



RESEARCH ARTICLE

Comparative analysis of organic composts and their impact on seed germination and seedling growth of maize (*Zea mays* L.)

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Abstract

A study was conducted at the Research Institute on Organic Farming (RIOF), University of Agricultural Sciences, Bangalore, Karnataka, to characterise three different organic composts to evaluate their effects on seed germination and seedling growth in maize. Three composts selected for the study included farm compost, city compost and blended compost. Physical characterisation of composts revealed that all the three composts were black and free from foul odour. Farm compost exhibited the highest moisture content (35.00 %), bulk density (0.76 Mg m⁻³), while city compost exhibited maximum nutrient contents, including nitrogen (2.49 %), phosphorus (0.67 %), potassium (0.67 %), calcium (2.05 %), sulphur (0.40 %), zinc (389 mg kg⁻¹) and copper (205 mg kg⁻¹). It also contained higher concentrations of heavy metals such as cadmium (3.11 mg kg⁻¹), chromium (33.04 mg kg⁻¹) and lead (51.53 mg kg⁻¹), along with greater microbial populations. Studies on seed germination and seedling growth indicated that blended compost was the most effective medium for optimising early-stage maize development, yielding the highest germination percentage (94.33 %), vigour index (2147.33), seedling height (22.73 cm), number of leaves (3.00), leaf dry weight (0.427 g), stem dry weight (0.302 g) and root dry weight (0.154 g).

Keywords: characterisation; compost; germination; growth; maize

Introduction

Maize (*Zea mays* L.) is one of the three most widely consumed cereal crops globally, following wheat and rice (1). It has gained considerable commercial importance due to its ease of cultivation, wider adaptability, high yield potential and favourable market value. As a C4 plant, maize exhibits greater photosynthetic and physiological efficiency compared to other cereals (2) and performs well across diverse soil and climatic conditions. Globally, maize is cultivated over an area of 194 million hectares, with a production of 1148 million tonnes and an average productivity of 5.75 t ha⁻¹ (3). In India, it is grown throughout the year under varied agro-climatic conditions for multiple purposes, including grain, fodder, green cobs, sweet corn and industrial uses, contributing about 9 % to total food grain production (4).

In recent years, the increasing demand for food grains, coupled with a steady rise in maize area and productivity, has emphasised the need for sustainable nutrient management practices. Maize, due to its rapid growth and high nutrient requirements, responds strongly to soil amendments, particularly organic nutrient sources (5). Soils rich in organic matter, with good water-holding capacity and near-neutral pH, are considered ideal for achieving higher maize productivity (6). In this context, the use of compost has gained importance as a sustainable input.

Composting is an environmentally sound method of recycling livestock manure and organic wastes into stabilised humus or organic fertiliser (7). It aids in waste reduction, detoxification and nutrient recycling, thereby supporting sustainable agricultural production (8). The application of mature compost improves soil fertility and promotes plant growth (9). However, the effectiveness of compost largely depends on its degree of maturity, as several challenges may arise during composting process, including the presence of salts, metal ions, ammonium nitrogen and dissolved organic compounds (10).

These components influence key soil properties such as pH and electrical conductivity (EC), thereby affecting plant growth through changes in osmotic balance and enzyme activity (11). High levels of ammonium nitrogen may inhibit plant and microbial metabolism (12), while certain dissolved organic compounds can exert phytotoxic effects (i.e., harmful effects on plant growth) (13). The carbon-to-nitrogen (C/N) ratio is another important indicator of compost stability, as the release of low molecular weight organic acids during decomposition can hinder seed germination (14).

The germination index (GI) is widely used as a sensitive biological indicator to assess compost maturity and phytotoxicity, with values ≥ 70 % considered suitable for agricultural use (15). However, the application of immature

compost can negatively affect plant growth by reducing oxygen availability in the rhizosphere and releasing toxic intermediates (16). Moreover, municipal waste-based composts may contain heavy metals, which can delay germination and impair root development and overall crop performance (17).

Although several studies have evaluated individual parameters of compost quality, limited attention has been given to integrating physical, chemical and biological indicators in relation to crop response, particularly in maize. Given the sensitivity of maize during germination and early growth stages, such evaluation becomes crucial.

Therefore, characterisation of compost maturity is essential to ensure its safe and effective use. Various physical, chemical and biological approaches have been developed to assess compost quality and detect phytotoxicity (15, 18). In this context, the present study was undertaken to comprehensively evaluate different composts using these indicators, with particular emphasis on phytotoxic effects and their implications for maize growth.

