in volume of about 0.077 m^3 and 0.075 m^3 respectively. Most of the scientist reported about reduction in weight rather than reduction in volume. In fact, when there is reduction in weight of weed biomass also affects reduction in volume linearly.

Table 3. Change in compost volume (m^3) during decomposition process of weed biomass as influenced by different treatments

Treatment	Change in volume (m^3)			
	Initial (m^3)	Final (m^3)	Reduction in volume (m^3)	Reduction in volume (%)
A) Source of compost (weed biomass)				
W1- *Cassia tora*	0.15	0.077	0.073	48.66
W2- *Sorghum helepense*	0.15	0.070	0.08	53.33
W3- Mix weeds	0.15	0.073	0.077	51.33
W4-*Parthenium hysterophorus*	0.15	0.075	0.075	50
SE (m) ±		0.002		
CD at 5%		**0.005**		
B) Decomposing culture				
C1- S9 culture	0.15	0.073	0.077	51.33
C2- PDKV culture	0.15	0.070	0.08	53.33
C3- Without culture	0.15	0.077	0.073	48.66
SE (m) ±		0.001		
CD at 5%		**0.004**		
Interaction A x B				
SE (m) ±		0.003		
CD at 5%		**NS**		
GM		0.073	0.076	50.94

4.3.2 Decomposing culture

Decomposing cultures were recorded significant difference in reduction volume of compost material during composting period. Among the three decomposing culture, PDKV decomposing culture recorded significantly higher reduction in volume about 0.08 m^3 during decomposition process followed by S9 decomposing culture and without culture. S9 decomposing culture were found less efficient than PDKV decomposing culture but found significantly effective over compost pit without microbial culture. It indicated that decomposition rate with PDKV

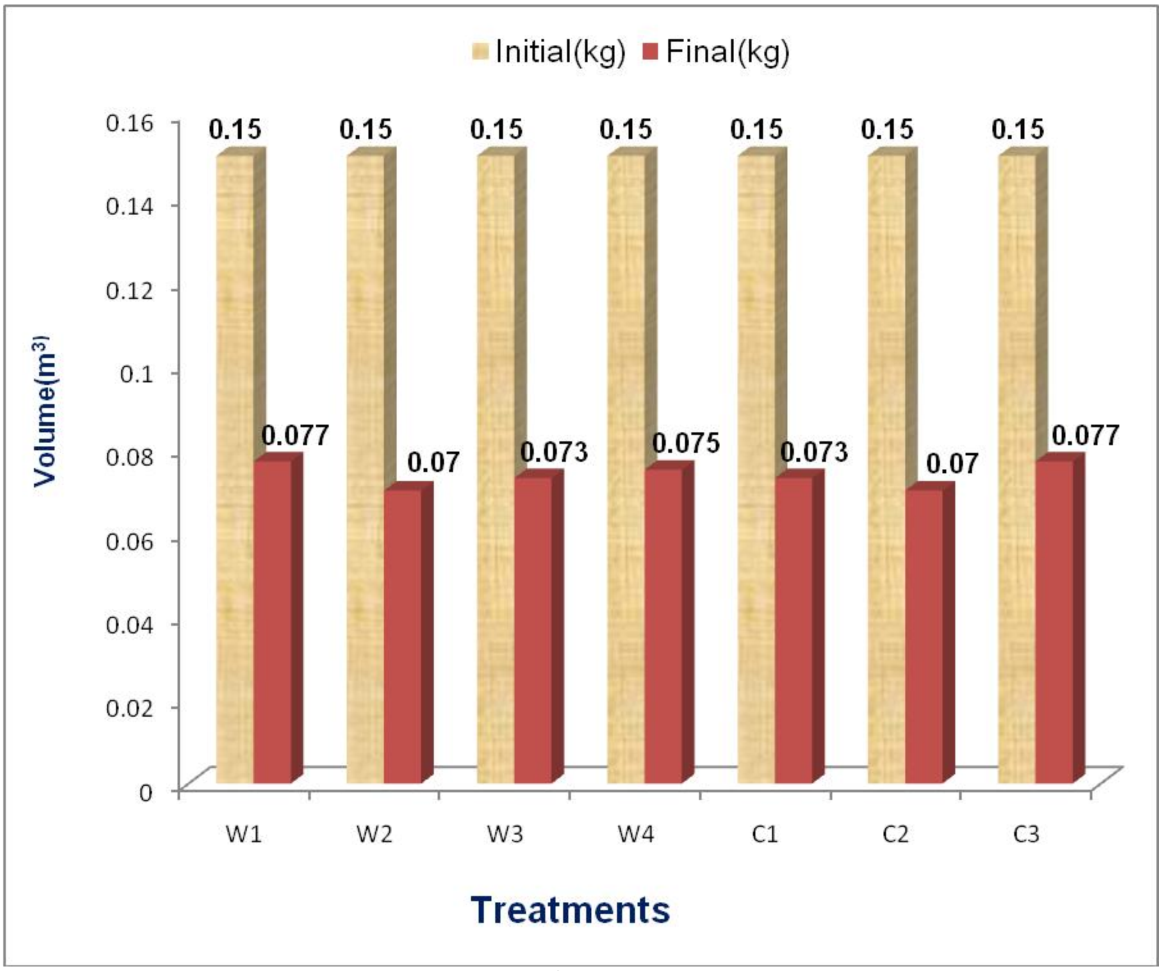


Fig.3 Change in compost volume (m^3) during decomposition process of weed biomass influenced by different treatments

W1 – Cassia tora
W2 – Sorghum helepense
W3 – Mix weeds
W4 – Parthenium hysterophorus

C1 – S9 culture
C2 – PDKV culture
C3 – Without culture

decomposing culture was significantly higher than other decomposing culture used in the experiment.

4.3.3 Interaction effect

Interaction between sources of compost i.e. weed biomass with decomposing cultures were found non-significant in terms of reduction in volume during decomposition.

4.4 Changes in pH of compost

pH influences rate of nutrient release through its influence on decomposition and solubility of materials. pH generally gives an approximate index of compost maturation (Dick *et al.* 1993). Active micro flora and fauna population depends on hydrogen ion concentration of the substrate under decomposition. pH greater than 7.5 favours soil borne pathogen proliferation. Availability of nutrient increases towards neutrality. During present investigation the changes in pH was recorded at 30 days interval after filling on compost pit. The observed values presented in Table 4.

4.4.1 Source of compost

In mix weed compost recorded higher pH followed by *Cassia tora, Parthenium hysterophorus* and *Sorghum helepense* compost during every observation. pH was increase continuously toward maturity. In mix weed compost found highest 7.92 and *Sorghum helepense* compost found lowest 7.38 pH at 90 DAF. pH found in *Cassia tora* and *parthenium hysterophorus* compost was 7.74 and 7.57 respectively at 90 DAF.

Microorganisms tend to modify their environment and the products of decomposition may alter pH over time (Nakasaki *et al.,* 2002). pH found in compost prepared from *Eichhornia crassipes* was 6.8 at maturity (Sasidharan *et al.* 2013). Kumar *et al.* (2012) reported that compost prepared from 1300 kg dung + 720 kg green cuttings of *Parthenium* + 1200 kg soil + 1800 lit. water was with pH 9.04 at maturity.

