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# Effect of crop residue mixtures and decomposing culture on chemical properties of compost

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**Abstract**
A field experiment entitled "Effect of crop residue mixtures and decomposing culture on quality of compost" 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 2023. The experiment was laid out in Factorial Randomized Block Design with crop residue mixtures i.e. CR1-cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%), CR2-soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%), CR3-wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) and CR4-raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) with three cultures which comprised PDKV culture, CIRCOT culture and jeevamrut culture. The combinations of twelve treatments were replicated three times. Samples were analyzed for pH, EC, total carbon, ash per cent, total NPK and microbial dynamics. The end of decomposition was judged by changes in colour, texture and C:N ratio of these decomposing materials. In case of chemical properties, CR4-raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) recorded maximum decrease in pH (7.23), total carbon (19.25%), C:N ratio (18.65), maturity days (110) and increase in ash (66.8%). CR2-soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) recorded significantly highest EC (1.38), N (1.23%) and P (0.56%). Significantly highest K content (1.10%) was recorded in crop residue mixture CR1-cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%), CR2-soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%). Among the decomposing cultures, PDKV culture recorded accelerated decomposition with the earliest maturity (123 days), maintained a relatively lower pH (7.25) and carbon content (19.93%) at maturity and higher EC (1.39 dS $m^{-1}$), and consistently recorded higher ash content (64.75%), and greater enrichment of N (1.05%), P (0.56%), and K (90.93%) throughout the decomposition process.

**Keywords:** Compost, crop residue mixtures, decomposing culture, chemical properties

## Introduction

There is a growing demand for agriculture driven by the increasing global population and improved living standards, necessitating more food production. However, modern agricultural practices, such as large-scale livestock farming and intense crop production, result in substantial unused solid and liquid waste. Annually, the world generates 125 million tonnes of nitrogen from livestock manure and a staggering 140 billion tonnes of lignocellulosic waste, constituting 30-40% of the total global solid waste. Managing and optimizing these leftover materials poses a significant global challenge, with many countries only able to recycle or reuse 30-75% of manure and crop residues. This inefficiency impacts the environment and resource management, emphasizing the need for sustainable agriculture and waste management (Prasad *et al*., 2020) [17]. In India, the annual generation of 500-550 million tonnes of crop residue underscores the importance of managing and utilizing these residues for enhanced agricultural and economic sustainability (Devi *et al*., 2017) [4].

Composting emerges as a valuable solution for managing crop residues, providing benefits for both agriculture and the environment. By transforming agricultural waste into enriched compost, it contributes organic matter and nutrients to the soil, promoting enhanced fertility and improved crop yields. Incorporating compost into farming practices supports sustainable and organic agriculture, mitigating the adverse impacts of conventional methods. Recognized as one of the best management practices, recycling crop residues through composting addresses the challenge of effectively handling excess crop residue.

Additionally, microbial communities, essential for compost decomposition, play a pivotal role in breaking down organic compounds, resulting in nutrient-rich compost beneficial for crop productivity. 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 crop residues and weed biomass are known to reduce the availability of important mineral nutrients to growing plants through immobilization into organic form during their decomposition. Hence it necessary to speed up the process of decomposition and to test feasibility of different crop residue and decomposing culture therefore it very important to study nutrients status of crop residues for enrichment of compost as well as role of decomposing culture for faster decomposition and preparation of bio enrich compost. In view of this, the field experiment was carried out. In view of this, the field experiment was carried out.

## Material and Methods

A field experiment entitled "Effect of crop residue mixtures and decomposing culture on quality of compost" was conducted at Centre for Organic Agriculture Research and Training Farm (COART), Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra) during the year 2022-23. The experiment was laid out in Factorial Randomized Block Design (FRBD) by using four crop residue mixtures treatments i.e. CR1-cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%), CR2-soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%), CR3-wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) and CR4-raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) with three decomposing cultures which comprised PDKV, CIRCOT and jeevamrut culture. The combinations of twelve treatments were replicated three times. The observations on changes in pH, EC, total carbon and ash content were recorded periodically during decomposition process. Similarly, samples were analyzed for NPK content. The end of decomposition process was judged by changes in C.N ratio of these decomposing materials.