Materials and Methods

Experimental site and study details

A study was conducted during kharif 2023 at Research Institute on Organic Farming (RIOF), University of Agricultural Sciences, Bangalore, Karnataka to characterise three different organic composts and to identify the impact of this compost on seed germination and seedling growth in maize. Three composts selected for the study include farm compost, city compost and blended compost (farm + city compost).

Preparation and source of composts

The farm compost was sourced from RIOF, Gandhi Krishi Vignan Kendra, Bengaluru, Karnataka. It was prepared by layering chopped crop residues including maize, finger millet and groundnut, with cow dung and cow urine. The heap was then plastered with a mixture of cow dung, soil and crop residues to form an outer layer. Moisture was maintained at 60–70 % without turning. The compost matured in 3 months was then sieved before use. The city compost procured from Karnataka Compost Development Corporation Limited, Bengaluru was produced using the aerobic windrow technique developed by Fletcher Sims. Segregated wet waste was arranged in windrows of 2–2.3 m in height and 1–3 m apart on a concrete platform. The windrows were then mixed with decomposed compost, treated with effective microorganism culture (1 kg per 1 metric ton of waste) and sprayed with cow dung slurry. Moisture and temperature were maintained at 50 % and 55–60 °C respectively and the windrows were turned every 8 days using an excavator to ensure aerobic conditions. Composting was completed in 4 weeks, followed by sieving through progressively smaller mesh sizes (35 mm, 16 mm and 4 mm) to obtain the final city compost, which was packed after curing the semi-finished material for 10 days. The blended composts were prepared by thoroughly mixing farm and city composts in precise proportions based on their recommended rate of 10 and 7.5 t ha⁻¹, respectively, as per the package of practices. The preparation process involved calculating the exact quantities of each compost type on a weight-by-weight basis. The three composite compost samples were shade-dried and sieved through a 2 mm mesh prior

to characterisation.

Procedure for characterisation of composts

Physical properties such as moisture and bulk density were measured from composts. The gravimetric water content method was employed to determine the moisture content in compost samples (19). Bulk density of the composts was measured using 50 mL volume container where composts were filled, gently tapped for several times (20) and the bulk density was then calculated using the formula (Eqn 1) given below:

$$\text{Bulk density (g cm}^{-3}\text{)} = \frac{W_2 - W_1}{V} \quad (\text{Eqn. 1})$$

Where, W_1 = Weight of the empty bottle (g)

W_2 = Weight of the bottle including compost (g)

V = Volume of water filling the bottle (cm³)

The electrochemical properties, including pH and EC, of the compost samples were determined using 1:10 (w/v) aqueous suspension of compost and water with a digital pH and conductivity meter. Organic carbon content was analysed by the dry combustion method (21). Laboratory scale extraction of humic substances from the three different organic manures was carried out by taking 10 g of air-dried compost samples into a 250 mL conical flask, to which 100 mL of 0.1 N NaOH was added. The mixture was stoppered and equilibrated for 24 hr using an end-over-end shaker. The supernatant containing humic acid and fulvic acid was separated from humin by centrifugation and collected. The extraction process was repeated until a clear supernatant was obtained and further extraction was carried out three times with 50 mL of extractant for complete recovery of the humic substances. The residue remaining after alkali extraction (humin) was oven-dried, weighed and expressed as percentage dry weight. The alkali extract was acidified to pH 2 with 2 N HCl, stirred well and allowed to stand at room temperature for 24 hr. The soluble humic and fulvic acid was separated from coagulate by centrifugation as described in earlier study (22, 23). The mixture was then separated by centrifugation and the process was repeated 3–4 times in succession and the residue was washed with distilled water, freeze-dried and weighed. The fulvic acid fraction was transferred into dialysis bags with a 100 molecular weight cut-off (MWCO) and dialysed against double distilled water for 24 hr. The dialysed fraction was then freeze-dried to obtain fulvic acid.

Nitrogen content was quantified using a Kjeldahl nitrogen analyser following digestion with a Gerhardt instrument. The C:N ratio of the compost samples was calculated by dividing the total organic carbon content by the total nitrogen content. Total phosphorus was measured by the vanado-molybdo phosphoric yellow colour method, with intensity measured at 460 nm using a spectrophotometer (24).