Table 4. Change in pH of compost during decomposition process as influenced by different treatments

Treatment	pH		
	30 DAF	**60 DAF**	**90 DAF**
A) Source of compost (weed biomass)			
W1- *Cassia tora*	7.21	7.31	7.74
W2- *Sorghum helepense*	6.70	6.84	7.38
W3- Mix weeds	7.38	7.58	7.92
W4-*Parthenium hysterophorus*	7.01	7.46	7.57
SE (m) ±	0.17	0.17	0.13
CD at 5%	**0.49**	**0.50**	**0.37**
B) Decomposing culture			
C1- S9 culture	7.06	7.38	7.71
C2- PDKV culture	7.44	7.69	7.83
C3- Without culture	6.73	6.83	7.43
SE (m) ±	0.14	0.15	0.11
CD at 5%	**0.42**	**0.43**	**0.32**
Interaction A x B			
SE (m) ±	0.29	0.30	0.22
CD at 5%	**NS**	**NS**	**NS**
GM	7.07	7.29	7.65

4.4.2 Decomposing culture

Among the three decomposing cultures, PDKV showed higher pH value during composting period of all weed biomass followed by S9 culture. PDKV culture treated pit recorded 7.44 pH at 30 DAF and slowly Increase towards 7.83 at the end of maturity i.e. 90 DAF followed by S9 culture (7.71). Compost without microbial inoculums recorded the lowest pH during composting trial which increased from 6.73 to 7.43. These results are in conformity with those reported by Gogai *et al*. (2013) observed the alkaline pH values are usually indicators of maturity of composts, since pH increases later stages of decomposition.

4.4.3 Interaction effect

Interaction differences between sources of compost with decomposition cultures were found non-significant on pH during decomposition process at all stages.

4.5 Changes in electrical conductivity (dS/m)

Electrical conductivity (EC) of substrate is defined as the reciprocal of the electrical resistance of the extract of the substrate. It is directly proportional to salt content of the material. Compost with lower EC and alkaline pH are important factor of compost maturity. During experimentation, EC value measured at every 30 days interval during compost period of the weed biomass used. The data recoded presented in Table 5.

Table 5. Changes in Electrical conductivity (dS/m) during composting as influenced by of sources and decomposing culture

Treatment	Electrical conductivity (dS/m)		
	30 DAF	**60 DAF**	**90 DAF**
A) Source of compost (weed biomass)			
W1- *Cassia tora*	0.94	1.12	1.11
W2- *Sorghum helepense*	1.03	1.14	1.21
W3- Mix weeds	0.93	1.02	1.10
W4-*Parthenium hysterophorus*	1.02	1.10	1.18
SE (m) ±	0.03	0.03	0.03
CD at 5%	**0.09**	**0.08**	**0.08**
B) Decomposing culture			
C1- S9 culture	0.94	1.09	1.12
C2- PDKV culture	0.93	1.04	1.10
C3- Without culture	1.07	1.15	1.20
SE (m) ±	0.03	0.02	0.02
CD at 5%	**0.08**	**0.07**	**0.07**
Interaction A x B			
SE (m) ±	0.05	0.05	0.05
CD at 5%	**NS**	**NS**	**NS**
GM	0.98	1.09	1.14

4.5.1 Source of compost

Mix weed compost recorded lower EC value than *Cassia tora*, *Sorghum helepense* and *Parthenium hysterophorus* compost at every reading. In Mix weed compost pit found lowest increased in EC from 0.93 to 1.10 dS/m. In *Sorghum helepense* compost pit found highest increased in EC from 1.03 to 1.21 dS/m. In *Cassia tora* and *Parthenium hysterophorus* compost pit EC increased from 0.94 to 1.11 dS/m and 1.02 to 1.18 dS/m. Initial lower EC of all compost were increased slowly during decomposition with increase in activity of microbes turned into matured compost. EC found in compost prepared from *Eichhornia crassipes* was 0.02 dS/m at maturity (Sasidharan *et al.* 2013).The data recoded presented in Table 5.

4.5.2 Decomposing culture

Among the three decomposing cultures PDKV culture noted significantly lowest EC from initial 0.93 dS/m to final 1.10 dS/m followed by S9 culture (0.94 dS/m to 1.12 dS/m). Whereas, without cultured pits recorded statistically higher EC value from initial 1.07 to final 1.20 dS/m. There was increase in EC but not beyond critical level i.e. < 1.5 dS/m in mature compost. Rashad *et al*. (2010) reported that reduction in EC values during incubation might be attributed to the reduction water soluble substances and the vitalisation of NH_3 as well as precipitation of mineral salts during the biodegradation process which lowers the EC value < 1.5 dS/m in mature compost. Whereas, Gogai *et al.* (2013), observed the lowest value of 3.57 dS/m in the treatment (Azatobacter + PSB). Kumar *et al.* (2012) reported that compost prepared from 1300 kg dung + 720 kg green cuttings of *Parthenium* + 1200 kg soil + 1800 lit. water was with EC 0.48 dS/m at maturity.

4.5.3 Interaction effect

Interaction differences between sources of compost with decomposition cultures were found non-significant on EC (dS/m) during decomposition process at all stages.

4.6 Changes in total C, total N and C:N ratio during composting

4.6.1 Total carbon content (%)

Atmospheric carbon converted in to cellulose, hemicellulose and lignin by the plant through photosynthesis process. This converted carbon becomes a complex material which can be decomposed by the microorganism's inoculum. Carbon content in weed biomass serves as source and cell protoplasm for microbial population build up about 2/3 of carbon respired / evolved as CO_2 and remaining one-third is combined with nitrogen in the microbe's cells. Increase in the reduction of carbon content was due to the increase in the microbial activities during decomposition.

Table 6. Changes in carbon content (%) during composting as influenced by sources of compost and decomposing culture

Treatment	Total carbon content (%)		
	30 DAF	**60 DAF**	**90 DAF**
A) Source of compost (weed biomass)			
W1- *Cassia tora*	37.06	36.43	22.42
W2- *Sorghum helepense*	40.40	36.40	26.43
W3- Mix weeds	36.40	33.93	20.58
W4-*Parthenium hysterophorus*	40.02	38.27	25.93
SE (m) ±	1.09	0.93	0.79
CD at 5%	**3.20**	**2.74**	**2.32**
B) Decomposing culture			
C1- S9 culture	38.72	35.58	24.32
C2- PDKV culture	36.40	34.80	20.91
C3- Without culture	40.29	38.39	26.30
SE (m) ±	0.94	0.81	0.69
CD at 5%	**2.77**	**2.37**	**2.01**
Interaction A x B			
SE (m) ±	1.89	1.62	1.37
CD at 5%	**NS**	**NS**	**NS**
GM	38.47	36.25	23.84

During experimentation, it was observed that Initial values of total carbon were measured at the time of filing the compost pit and at 30 DAF up to maturation and the observed values are presented in table 6