The compost is prepared in compost heap having dimension 1 x 0.5 x 0.6 $m^3$. Compost heap was filled with crop residue mixtures with decomposing culture. Cover all the surface of bottom of heap with teak plant leaves and spread 5 cm layer of soil on the surface of teak leaves. At bottom, 5 kg of straw was spread evenly and then spread 1 kg of weed biomass and then spread evenly 1 kg of leaf litter. Then cow dung slurry was prepared from mixture of 12 kg dung in 50 lit of water and 40 ml PDKV culture or jeevamrut culture or 400 ml CIRCOT decomposing culture. Likewise, total four layer were filled in compost heap. Last layer was plastered with thick slurry of 10 kg dung, 5 kg soil and 10-liter of water. Compost was watered regularly when required to maintain moisture content up to 50-60%. Total 40 kg initial crop residues, weed biomass and leaf litter was added in one compost heap. Chemical analysis of Total N, P, K and total carbon of crop residue mixtures were determined by using Kjeldahl method, Spectrophotometer, Flame Photometer and Dry Combustion method respectively.

## Results and Discussion

**pH of compost:** During present investigation the changes in mean pH 8.18, 7.79, 7.52 and 7.32 was recorded at 30, 60, 90 DAF and at maturity respectively. The pH was decreased continuously from 30 DAF to till maturity of compost.

In composting of raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) ($CR_4$) record significantly lower pH 8.02, 7.64 and 7.23 during decomposition process at 30, 60 DAF and at maturity respectively followed by soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) ($CR_2$) and wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) ($CR_3$). At 90 DAF raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) ($CR_4$) record significantly lower pH 7.47 during decomposition process at 90 DAF being at par with soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_2$). Significantly highest pH was observed in cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_1$) which decreases from 8.28 at 30 days to 7.40 at maturity. Decreasing pH of compost raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) ($CR_4$) might be due to activity of active micro flora and micro fauna which produces organic acids and $CO_2$ (respiration) during the decomposition of organic matter. In initial process pH tends to be slightly acidic but towards end it turns near to neutral (Venegas and Gonzalez, 2005). Similar results were noted by Gogoi *et al*. (2013) [7] and Meena *et al*. (2023) [14].

Among the three decomposing cultures, PDKV culture showed significantly lower pH value during composting period of all crop residue mixtures followed by CIRCOT culture. Jeevamrut culture treated heap recorded pH 8.21, 7.83 and 7.56 at 30, 60, 90 DAF of compost and slowly decreases towards 7.38 at the end of maturity followed by CIRCOT culture (7.33). The highest pH was observed in jeevamrut culture during composting treatment which decreased from 8.21 to 7.38. The decrease in pH due to PDKV culture might be because of the microbial activity produces organic acids as metabolic byproducts, leading to a decrease in pH. The organic acids released during decomposition contribute to the acidity of the compost, resulting in a lower pH. These results were in conformity with those reported by Gogoi *et al*. (2013) [7] observed the alkaline pH values are usually indicator of maturity of compost. Also stated by Meena *et al*. (2023) [14].

Interaction effect of crop residue mixtures with decomposition cultures were found non-significant on pH during decomposition process at all stages.

## Electrical conductivity (EC)

During experimentation, EC value measured at every 30 days interval during compost period of the crop residue mixtures used. The mean EC was observed 0.82 dS $m^{-1}$, 1.11 dS $m^{-1}$, 1.22 dS $m^{-1}$ and 1.35 dS $m^{-1}$ at 30, 60, 90 DAF and at maturity respectively. EC was increased continuously from 30 DAF to till maturity of compost.