Potassium content was estimated using flame photometric analysis. Calcium and magnesium contents in di-acid digested samples were determined by titration with standard versenate solution (ethylenediaminetetraacetic acid), using murexide indicator for calcium and Eriochrome Black T (EBT) indicator for calcium plus magnesium and magnesium was calculated by their difference (21). Sulphur content was determined using the turbidimetric method (21). Micronutrients,

including iron, zinc, manganese and copper, were analysed using an atomic absorption spectrophotometer (AAS) with appropriate hollow cathode lamps (25). Heavy metals such as nickel, cadmium, chromium, lead and mercury were measured using inductively coupled plasma-optical emission spectrometry (ICP-OES, Model 700, Perkin Elmer, USA).

Compost samples were analysed for microbial populations, including bacteria, fungi and actinomycetes, using Nutrient agar, Rose Bengal agar and Kusters agar in petri plates. The plates were incubated at room temperature for 2–7 days and colonies were counted using a digital colony counter.

Germination and seedling growth performance

Certified seeds of maize procured from Arunodaya Seeds Private Limited, Bangalore, Karnataka were used for the study. Approximately 180 g of each compost sample was placed in seedling trays of 200 g capacity. For each treatment, three replicates were maintained with 25 seeds each. The seedlings were carefully uprooted at the end of the experimental period and both above-ground and below-ground responses were recorded. Agro-botanical parameters, including seedling height and number of leaves, were measured. Fresh and dry weights of the leaf, root and stem were also recorded.

Germination percentage (Eqn. 2) and vigour index (Eqn. 3) was calculated by using the formula (26) and is mentioned below:

$$\text{Germination percentage (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total seeds}} \times 100 \quad (\text{Eqn. 2})$$

$$\text{Vigour index} = \text{Germination percentage} \times \text{seedling length (shoot + root)} \quad (\text{Eqn 3})$$

The data were then subjected to one-way analysis of variance (ANOVA) and the significance of difference between means was determined by Duncan's multiple range test ($p < 0.05$) using OPSTAT (27).

Results and Discussion

The results of the compost characterisation including physical, electrical, chemical and biological properties are presented in Table 1.

Colour and odour

The three composts such as farm, city and blended composts were black, homogenous, with a fine powdery texture and free from any foul odour, which indicates maturity and stability of composts where complex organic materials had fully decomposed into stable humic substances such as humic acid, fulvic acid and humin (18, 28). The absence of foul odour can be attributed to continuous aeration of the compost pile, which restricts the formation of anaerobic zones responsible for odour emissions (29).

Moisture content

The moisture content of the collected composts was within the range of 20–40 % and the difference in moisture content was primarily attributed to the composting methods employed. Farm compost, prepared using the heap method, had limited aeration and therefore retained higher moisture (35.00 %). This may also be due to the addition of cow dung slurry and frequent watering to maintain the optimal microbial activity. City compost, prepared by the aerobic windrow method, exhibited lower moisture content (22.40 %). This method maintains optimal oxygen levels through regular turning, which enhances microbial activity and

Table 1. Physical, electrochemical, chemical and biological properties of composts

Parameters	Farm compost	City compost	Blended compost
Physical properties			
Colour	Black	Black	Black
Odour	No foul odour	No foul odour	No foul odour
Moisture (%)	35.00	22.40	27.20
Bulk density (Mg m ⁻³)	0.77	0.76	0.72
Electrochemical properties			
pH	7.42	6.55	7.01
Electrical conductivity (dS m ⁻¹)	3.16	2.19	1.32
Chemical properties			
Organic carbon (%)	22.96	27.08	26.69
Humic acid (%)	4.12	6.35	5.12
Fulvic acid (%)	2.47	3.65	3.05
Humin (%)	93.41	90.00	91.83
C:N ratio	15.72	10.87	10.80
Total nitrogen (%)	1.46	2.49	2.47
Total phosphorus (%)	0.54	0.67	0.55
Total potassium (%)	0.46	0.67	0.50
Total calcium (%)	1.07	2.05	1.42
Total magnesium (%)	0.54	0.28	0.48
Total sulphur (%)	0.23	0.40	0.31
Iron (mg kg ⁻¹)	9785	8358	7169
Zinc (mg kg ⁻¹)	123	389	199
Manganese (mg kg ⁻¹)	583	182	321
Copper (mg kg ⁻¹)	29.21	205	71.15
Nickel (mg kg ⁻¹)	31.09	22.27	24.70
Cadmium (mg kg ⁻¹)	ND	3.11	2.14
Chromium (mg kg ⁻¹)	23.14	33.04	29.46
Lead (mg kg ⁻¹)	24.96	51.53	17.16
Mercury (mg kg ⁻¹)	ND	ND	ND
Biological properties			
Bacteria (CFU g ⁻¹)	3 × 10 ⁷	12 × 10 ⁷	8 × 10 ⁷
Fungi (CFU g ⁻¹)	10 × 10 ⁴	27 × 10 ⁴	12 × 10 ⁴
Actinomycetes (CFU g ⁻¹)	15 × 10 ³	18 × 10 ³	14 × 10 ³