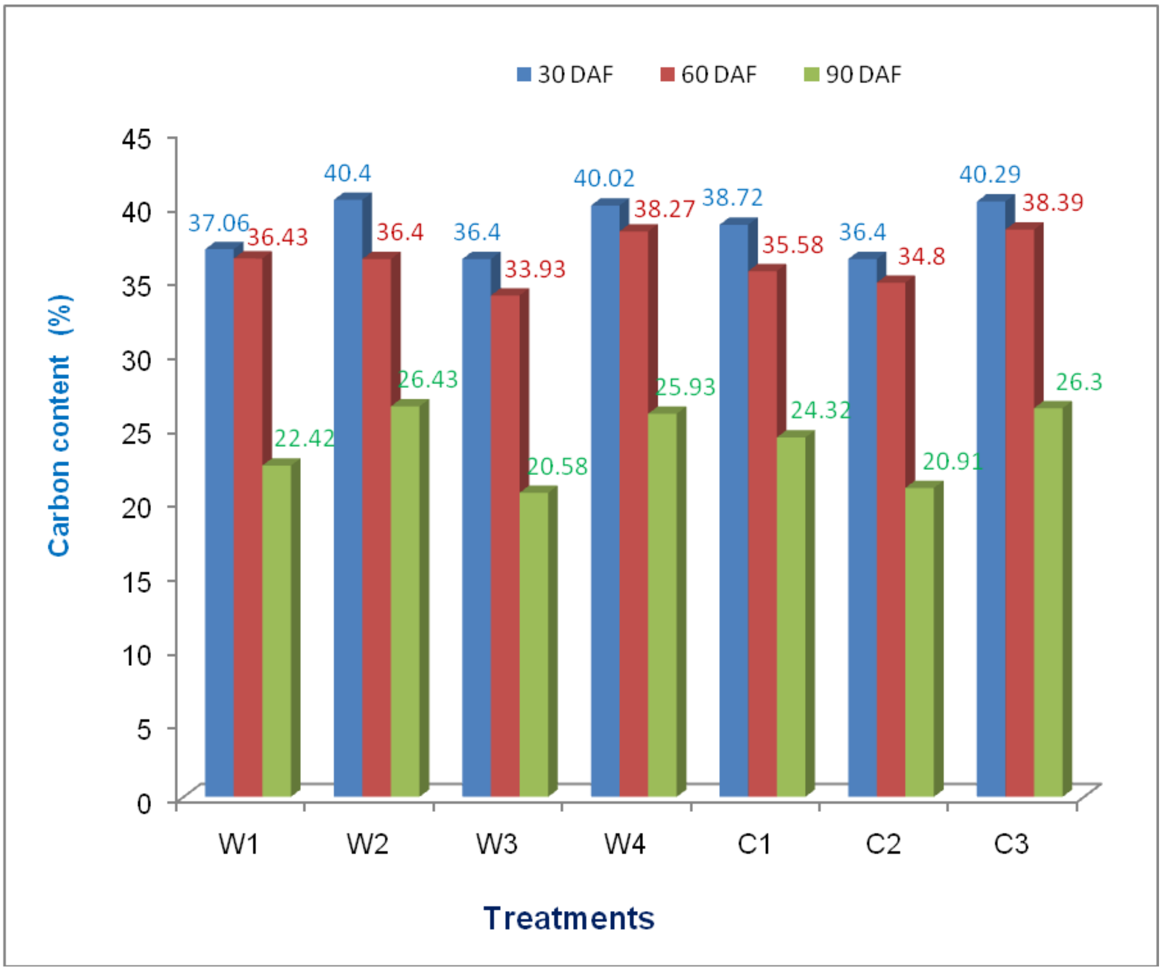


Fig. 4 Changes in carbon content (%) during composting as influenced by sources of compost and decomposing culture

W1 – Cassia tora
W2 – Sorghum helepense
W3 – Mix weeds
W4 – Parthenium hysterophorus

C1 – S9 culture
C2 – PDKV culture
C3 – Without culture

and illustrate in Fig.4. The average initial value of total carbon (%) was found 44.3 per cent and reduced up to 23.84 per cent.

4.6.1.1 Source of compost

During composting period, there was noteworthy reduction in total carbon content of matured compost which statistically significant differences among the treatment out of four weed biomass higher reduction in total carbon per cent was recoded in mix weed compost with initial value of 48.8 per cent and decreases up to 20.58 per cent at 90 DAF. Lowest reduction in total carbon per cent was recorded in *Sorghum helepense* compost with initial value of 40.2 per cent and decreases up to 26.43 per cent at 90 DAF. *Cassia tora* compost also recorded reduction in total carbon content to about 22.42 per cent at 90 DAF from initial total carbon content of about 41.6 per cent and *Parthenium* hysterophorus compost recorded reduction in total carbon content to about 25.93 per cent at 90 DAF from initial total carbon content is about 46.6 per cent. The total carbon found in compost prepared from *Eichhornia crassipes* was 41.4% at maturity (Sasidharan *et al*. 2013).

4.6.1.2 Decomposing culture

Decomposing cultures were recorded significant differences in decrease of total carbon content of compost material during decomposition period. Among the three decomposing cultures PDKV decomposing culture recorded significantly higher decrease in total carbon content to about 20.91 per cent at 90 DAF from initial value during experimentation followed by S9 culture. The compost pit without culture showed lesser reduction per cent in total carbon of composted crop residues during duration of composting and required more time to mature. All cultured pits where found significantly superior over without microbial cultured compost pit.

4.6.1.3 Interaction

Interaction effect regarding total carbon content between sources of compost application and decomposing cultures were not found significant.

4.6.2 Total Nitrogen content (%)

Next to carbon, nitrogen forms one of the important constituents of plant and animal requirement. It is normally found in cells in the form of organic molecules, especially proteins. A part is hydrolyzed amino acids and is used by microorganisms and the rest is determined to yield ammonia and CO_2 which is releases through respiration. Initially, before the start of composting, the total nitrogen was tested with chemical analysis. The changes in the nitrogen content was measured at the time of filing the compost pit and after maturation and observed values are presented in Table 7. The average initial value of total nitrogen (%) was found as 1.49 per cent and decrease up to 1.29 per cent by weight after decomposition.

Table 7. Changes in nitrogen content (%) during composting as Influenced by sources of compost and decomposing culture

Treatment	Nitrogen (%)	
	Initial	Final
A) Source of compost (weed biomass)		
W1- *Cassia tora*	1.58	1.32
W2- *Sorghum helepense*	1.08	1.23
W3- Mix weeds	1.42	1.36
W4-*Parthenium hysterophorus*	1.88	1.28
SE (m) ±		0.03
CD at 5%		**0.09**
B) Decomposing culture		
C1- S9 culture	-	1.28
C2- PDKV culture	-	1.35
C3- Without culture	-	1.25
SE (m) ±		0.03
CD at 5%		**0.08**
Interaction A x B		
SE (m) ±		0.05
CD at 5%		**NS**
GM		1.29

4.6.2.1 Source of compost

The data presented in table 7 revealed that final compost showed significant differences among source of compost. The compost derived from mix weed at 90 DAF recorded statistically higher nitrogen content of 1.36 % followed by *Cassia tora* with 1.32 %, *Parthenium hysterophorus* with 1.28 %. The compost derived from *Sorghum helepense* at 90 DAF recorded statistically lower nitrogen content of 1.23 %. The nitrogen content found in compost prepared from *Eichhornia crassipes* was 2.9% at maturity (Sasidharan *et al*. 2013). . Attayee *et al.* (2017) reported that total nitrogen content of compost obtained from *Parthenium* + cow dung 3:1 was 1.54% . Kumar *et al.* (2012) reported that compost prepared from 1300 kg dung + 720 kg green cuttings of *Parthenium* + 1200 kg soil + 1800 lit. water was with nitrogen content 2.37% at maturity.