The EC was found significantly highest (0.85 dS $m^{-1}$, 1.14 dS $m^{-1}$, 1.25 dS $m^{-1}$ and 1.38 dS $m^{-1}$) at 30, 60, 90 DAF and at maturity respectively in composting with soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) ($CR_2$) being at par with crop residue mixture wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_3$)heap which was superior over rest crop residue mixtures. However, the lowest EC 0.79 dS $m^{-1}$, 1.08 dS $m^{-1}$, 1.19 dS $m^{-1}$ and 1.31 dS $m^{-1}$ at 30, 60, 90 DAF and at maturity respectively was observed with treatment $CR_4$-raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%). The increase in Electrical Conductivity during composting of soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) ($CR_2$) might be due to increase in activity of microbes, addition of water, progress in composting and the concentration of mineral salts such as phosphate and ammonium ions during the drying phase. Similar observations were noted by Jagadabhi (2019), Pandule *et al*. (2019) [16] and Meena *et al*. (2023) [14]..

**Table 1:** Periodical changes in pH during composting as influenced by different crop residue mixtures and decomposing culture

| Treatment | Days after filling | | | |
|---|---|---|---|---|
| | 30 | 60 | 90 | At maturity |
| **Factor A-Crop Residue Mixtures** | | | | |
| $CR_1$-Cotton stalk (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 8.28 | 7.87 | 7.58 | 7.40 |
| $CR_2$-Soybean straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 8.16 | 7.77 | 7.48 | 7.31 |
| $CR_3$-Wheat straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 8.24 | 7.85 | 7.56 | 7.34 |
| $CR_4$-Raw FYM (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 8.02 | 7.64 | 7.47 | 7.23 |
| SE (m) ± | 0.009 | 0.008 | 0.005 | 0.010 |
| CD at 5% | 0.030 | 0.024 | 0.016 | 0.033 |
| **Factor B-Decomposing culture** | | | | |
| $D_1$-PDKV Culture | 8.15 | 7.74 | 7.49 | 7.25 |
| $D_2$-CIRCOT Culture | 8.18 | 7.78 | 7.52 | 7.33 |
| $D_3$-Jeevamrut Culture | 8.21 | 7.83 | 7.56 | 7.38 |
| SE (m) ± | 0.008 | 0.007 | 0.005 | 0.010 |
| CD at 5% | 0.020 | 0.020 | 0.013 | 0.028 |
| **Interaction (A×B)** | | | | |
| SE (m) ± | 0.020 | 0.020 | 0.011 | 0.024 |
| CD at 5% | NS | NS | NS | NS |
| GM | 8.18 | 7.79 | 7.52 | 7.32 |

Decomposing culture recorded significantly increase in EC values. Among the three decomposing cultures, PDKV decomposing culture recorded significantly highest EC from initial 0.85 dS $m^{-1}$ to final 1.39 dS $m^{-1}$ followed by CIRCOT culture (0.82 dS $m^{-1}$ to 1.35 dS $m^{-1}$). Whereas, jeevamrut culture recorded statistically lower EC value from initial 0.79 dS $m^{-1}$ to final 1.30 dS $m^{-1}$. Increase in EC during composting treated with PDKV culture might be due to increase in microbial activity in compost, accelerating organic matter breakdown. Microbial decomposition releases ions, elevating the compost's electrical conductivity (EC). The results are in conformity with the findings of Gogoi *et al*. (2013) [7] and Pandule *et al.* (2019).

Interaction differences between crop residue mixture with decomposition cultures were found non-significant on EC (dS $m^{-1}$) during decomposition process at all stages.