4.6.2.2 Decomposing culture

Decomposing cultures noted nitrogen content with significant differences among themselves. PDKV culture recorded significantly higher in total nitrogen to about 1.35 per cent during decomposition followed by S9 cultures. Without culture found lower in nitrogen content than PDKV and S9 culture. However all these two decomposing cultures were found significantly effective over without decomposing cultures in compost pit. Similar records of availability of nitrogen were stated by Nallathambi and Marimuthu (1993), Bharne *et al.* (2003), Raut *et al.* (2003) and Rao (2007).

4.7.2.3 Interaction effect

Interaction effect regarding total nitrogen content between sources of compost application and decomposing cultures were not found significant.

4.6.3 Changes in C: N ratio

The carbon-nitrogen ratio of organic matter is the most important aspect of composting. The process of conversion of organic materials in mature compost is chiefly microbiological and influenced by the proportions carbonaceous and nitrogenous constituents. Microorganisms need carbon for growth and nitrogen for protein synthesis. Most of the evident that C: N ratio of 30:1 of raw materials could be most desirable for efficient composting. Wide C: N ratio i.e. beyond 40:1 diminishes the biological activity. Which are required to degrade carbonaceous materials and prolonged period of composting. Composting process can be accelerated if raw material is shredded in to smaller pieces to exposure of greater surface area and also mix with microbial inoculation.

Table 8. Changes in C:N ratio during decomposition

Treatment	Days to maturity (DAF)	C:N Ratio	
		Initial	Final (90 DAF)
A) Source of compost (weed biomass)			
W1- *Cassia tora*	110	26.3:1	16.98 : 1
W2- *Sorghum helepense*	90	37.2:1	19.88 : 1
W3- Mix weeds	95	34.3:1	15.13 : 1
W4-*Parthenium hysterophorus*	105	24.7:1	19.25 : 1
B) Decomposing culture			
C1- S9 culture		-	18.45 : 1
C2- PDKV culture		-	15.48 : 1
C3- Without culture		-	19.65 : 1
GM			17.83 : 1

4.6.3.1 Source of compost

The data from Table 8 clearly indicated that reduction in Carbon: Nitrogen ratio (C:N ratio) of matured compost, recorded noticeable decrease from initial stage with different treatment. Out of four weed biomass highest reduction in C:N ratio was recorded with mix weed compost. Initial C:N ratio of mix weed were 34.3:1 which reduced after decomposition process to 15.13:1. Lowest reduction in C:N ratio was recorded with *Parthenium hysterophorus* from 24.7:1 to 19.25:1. *Cassia* *tora* and *Sorghum helepense* recorded 16.98:1 and 19.88:1 C:N ratio at 90 DAF. Gotass (1956) stated that decomposition of organic matter is affected by carbon and nitrogen ratio whereas Golueke (1977) reported that excessively higher C:N ratio resulted in to slower decomposition rate than optimum C:N ratio. The C:N ratio found in compost prepared from *Eichhornia crassipes* was 14.2 at maturity (Sasidharan *et al*. 2013).

4.6.3.2 Decomposing culture

Decomposing cultures were recorded decrease of total C:N ratio of compost material during composting period. Among the three decomposing culture PDKV decomposing culture recorded significantly higher decrease in total C:N ratio to about 15.48:1 followed S9 decomposing culture. The inoculated compost pit with decomposing culture was superior over compost pit without culture. Somani *et al*. (1982) reported that the decomposition is faster when C:N to of substrate is lower. Similar observation were reported Pande (1978), Yadav and Subbarao (1977), Bhasme *et al*. (2006) and Jeyapriya and Shaseetharan (2007).

4.7 Chemical studies of compost

4.7.1 Total Nitrogen content (%)

Next to carbon, nitrogen forms one of the important constituents of plant and animal requirement. It is normally found in cells in the form of organic molecules, especially proteins. A part is hydrolyzed amino acids and is used by microorganisms and the rest is delaminated to yield ammonia and CO_2 which is releases through respiration. Initially, before the start of composting, the total nitrogen was tested with chemical analysis. The changes in the nitrogen content was measured at the time of filling the compost pit and after maturation and observed values are presented in Table 7. The average initial value of total nitrogen (%) was found as 1.49 and decrease up to 1.29 percent by weight after decomposition.

4.7.1.1 Source of compost

The data presented in table 7 revealed that final compost showed significant differences among source of compost. The compost derived from mix weed at 90 DAF recorded statistically higher nitrogen content of 1.36 % followed by *Cassia tora* with 1.32 %, *Parthenium hysterophorus* with 1.28 % and *Sorghum helepense* with 1.23 % nitrogen. Attayee *et al.* (2017) reported that total nitrogen content of compost obtained from *Parthenium* + cow dung 3:1 was 1.54%. Kumar *et al.* (2012) reported that compost prepared from 1300 kg dung + 720 kg green cuttings of *Parthenium* + 1200 kg soil + 1800 lit. water was with nitrogen content 2.37% at maturity.

4.7.1.2 Decomposing culture

Decomposing cultures noted nitrogen content with significant differences among themselves. PDKV culture recorded significantly higher in total nitrogen to about 1.35 per cent during decomposition followed by S9 cultures. Without culture found lower in nitrogen content than PDKV and S9 culture. However all these two decomposing cultures were found significantly effective over without decomposing cultures in compost pit. Similar records of availability of nitrogen were stated by Nallathambi and Marimuthu (1993),), Bharne *et al.* (2003), Raut *et al.* (2003) and Rao (2007).

4.7.1.3 Interaction effect

Interaction effect regarding total nitrogen content between sources of compost application and decomposing cultures were not found significant.

4.7.2 Total Phosphorus content (%)

Phosphorus is essential for all life which is present in phospholipids, nuclic acid and ATP. The phosphorus requirement by living organism is much smaller in comparison to carbon and nitrogen. Most of the quantity of phosphorus released after the death of microorganisms.

Table 9. Changes in phosphorus (%) during composting as influenced by sources of compost and decomposing culture

Treatment	Phosphorus (%)	
	Initial	Final
A) Source of compost (weed biomass)		
W1- Cassia tora	0.36	0.60
W2- *Sorghum helepense*	0.28	0.58
W3- Mix weeds	0.42	0.65
W4-*Parthenium hysterophorus*	0.34	0.61
SE (m) ±		0.02
CD at 5%		**0.05**
B) Decomposing culture		
C1- S9 culture	-	0.61
C2- PDKV culture	-	0.65
C3- Without culture	-	0.58
SE (m) ±		0.02
CD at 5%		**0.04**
Interaction A x B		
SE (m) ±		0.03
CD at 5%		**NS**
GM		0.61

The changes in total phosphorus content at the time of filling of the compost pit and maturation and observed values are presented in Table 9. The mean values of total phosphorus (%) were found 0.35 % before decomposition and increases up to 0.61 % in all compost.

4.7.2.1 Source of compost

There was improvement in total phosphorus content of mature compost. Out of four compost sources statistically highest total phosphorus was recorded with mix weed compost 0.65 per cent after decomposition from initial of 0.42 per cent total phosphorus. *Sorghum helepense* compost recorded lowest total phosphorus with 0.58 per cent after decomposition from initial of 0.28 per cent. *Cassia tora* and *Parthenium hysterophorus* recorded increase in total phosphorus content at maturity with 0.60 per cent and 0.61 percent respectively. The phosphorus content found in compost prepared from *Eichhornia crassipes* was 2.72% at maturity (Sasidharan *et al*. 2013). Attayee *et al.* (2017) reported that total phosphorus content of compost obtained from *Parthenium* + cow dung 3:1 was 1.18 %. Kumar *et al.* (2012) reported that compost prepared from 1300 kg dung + 720 kg green cuttings of *Parthenium* + 1200 kg soil + 1800 lit. water was with phosphorus content 0.53% at maturity.

4.7.2.2 Decomposing culture

Decomposing cultures noted significant increase in phosphorus content after decomposition which shows significant difference among the treatments. Among the three decomposing culture, PDKV culture recorded significantly higher phosphorus content to about 0.65 per cent after decomposition followed by S9 culture. However all these two decomposing cultures were found significantly effective over without decomposing cultures in compost pit.

4.7.2.3 Interaction effect

Interaction effect regarding total phosphorus content between sources of compost application and decomposing cultures were not found significant.

4.7.3 Total Potash content (%)

The effect of source compost material decomposing culture, mean increase in organic potash was rested at 0.56 per cent from 0.44 per cent at the end of experimentation. These build up in potash place at Table 10.

Table 10. Changes in potash (%) during composting as influenced by source of compost and decomposing culture

Treatment	Potassium (%)	
	Initial	Final
A) Source of compost (weed biomass)		
W1- *Cassia tora*	0.44	0.57
W2- *Sorghum helepense*	0.36	0.53
W3- Mix weeds	0.52	0.59
W4-*Parthenium hysterophorus*	0.44	0.55
SE (m) ±		0.01
CD at 5%		**0.04**
B) Decomposing culture		
C1- S9 culture	-	0.55
C2- PDKV culture	-	0.59
C3- Without culture	-	0.54
SE (m) ±		0.01
CD at 5%		**0.04**
Interaction A x B		
SE (m) ±		0.02
CD at 5%		**NS**
GM		0.56

4.7.3.1 Source of composting

Data concerned to total potash content statistical significant differentiation was recorded among organic sources. During weed biomass decomposition, among these four weed biomass statistically highest improvement in total potash content was observed in mix weed compost with 0.59 per cent from initial 0.52 per cent. *Sorghum helepense* compost recorded lowest improvement in total potash per cent with 0.53 per cent from initial 0.36 per cent. *Cassia tora* and *Parthenium hysterophorus* recorded increase in total potash at 90 DAF with 0.57 and 0.55 respectively. The potassium content found in compost prepared from *Eichhornia crassipes* was 1.4% at maturity (Sasidharan *et al*. 2013). Attayee *et al.* (2017) reported that total potassium content of compost obtained from *Parthenium* + cow dung 3:1 was 1.72 %. Kumar *et al.* (2012) reported that compost prepared from 1300 kg dung + 720 kg green cuttings of *Parthenium* + 1200 kg soil + 1800 lit. water was with potassium content 1.79% at maturity.

4.7.3.2 Decomposing culture

Decomposing culture were showed significant difference in total potash content of compost. After comparison among the cultures, PDKV culture recorded significantly higher increase in total potash content with 0.59 per cent followed by S9 culture and without culture.

4.7.3.3 Interaction

Interaction effect regarding total potash content between sources of application and decomposing cultures were not found significant.

4.8 Microbial studies during decomposition

Microbial communities in compost under different weed biomass and composting method offer an important opportunity for exploring the availability of nutrients and decomposition rate. Present study has showed that the impact caused by composts on microbial population seems equally relevant to the effect of different microbial cultures. The moisture content in the pit was maintained between 60 to 70 per cent on dry weight basis. The observation recorded from the compost samples that were taken from the depth of 30 cm at 30 days intervals from filling of compost pit.

4.8.1 Bacterial dynamics during composting

Bacteria bring about a number of changes and biochemical transformations in the compost and thereby directly or indirectly help in the nutrition enrichment of raw weed biomass. The important transformations and process in which bacteria play vital role are decomposition of cellulose, hemicelluloses and other carbohydrates, ammonification, nitrification, denitrification, oxidation and reduction of sulphur and iron compounds. The bacterial count recorded with various treatment was presented in Table 11 and graphically represented in Fig. 5.

Table 11. Bacteria count as influenced by different treatment during decomposition of weed biomass

Treatment	Bacteria (cfu x 10^6 g^{-1})		
	30 DAF	**60 DAF**	**90 DAF**
A) Source of compost (weed biomass)			
W1- *Cassia tora*	28	51	62
W2- *Sorghum helepense*	26	47	57
W3- Mix weeds	30	55	66
W4-*Parthenium hysterophorus*	29	50	59
B) Decomposing culture			
C1- S9 culture	28	52	62
C2- PDKV culture	32	54	64
C3- Without culture	25	47	57
GM	28.28	50.85	61

4.8.1.1 Source of compost

Data concerned to bacterial count significant differentiation was evident among organic sources of *Cassia tora*, *Sorghum helepense*, Mix weed and *Parthenium hysterophorus* compost during the compost experimentation. Bacterial population increased significantly throughout the decomposition process of weed biomass. Bacterial population again showed two times increase in population count at 60 DAF in all weed biomass. Mix weed compost recorded statistically highest bacterial count 66 x 10^6 cfu g^{-1} at 90 DAF whereas *Cassia tora* compost also recorded increase in bacterial count 62 x 10^6 cfu g^{-1} at 90 DAF and *Parthenium hysterophorus* compost recorded increase in bacteria count 59 x 10^6 cfu g^{-1} at 90 DAF. Sorghum helepense compost recorded lowest increase in bacterial count 57 x 10^6 cfu g^{-1} at 90 DAF.

The data clearly indicated that in mix weed compost observed higher activity of bacteria earlier than other weed compost might be due to the smaller size of weed biomass and lower C.N ratio. Towards neutrality population count of bacteria population increase profoundly which is the indicator of maturation of compost. Such phenomenon was recorded in their studies by Gaur *et al*. (1971) reported the increased trend of