**Table 2:** Periodical changes in EC (dS $m^{-1}$) during composting as influenced by different treatments

| Treatment | Days after filling | | | |
|---|---|---|---|---|
| | 30 | 60 | 90 | At maturity |
| **Factor A-Crop Residue Mixtures** | | | | |
| $CR_1$-Cotton stalk (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 0.81 | 1.10 | 1.21 | 1.34 |
| $CR_2$-Soybean straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 0.85 | 1.14 | 1.25 | 1.38 |
| $CR_3$-Wheat straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 0.84 | 1.12 | 1.22 | 1.36 |
| $CR_4$-Raw FYM (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 0.79 | 1.08 | 1.19 | 1.31 |
| SE (m) ± | 0.008 | 0.007 | 0.006 | 0.007 |
| CD at 5% | 0.023 | 0.021 | 0.017 | 0.020 |
| **Factor B-Decomposing culture** | | | | |
| $D_1$-PDKV Culture | 0.85 | 1.15 | 1.25 | 1.39 |
| $D_2$-CIRCOT Culture | 0.82 | 1.11 | 1.22 | 1.35 |
| $D_3$-Jeevamrut Culture | 0.79 | 1.06 | 1.19 | 1.30 |
| SE (m) ± | 0.007 | 0.006 | 0.005 | 0.006 |
| CD at 5% | 0.020 | 0.018 | 0.015 | 0.018 |
| **Interaction (A×B)** | | | | |
| SE (m) ± | 0.017 | 0.015 | 0.012 | 0.012 |
| CD at 5% | NS | NS | NS | NS |
| GM | 0.82 | 1.11 | 1.22 | 1.35 |

**Total carbon content**

The mean total carbon content was recorded 35.77, 25.45, 24.29 and 20.95 at 30, 60, 90 DAF and at maturity respectively. Total carbon content was decreased continuously from initial to maturity of compost.

During the period of composting, there was noteworthy reduction in total carbon content of matured compost which statistically significant differences among the treatments. Significantly highest reduction in total carbon content was recoded in raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$) with initial value of 34.14 per cent and decreases 28.11, 25.02, 22.76 and 19.25 at 30, 60, 90 and at maturity respectively which was superior over other treatments. Lowest reduction in total carbon per cent was recorded in wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_3$) with initial value from 61.22 per cent and decreases up to 22.69 per cent at maturity. soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_2$) also recorded reduction in total carbon content to about 20.37 per cent at maturity from initial total carbon content from 55.45 to 20.37 per cent at maturity. Similarly, cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_1$) recorded reduction in total carbon content from 56.32 to 21.47 per cent at maturity.

**Table 3:** Periodical changes in total carbon (%) during composting as influenced by different treatments

| Treatment | Days after filling | | | |
|---|---|---|---|---|
| | 30 | 60 | 90 | At maturity |
| **Factor A-Crop Residue Mixtures** | | | | |
| $CR_1$-Cotton stalk (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 37.84 | 29.77 | 25.44 | 21.47 |
| $CR_2$-Soybean straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 35.17 | 28.07 | 24.87 | 20.37 |
| $CR_3$-Wheat straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 41.97 | 32.27 | 27.11 | 22.69 |
| $CR_4$-Raw FYM (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 28.11 | 25.02 | 22.76 | 19.25 |
| SE (m) ± | 0.74 | 0.33 | 0.29 | 0.15 |
| CD at 5% | 0.97 | 0.96 | 0.85 | 0.44 |
| **Factor B-Decomposing culture** | | | | |
| $D_1$-PDKV Culture | 33.47 | 24.14 | 23.19 | 19.93 |
| $D_2$-CIRCOT Culture | 35.86 | 25.76 | 24.39 | 21.04 |
| $D_3$-Jeevamrut Culture | 37.99 | 26.47 | 25.30 | 21.87 |
| SE (m) ± | 0.64 | 0.27 | 0.25 | 0.13 |
| CD at 5% | 1.87 | 0.84 | 0.74 | 0.38 |
| **Interaction (A×B)** | | | | |
| SE (m) ± | 1.56 | 0.74 | 0.62 | 0.32 |
| CD at 5% | NS | NS | NS | NS |
| GM | 35.77 | 25.45 | 24.29 | 20.95 |

At harvest lowest total carbon content observed in raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$) might be due to surges in microbial population, driving heightened respiratory activity. Microbes, relying on carbon as an energy source, metabolize almost all of it during cellular processes, transforming it into $CO_2$. This respiratory activity plays a key role in oxidizing organic carbon, releasing $CO_2$ into the atmosphere. Ultimately, this microbial-driven process reduces the compost's overall carbon content. Also, it has lower initial total carbon content as compared to others. Similar observations were noted by Devi *et al*. (2012), Pandule *et al*. (2019) [16] and Meena *et al*. (2023) [14].