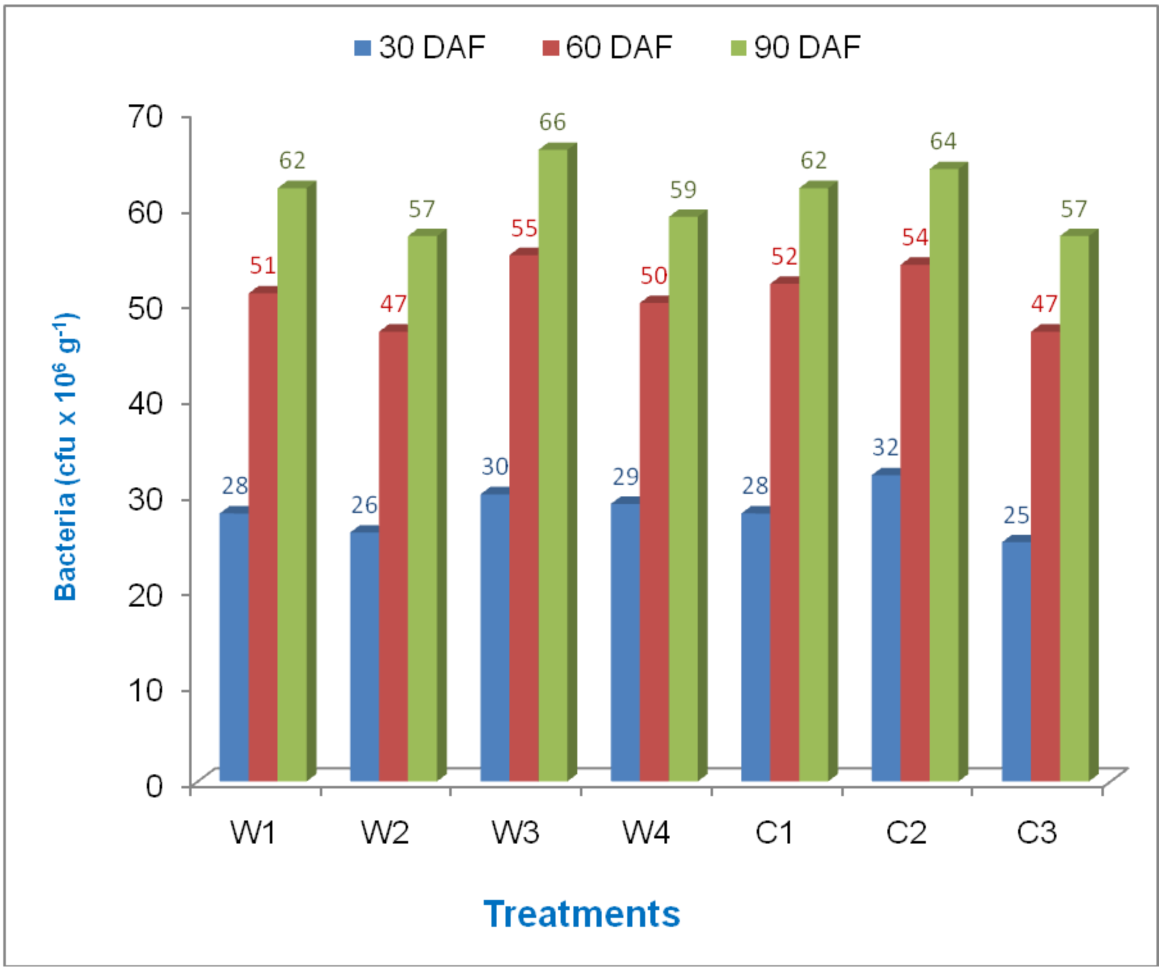


Fig. 5. Bacterial count as influenced by different treatment during decomposition of weed biomass

W1 – Cassia tora
W2 – Sorghum helepense
W3 – Mix weeds
W4 – Parthenium hysterophorus

C1 – S9 culture
C2 – PDKV culture
C3 – Without culture

bacterial population. Similar result was reported by Gaur and Mukherjee (1980), Niranjane *et al.* (1993), Juma and McGill (1998) and Goyal *et al.* (2005).

4.8.1.2 Decomposing culture

All decomposing cultures were recorded significant differences in increasing of bacterial count during decomposition period. Among the three decomposing cultures, PDKV decomposing culture recorded significantly higher increase in bacterial count around 64 x 10^6 cfu g^{-1} at 90 DAF followed by S9 culture and without microbial culture.

4.8.1.3 Interaction effect

Interaction effect regarding bacterial population was not recorded significant result between source of compost and decomposing culture.

4.8.2 Fungal dynamics during composting

Fungi perform important services related to nutrient recycling and disease suppression. The fungus plays important role in transformation cellulose, hemicelluloses and other carbohydrates during decomposition. Fungus helps in recycling nitrogen and phosphorus from complex material of weed biomass. Due to their smaller size and much greater area, fungus can efficiently scavenge N and P with better nutrient extraction efficiency. The data in respect of fungal count recorded during experimentation is placed at Table 12 and represented graphically in Fig. 6.

Table 12. Fungal count as influenced by different treatment during decomposition of weed biomass

Treatment	Fungi (cfu x 10^4 g^{-1})		
	30 DAF	**60 DAF**	**90 DAF**
A) Source of compost (weed biomass)			
W1- *Cassia tora*	29	64	62
W2- *Sorghum helepense*	26	59	61
W3- Mix weeds	32	66	68
W4-*Parthenium hysterophorus*	27	60	62
B) Decomposing culture			
C1- S9 culture	29	61	64
C2- PDKV culture	30	65	65
C3- Without culture	26	60	60
GM	28	62.14	63.14

4.8.2.1 Source of compost

The data presented in Table 12 showed that fungal count with significant differentiation was evident among organic sources of *Cassia tora*, *Sorghum helepense*, Mix weed and *Parthenium hysterophorus* compost with increased fungal population at all stages. Mix weed compost statistically recorded highest fungal count 68 cfu x 10^4 g^{-1} at 90 DAF whereas *Cassia tora* compost recorded 62 cfu x 10^4 g^{-1} and *Parthenium hysterophorus* compost recorded fungus count 62 cfu x 10^4 g^{-1} at 90 DAF. *Sorghum helepense* compost recorded statistically lowest fungal count 61 x 10^4 g^{-1} at 90 DAF.

It is clear from data that mix weed compost recorded higher activity of fungus than other weed compost might be due to smaller size of weed biomass and lower CN ratio. Such phenomenon recorded in their study by Gaur *et al*. (1971) recoded that the increased trend of fungal population. Similar result were reported by Sorensen *et al*. (1997), Juma and McGill (1998), Gawade (2001), Gauri Kakad (2005), Goyal *et al.* (2005) and Terdal (2005).

4.8.2.2 Decomposing culture

Decomposing cultures were recorded significant differences in increase of fungal count of compost material. Among the three