Decomposing cultures were recorded significant difference in decrease of total carbon content of compost material during decomposition period. Among the decomposing cultures, PDKV decomposing culture recorded significantly higher decrease in total carbon content from 33.47% to 19.93% at maturity followed by CIRCOT culture from 35.86% to 21.04%. The compost heap treated with jeevamrut culture showed lesser reduction per cent in total carbon of composted crop residues during duration of composting and required more time to mature. The decrease in total carbon content in compost treated with PDKV culture might be due to the microbial community in the culture plays a pivotal role in intensifying carbon mineralization, resulting in a more significant reduction in total carbon during the composting phase compared to other decomposing cultures. The specific characteristics and metabolic pathways of the PDKV decomposing culture contribute to its efficacy in facilitating the breakdown of carbonaceous compounds, leading to a compost with lower total carbon content. Similar observations were noted by Shinde *et al.* (2016) [20], Pandule *et al*. (2019) [16] and Meena *et al*. (2023) [14]. Interaction effect regarding total carbon content between crop residue mixture and decomposing cultures were found non-significant.

**Total ash content**

The mean ash content was recorded 33.81, 39.77, 47.00 and 57.85 at 30, 60, 90 DAF and at maturity respectively. Total ash content was increased continuously from 30 DAF to till maturity of compost in respective treatments.

During composting, there was noteworthy increase in total ash content of matured compost which shows statistically significant differences among the treatments. The significantly highest ash content was recoded (51.55%, 55.98%, 61.45% and 66.8%) at 30, 60, 90 DAF and at maturity respectively was recorded with composting of raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$) followed by soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) composting ($CR_2$). However, lowest total ash per cent was recorded in wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_3$) with 27.56%, 43.17%, 50.57% and 66.8% at 30, 60, 90 DAF and at maturity respectively. The highest increase in the ash content in FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$) might be due to the lower per cent of initial total carbon, breakdown and decomposition of organic materials present in the compost heap. Similar observations were noted by Devi *et al.* (2012) [5], Gill *et al.* (2016) [6] and Jambhulkar *et al.* (2021) [9].

Decomposing cultures were recorded significant differences in increase of total ash content of compost material during decomposition period. Among the decomposing cultures, PDKV decomposing culture recorded significantly higher increase in total ash content from 40.33%, 51.02%, 58.44% and 64.75% at 30, 60, 90 and at maturity respectively during experimentation followed by CIRCOT culture (38.38%, 49.49%, 56.01% and 63.02%) at 30, 60, 90 and at maturity respectively. The compost heap treated with jeevamrut culture showed lesser increase in total ash content. This increase in ash content might be due to breakdown of the total carbon and decomposition of organic material. Similar observations were noted by Jambhulkar *et al.* (2021) [9]. Interaction effect regarding total ash content between sources of compost application and decomposing cultures were not found significant.

**Table 4:** Periodical changes in ash (%) during composting as influenced by crop residue mixture and decomposing culture

| Treatment | Days after filling | | | |
|---|---|---|---|---|
| | 30 | 60 | 90 | At maturity |
| **Factor A-Crop Residue Mixtures** | | | | |
| $CR_1$-Cotton stalk (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 34.58 | 48.64 | 57.02 | 63.50 |
| $CR_2$-Soybean straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 39.36 | 51.63 | 57.77 | 64.92 |
| $CR_3$-Wheat straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 27.56 | 43.17 | 50.57 | 57.04 |
| $CR_4$-Raw FYM (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 51.55 | 55.98 | 61.45 | 66.8 |
| SE (m) ± | 0.61 | 0.25 | 0.23 | 0.25 |
| CD at 5% | 1.80 | 0.74 | 0.69 | 0.74 |
| **Factor B-Decomposing culture** | | | | |
| $D_1$-PDKV Culture | 40.33 | 51.02 | 58.44 | 64.75 |
| $D_2$-CIRCOT Culture | 38.38 | 49.49 | 56.01 | 63.02 |
| $D_3$-Jeevamrut Culture | 35.88 | 49.05 | 55.66 | 61.43 |
| SE (m) ± | 0.53 | 0.22 | 0.20 | 0.22 |
| CD at 5% | 1.55 | 0.64 | 0.60 | 0.64 |
| **Interaction (A×B)** | | | | |
| SE (m) ± | 1.30 | 0.54 | 0.50 | 0.53 |
| CD at 5% | NS | NS | NS | NS |
| GM | 38.23 | 49.85 | 56.70 | 63.07 |

## Total Nitrogen content (%)

Initially, before the start of composting, the total nitrogen was tested with chemical analysis. The changes in the nitrogen content were measured initially and at maturity. The average initial value of total nitrogen (%) was found as 0.79 per cent and decrease up to 1.02 per cent by weight after decomposition.

**Table 5:** Changes in total nitrogen (%) during composting as influenced by crop residue mixtures and decomposing culture

| Treatment | Total Nitrogen (%) | | Total Phosphorus (%) | | Total Potassium (%) | |
|---|---|---|---|---|---|---|
| | Initial | Final | Initial | Final | Initial | Final |
| **Factor A-Crop Residue Mixtures** | | | | | | |
| $CR_1$-Cotton stalk (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 0.71 | 0.93 | 0.35 | 0.53 | 0.82 | 1.10 |
| $CR_2$-Soybean straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 1.00 | 1.23 | 0.36 | 0.56 | 0.69 | 0.96 |
| $CR_3$-Wheat straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 0.75 | 1.05 | 0.34 | 0.54 | 0.63 | 0.82 |
| $CR_4$-Raw FYM (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 0.69 | 0.88 | 0.33 | 0.50 | 0.45 | 0.72 |
| SE (m) ± | - | 0.008 | - | 0.014 | - | 0.007 |
| CD at 5% | - | 0.022 | - | 0.040 | - | 0.021 |
| **Factor B-Decomposing culture** | | | | | | |
| $D_1$-PDKV Culture | - | 1.05 | - | 0.56 | - | 0.93 |
| $D_2$-CIRCOT Culture | - | 1.02 | - | 0.54 | - | 0.90 |
| $D_3$-Jeevamrut Culture | - | 0.99 | - | 0.49 | - | 0.87 |
| SE (m) ± | - | 0.007 | - | 0.012 | - | 0.006 |
| CD at 5% | - | 0.015 | - | 0.035 | - | 0.018 |
| **Interaction (A×B)** | | | | | | |
| SE (m) ± | - | 0.013 | - | 0.008 | - | 0.015 |
| CD at 5% | - | NS | - | NS | - | NS |
| GM | - | 1.02 | - | 0.53 | - | 0.90 |

The data recorded revealed that final compost showed significant differences among crop residue mixtures. The compost derived from soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) ($CR_2$) at maturity recorded statistically higher nitrogen content (1.23%) which was superior over rest of the treatments. However, wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_3$) (1.05%) recorded total N next to superior treatment. cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_1$) recorded 0.93% total N. The compost derived from raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$) at maturity recorded statistically lower nitrogen content of 0.88%.

In the study, maximum nitrogen content was recorded with soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) ($CR_2$) compost. The increase in nitrogen content may be due to high mineralization of organic matter by microbes by which N was retained in nitrate form. The increase in total N may be due to dry mass net loss as loss of organic carbon as $CO_2$ during composting. N values might also increase due the nitrogen fixing bacteria activity that commonly occurs at the end of composting. Similar observations were noted by Manna *et al.* (2000) [13], Rao *et al.* (2007) [18], Pandule *et al.* (2019) [16] and Meena *et al.* (2023) [14]

Decomposing cultures noted nitrogen content with significant differences as regards N content among different treatments. PDKV culture recorded significantly higher total nitrogen (1.05%) at maturity followed by CIRCOT culture

(1.02%). Recorded N content (1.02%) which is 0.03% lower than PDKV culture. Jeevamrut culture found lower (0.99%) in nitrogen content than PDKV and CIRCOT culture. However, both decomposing cultures were found significantly effective over jeevamrut decomposing cultures in compost heap.