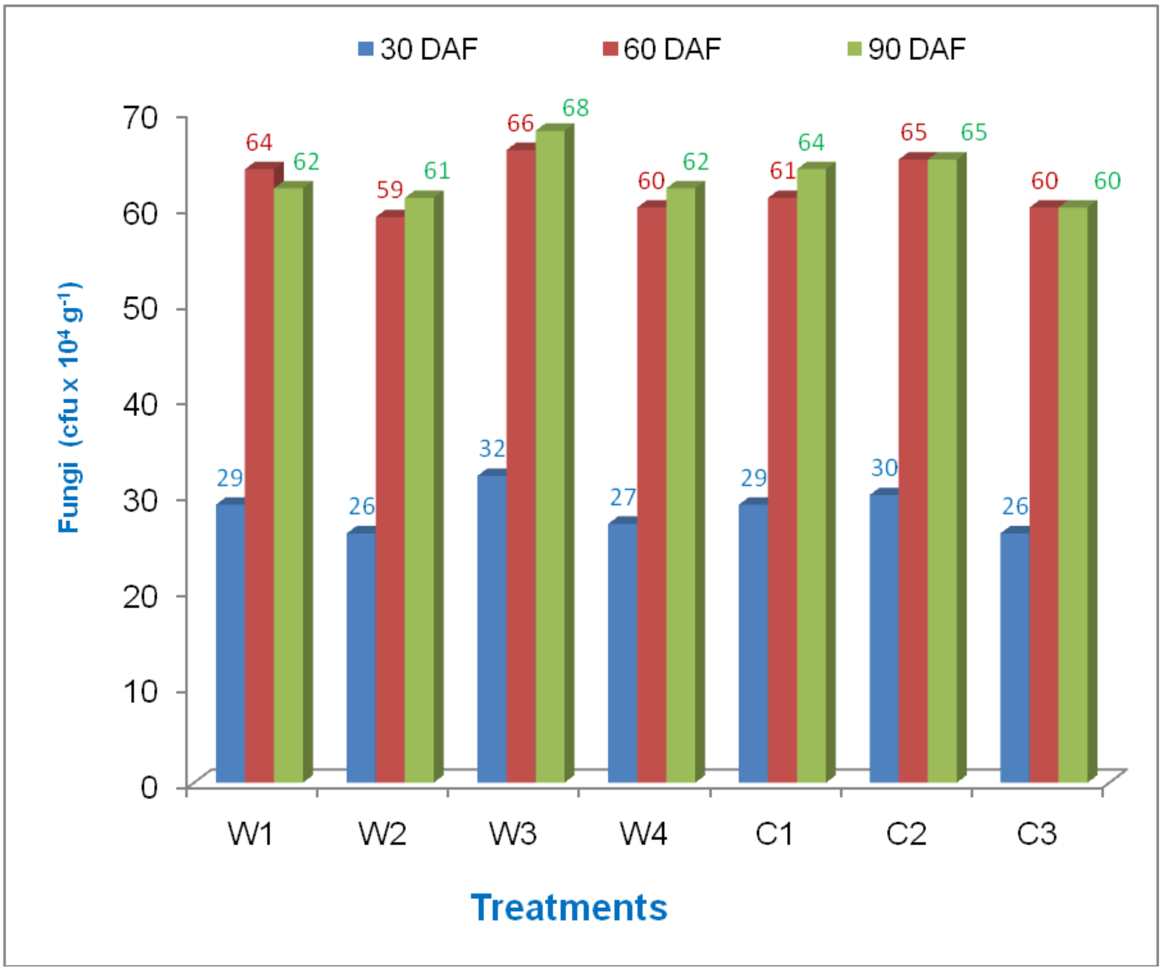


Fig. 6 Fungal count as influenced by different treatment during decomposition of weed biomass

W1 – Cassia tora
W2 – Sorghum helepense
W3 – Mix weeds
W4 – Parthenium hysterophorus

C1 – S9 culture
C2 – PDKV culture
C3 – Without culture

decomposing cultures, PDKV decomposing culture recorded significantly higher increase in fungal count around to 65 cfu x 10^4 g^{-1} at 90 DAF followed by S9 decomposing culture with fungal count of 64.61 cfu x 10^4 g^{-1}. All microbial cultures recorded significant more fungal population over no culture treatment.

4.8.2.3 Interaction effect

Interaction effect between source of compost and decomposing culture was not evident significant result regarding fungal development.

4.8.3 Actinomycetes dynamics during composting

Actinomycetes are the major microorganism responsible for the process of soil aggregation. Actinomycetes degrade starch actively and also bring about large losses of water soluble fractions. The maximum average number of actinomycetes colonies was found to 46.00 cfu x 10^{-4} g^{-1} in compost pit. The data in respect of actinomycetes count recorded during experimentation is placed at Table 13 and represented graphically in Fig. 7.

Table 13. Actinomycetes count as influenced by different treatment during decomposition of weed biomass

Treatment	**Actinomycetes (cfu x 10^4 g^{-1})**		
	30 DAF	**60 DAF**	**90 DAF**
A) Source of compost (weed biomass)			
W1- *Cassia tora*	22	43	46
W2- *Sorghum helepense*	19	38	43
W3- Mix weeds	23	44	48
W4-*Parthenium hysterophorus*	20	42	45
B) Decomposing culture			
C1- S9 culture	22	43	46
C2- PDKV culture	24	45	48
C3- Without culture	18	37	43
GM	21.14	41.71	45.57

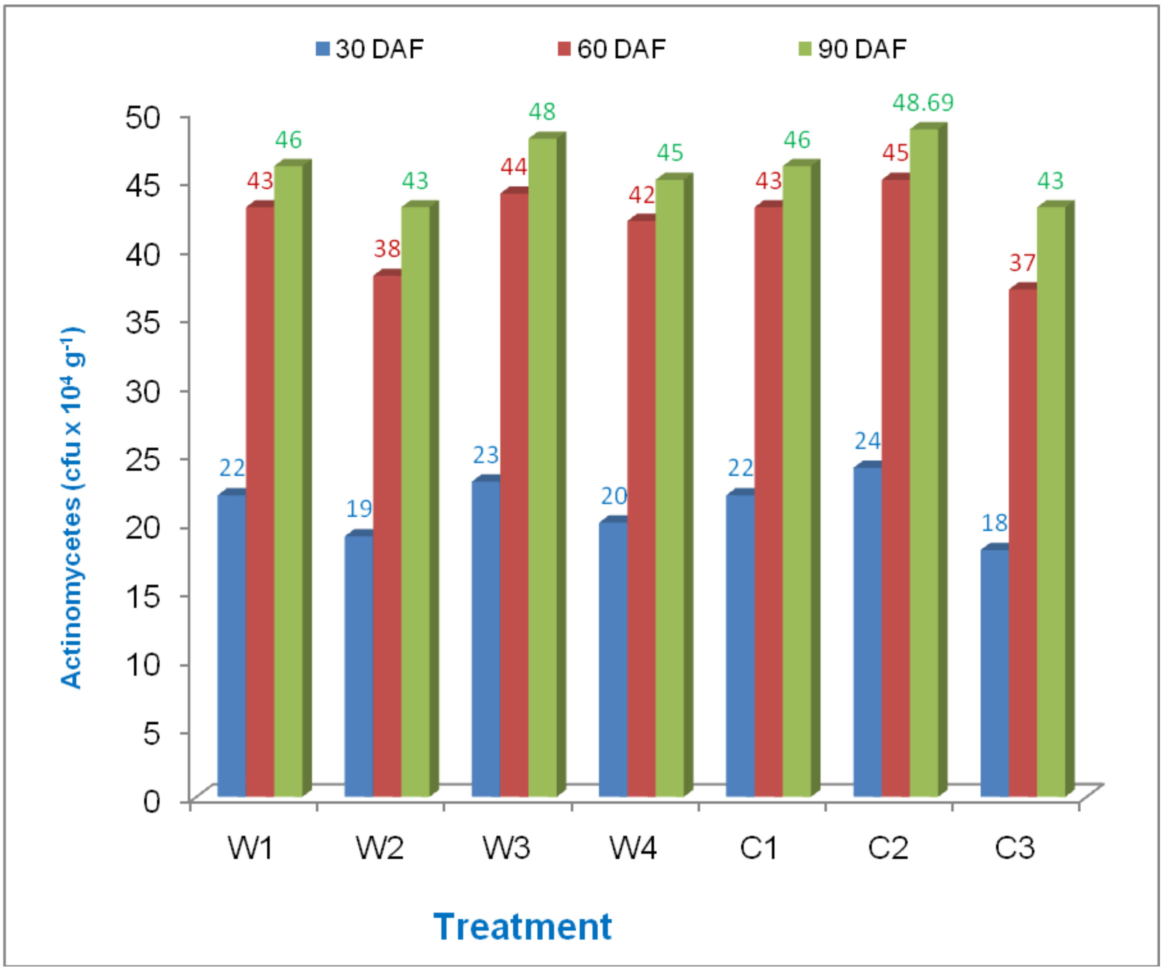


Fig. 7 Actinomycetes count as influenced by different treatment during decomposition of weed biomass

W1 – Cassia tora
W2 – Sorghum helepense
W3 – Mix weeds
W4 – Parthenium hysterophorus

C1 – S9 culture
C2 – PDKV culture
C3 – Without culture

4.8.3.1 Source of compost

The data presented in Table 13 and Fig.7 observed that significant differentiation in actinomycetes count was evident among organic sources of *Cassia tora*, *Sorghum helepense*, Mix weed and *Parthenium hysterophorus* compost with increased count at all slages. Mix weed compost recorded statistically highest actinomycetes count 48 cfu x 10^{-4} g^{-1} at 90 DAF whereas *Cassia tora* compost recorded increase in actinomycetes count 46 cfu x 10^{-4} g^{-1} at 90 DAF and *Parthenium hysterophorus* compost recorded fungus count 45 cfu x 10^{-4} g^{-1}.Sorghum helepense compost recorded lower fungal count 43 cfu x 10^{-4} g^{-1}. It is clear from data that mix weed compost showed higher activity of actinomycetes than other weed compost might be due to smaller size of crop residue and lower C:N ratio.