The highest nitrogen content was recorded in PDKV decomposing cultures is might be due to microbial activity. Nitrogen transformations, including the rapid increase in ammonia nitrogen, contribute to the enrichment of nitrogen content in the composting process. Similar records of availability of nitrogen were stated by Bharne *et al.* (2003) [2] and Rao (2007) [18]. Interaction effect regarding total nitrogen content among the crop residue mixture and decomposing cultures were not found significant.

**Total Phosphorus content (%)**

The mean values of total phosphorus (%) were found 0.35% before decomposition and increases up to 0.53% in all compost. There was improvement in total phosphorus content of mature compost. Out of four crop residue mixtures significantly higher total phosphorus was recorded with soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_2$) i.e. 0.56 per cent at maturity from initial of 0.36 per cent total phosphorus being at par with wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_3$) and cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_1$) which recorded increase in total phosphorus content at maturity with 0.54 per cent and 0.53 per cent respectively superior over ($CR_4$). Lowest P content was recorded with raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$) i.e. 0.50 per cent at maturity from initial of 0.33 per cent.

In all treatments phosphorus content in mature compost was increased and highest phosphorus content was recorded with soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_2$) compost probably due to mineralization and mobilization of phosphorus as a result of microbial activity. This results are in conformity with the findings of Bharne *et al.* (2003) [2], Raut *et al.* (2003) [2] and Rao (2007) [18].

Decomposing cultures noted significant increase in phosphorus content after decomposition which shows significant difference among the treatments. Among the three decomposing cultures, PDKV culture recorded significantly higher phosphorus content (0.56%) at maturity followed by CIRCOT culture (0.54%). However, all these two decomposing cultures were found significantly effective over jeevamrut decomposing cultures in compost heap. Jeevamrut culture recorded 0.49% total P.

Maximum P per cent was recorded in PDKV culture might be due to influenced microbial activity. Beneficial microorganisms contribute to the degradation process, enhancing the availability of P. Similar results of phosphorus were recorded by Pandule *et al.* (2019) [16] and Jambhulkar *et al.* (2021) [9]. Interaction effect regarding total phosphorus content between crop residue mixture and decomposing cultures were not found significant.

**Total Potash content (%)**

There was increase in K content at maturity as compared with initial in all treatments. The mean K content was 0.90% at maturity. Data concerned to total potash content statistically significant among crop residue mixtures treatments. During crop residue mixtures decomposition, among these four crop residue mixtures statistically highest improvement in total potash content. As compared with initial cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_1$) recorded 1.10 per cent from initial 0.82 per cent which was significantly superior over all other treatments. However, raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$) recorded lowest improvement in total potash per cent with 0.72 per cent from initial 0.45 per cent. soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_2$) and wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_3$) recorded increase in total potash at maturity with 0.96 and 0.82 respectively.

Potassium content in compost was increases as compare with initial content in different crop residue and highest potassium content was recorded with cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_1$) which might be due to more initial total K content and acid production by the microorganisms which is important for solubalizing the insoluble potassium and also indicated that the microbial flora influences the level of available potassium. Similar findings were stated by Bharne *et al.* (2003) [2], Raut *et al.* (2003) [2] and Bhuyan (2007) [3].

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 0.93 per cent followed by CIRCOT culture and jeevamrut culture. Increase in total K content in PDKV culture might be due to the faster breakdown of organic materials, contributing to an increase in the total potassium content in the compost. Similar records of availability of potash were stated by Pandule *et al.* (2019) [16] and Jambhulkar *et al.* (2021) [9]. Interaction effect regarding total potash content between sources of application and decomposing cultures were not found significant.

**C:N ratio**

C:N ratio on an average was recorded maximum during initial stage (68.11) which was lower down at maturity (20.19). The changes in C:N ratio at the time of filling of the compost heap and after maturation and observed values are presented in Table 16 and depicted Figure 15. The C:N ratio was in decreasing trend at maturity as compared to initial.

The data from Table 16. 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 crop residue mixtures lower C:N ratio at maturity was recorded with raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$). Initial C:N ratio of raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$) were 50.20 which reduced after decomposition process to 18.65 at maturity. Lowest reduction in C:N ratio was recorded with wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_3$) from 89.63 to 21.51. However, soybean straw (50%) + weed biomass (10%) + leaf litter

(10%) + cowdung slurry (30%) compost ($CR_2$) and cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_1$) recorded 19.45 and 21.16 C:N ratio at maturity respectively.