Such phenomenon recorded in their study by Gaur *et al*. (1971) recorded that the increased trend of bacterial population. Similar result were reported by Sorensen *et al*. (1997), Juma and McGill (1998), Gawade (2001) and Goyal *et al.* (2005).

4.8.3.2 Decomposing culture

Decomposing cultures were recorded significant differences in increase of actinomycetes count of compost material. Among the three decomposing cultures, PDKV decomposing culture recorded significantly higher increase in actinomycetes count around to 48 cfu x 10^{-4} g^{-1} at 90 DAF followed by S9 decomposing culture with actinomycetes of 46 cfu x 10^{-4} g^{-1} at 90 DAF. All microbial cultures recorded significant more actinomycetes population over no culture treated compost pit.

4.8.3.3 Interaction effect

Interaction effect between source of compost and decomposing culture was not evident significant result regarding actinomycetes development.

CHAPTER V

SUMMARY AND CONCLUSIONS

A field experiment entitled "Effect of different decomposing culture on quality of compost from weed biomass" was conducted at Centre for Organic Agriculture Research and Training Farm, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) during the year 2018-19.

5.1 Enrichment of crop residue (Composting)

The experiment was laid out in Factorial Randomized Block Design with using four weed biomass i.e. *Cassia tora, Sorghum helepense*, Mix weeds and *Parthenium hysterophorus* with three cultures which comprised PDKV, S9 and control without culture. The combinations of twelve treatments were replicated three times. The observations on changes in temperature, volume, weight of compost, Total carbon content were recorded periodically during decomposition process. Similarly samples were analysed for microbial dynamics, NPK content. The end of decomposition process was judged by changes in C.N ratio of these decomposing materials. The results are summarized as below.

5.2 Temperature change (°C)

During composting process, the initial rise and early decline in temperature was more in *Parthenium hysterophorus* compost followed by Mix weed, *Sorghum helepense* and *Cassia tora* compost. In *Parthenium hysterophorus* compost pit, temperature raised maximum to 47.2°C in third week and declined to 33.2°C towards maturity. In case of Cassia tora, *Sorghum helepense* and Mix weed compost pit, it was maximum at 44.7°C, 44.8°C, 45.6°C and declined to 28.8°C, 29.4°C, 30.1°C respectively. Among the decomposing cultures, PDKV culture recorded higher temperature followed by S9 culture and without culture.

5.3 pH and EC

Active micro flora and fauna population depends on hydrogen ion concentration of the substrate of decomposition. During the process of composting all composts were acidic in nature and steadily pH was increased towards maturity. In mix weed compost, higher pH increased from 7.38 to 7.92. In *cassia tora* and *Parthenium hysterophorus* compost it was raised from 7.21 to 7.74 and 7.01 to 7.57 respectively. In *Sorghum helepense* compost, lower pH increase from 6.70 to 7.38. PDKV cukture recorded higher pH value followed by without culture.

Initial lower EC of all composts was increased slowly as decomposition moved towards maturity of compost. In mix weed compost, EC increase from 0.93 to 1.10 dS/m, whereas *cassia tora* increase from 0.94 to 1.11 dS/m, *Parthenium hysterophorus* from 1.02 to 1.18 dS/m and in *Sorghum helepense* compost from 1.03 to 1.21 dS/m. PDKV culture noted significantly lower EC increased from 0.93 to 1.10 dS/m over other decomposing cultures.

5.4 Changes in compost volume (m^3)

In *Sorghum helepense* compost pit, the reduction in volume was significantly higher which were about 0.08 m^3 out of 0.15 m^3. In *cassia tora* compost pit, the reduction in volume was lower which were about 0.073 m^3. In mix weed and *Parthenium hysterophorus* compost pit, reduction in volume which were about 0.077 m^3 and 0.075 m^3 respectively. Among the three decomposing cultures, PDKV culture recorded significantly higher decline in volume of about 0.08 m^3 followed by S9 culture and without culture.

5.5 Changes in compost weight (kg)

In *Sorghum helepense* compost pit, the reduction in weight was significantly more which about 32.69 kg out of initial 60 kg. However in *Cassia tora,* Mix weeds and *Parthenium hysterophorus* reduction in weight of compost is about 29.13 kg, 31.8 kg and 31 kg respectively. Among the three decomposing culture, PDKV culture recorded significantly higher reduction in weight is about 32.8 kg followed by S9 culture and without culture.

5.6 Change total carbon content (%)

Mix weed compost recorded fast reduction in total carbon content up to 90 DAF followed by *Cassia tora, Parthenium hysterophorus* and *Sorghum helepense* compost. PDKV culture recorded fast reduction in total carbon content than S9 and without culture.

5.7 Microbial dynamics

At 90 DAF, mix weed compost recorded statistically higher bacterial, fungal and actinomycetes count followed by *Cassia tora, Parthenium hysterophorus* and *Sorghum helepense* compost. However, PDKV culture recorded higher microbial count followed by S9 and without culture.

5.8 Changes in C:N ratio

Mix weed compost recorded fast reduction in C:N ratio (from 34.3:1 to 15.13:1) up to 90 DAF and became stable followed by *Cassia tora, Parthenium hysterophorus* and *Sorghum helepense* compost . PDKV culture accelerated the speed of decomposition which decline C:N ratio compost pit followed by S9 and without culture.

5.9 Total N, P and K content (%)

Mix weed compost recorded comparatively better improvement in total nitrogen, phosphorus and potassium content followed by *Cassia tora*, *Parthenium hysterophorus* and *Sorghum helepense*. Among the three cultures used in the experiment, PDKV culture recorded higher increase in total N, P and K content from initial level followed by S9 and without culture.

Conclusion

Based on the results of the present experiment conducted to evaluate the best weed biomass and decomposing culture to produce enriched compost.

It is concluded that,

1. Mix weed was most useful for production of compost followed by *Cassia tora, Parthenium hysterophorus* and *Sorghum helepense*. PDKV decomposing culture was found to be most effective inoculant for decomposition of weed biomass followed by S9 culture and without culture (Dung slurry).
2. Among the four weed species the rate of decomposition of *Sorghum helepense* is faster than *Cassia tora*, Mix weed and *Parthenium hysterophorus.*
3. The compost prepared from mix weed species was with better chemical and biological properties followed by *Cassia tora*, *Parthenium hysterophorus* and *Sorghum helepense* compost.

Above conclusions are based on one year research and its need further confirmation by repeating the trial.

CHAPTER VI

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