The C:N ratio declined at maturity might be due to loss of organic carbon through oxidation in the form of $CO_2$ ultimately decrease in carbon and simultaneously increase in total nitrogen due to mineralization of organic residue and volatilization of nitrogen as ammonia. Hence, C:N ratio decreases. Similar observations were reported Pandule *et al*. (2019) [16] and Meena *et al*. (2023) [14].

Decomposing cultures were recorded decrease of total C:N ratio of compost material during composting period. Among the three decomposing cultures PDKV decomposing culture recorded significantly lower in total C:N ratio (18.75) followed CIRCOT culture (20.04). However higher C:N rario was recorded in jeevamut culture (21.79). The inoculated compost heap with decomposing culture was superior over jeevamrut culture.

**Table 6:** Changes in C:N ratio and days to maturity during composting as influenced by crop residue mixtures and decomposing culture

| Treatment | Days to maturity | C:N ratio | |
|---|---|---|---|
| | | Initial | Final |
| **Factor A-Crop Residue Mixtures** | | | |
| $CR_1$-Cotton stalk (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 137 | 77.15 | 21.16 |
| $CR_2$-Soybean straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 125 | 55.45 | 19.45 |
| $CR_3$-Wheat straw (50%) + Weed biomass (10%) + Leaf litter (10%) + Cowdung slurry (30%) | 148 | 89.63 | 21.51 |
| $CR_4$-Raw FYM (50%) + Weed biomass (10%) + Leaf litter (10%) + Cow dung slurry (30%) | 110 | 50.20 | 18.65 |
| **Factor B-Decomposing culture** | | | |
| $D_1$-PDKV Culture | 123 | - | 18.75 |
| $D_2$-CIRCOT Culture | 130 | - | 20.04 |
| $D_3$-Jeevamrut Culture | 137 | - | 21.79 |
| GM | 130 | 68.11 | 20.19 |

Lower C:N ratio might be due to the faster decomposition, lowering total carbon and increasing total N by enhancing the microbial acivity. Similar observation was reported Jeyapriya and Pandule *et al*. (2019) [16].

## Maturity of compost

The mean value of compost maturity was 130 days. Compost prepared from treatment raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$) was matured significantly earlier *i.e.*110 days followed by treatments soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_2$) at 125 days and treatment cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_1$) which 137 days. However, compost prepared from treatment $CR_3$-wheat straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) was matured later i.e. 148 days.

Compost prepared from treatment raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) compost ($CR_4$) was matured earlier *i.e.,* 110 day due to the lower C:N ratio of crop residue mixture and presence of more humic acid. Similar findings were reported by Aye (2016) [1], Nazirkar and Tambe (2016) [15] and Pandule *et al.* (2019) [16].

Among the three decomposing cultures, compost prepared from PDKV culture was matured significantly earlier *i.e.*123 days followed by CIRCOT and jeevanrut culture which matures 130 and 137 DAF respectively. Similar findings were reported by Shinde *et al.* (2016) [20] and Pandule *et al.* (2019) [16].

## Conclusion

Compost prepared with soybean straw (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) was significantly improved the quality in terms of higher EC, total N and P while raw FYM (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) recorded maximum decrease in pH (7.23), total carbon (19.25%), C:N ratio (18.65), maturity days (110) and increase in ash (66.8%) and cotton stalk (50%) + weed biomass (10%) + leaf litter (10%) + cowdung slurry (30%) was significantly recorded higher total K content. Among the decomposing cultures, PDKV culture recorded accelerated decomposition with the earliest maturity (123 days), maintained a relatively lower pH (7.25) and carbon content (19.93%) at maturity and higher EC (1.39 dS $m^{-1}$), and consistently recorded higher ash content (64.75%), and greater enrichment of N (1.05%), P (0.56%), and K 90.93%) throughout the decomposition process.

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