the decomposition of organic matter. These microbial processes generate substantial energy, resulting in elevated internal temperatures. These high temperatures further accelerated the composting process, enhanced evaporation and facilitated the removal of excess moisture, leading to rapid drying (30). Blended compost exhibited intermediate moisture content (27.20 %), falling between that of farm and city compost. This could be attributed to the redistribution of moisture during the blending process, balancing the moisture retention capacity of farm compost with the drying effect of city compost (31).

Bulk density

Bulk density indicates the gradual progression of the decomposition process (32). Among the three composts, farm compost exhibited the highest bulk density (0.77 Mg m⁻³) followed by city compost (0.76 Mg m⁻³), while the lowest was observed in blended compost (0.72 Mg m⁻³). This may be attributed to differences in porosity, organic matter content, surface area and moisture levels, with blended and city composts having a more porous structure, higher surface area and lower moisture content compared to farm compost (33).

pH

The optimal pH range for high-quality compost is between 6.0 and 7.5 (34). All the composts used in the study fell within this range, confirming their suitability as soil amendment. The pH of farm compost was 7.42, slightly alkaline in nature. City compost was slightly acidic in nature (6.55). Blended compost recorded a near-neutral pH (7.01) which may be attributed to the neutralisation effect of acidic and alkaline components present in city and farm compost respectively, resulting in a more balanced pH.

Electrical conductivity

Electrical conductivity (EC) values recorded in this study fall within the acceptable limits for mature compost (<6.0 for city compost and <5.0 for farm compost) as per Fertilizer Control Order (FCO) standards, indicating the absence of phytotoxic compounds (35). Among the three composts, the highest EC was observed in farm compost (3.16 dS m⁻¹) followed by city compost (2.19 dS m⁻¹) and lowest in blended compost (1.32 dS m⁻¹). The higher EC in farm compost could be attributed to higher concentration of ions, as decomposition of organic materials releases ions that may have accumulated in the farmyard manure (FYM). Organic materials upon decomposition liberate basic ions that accumulate on the surface of composts and raise the EC of compost (36–38).

Organic carbon

Among the three composts, organic carbon content was highest in city compost (27.08 %) followed by blended compost (26.69 %) and lowest in farm compost (22.96 %). The higher carbon content observed in city compost compared to farm compost may be attributed to the presence of more stable and humified organic matter, formed through the decomposition and transformation of complex organic compounds into simpler, more stable forms (39). Additionally, microbial assimilation of carbon by the effective microorganisms introduced during composting might have contributed to the elevated carbon levels (40).

Humic fractions

Humic substances are the key components of humified organic matter and consist of humic acid, fulvic acid and humin (41). Characterisation of humic fractions revealed that city compost

exhibited the highest concentrations of humic acid (6.35 %) and fulvic acid (3.65 %) followed by blended compost with humic acid (5.12 %) and fulvic acid (3.05 %). The farm compost yielded the lowest proportions of humic acid (4.12 %) and fulvic acid (2.47 %).

The quantity of humic compounds in finished compost depends on the nature of the input material and active composting time needed for compost production (42). The city compost had more nutrient content and an effective microorganism culture was added during the production process. Humification occurs more intensively and quickly in composting piles inoculated with microorganisms (43). Hence the production of amino acids and reducing sugars during the degradation process might have boosted the synthesis of humic substances in city compost (44). The lowest fractions of humic substances in farm compost might be attributed to the inclusion of green waste, crop residues and shredded straw rich in decomposition-resistant lignin and cellulose. This could have hindered the humification process as well as the duration and quality of the composting process (31, 45). Humin content was highest in farm compost (93.41 %) followed by blended compost (91.83 %) and lowest in city compost (90.00 %). This could be due to the higher proportion of recalcitrant organic matter such as lignin and cellulose in residues used to prepare farm compost which increased the humin content (46).

C:N ratio

C:N ratio is indicative of advanced process of composting (47) and ratio of the final compost used in the study aligned with the recommended range of 10–15:1. Among the composts, C:N ratio was observed in farm compost (15.72) followed by city compost (10.87) and lowest in blended compost (10.80). High C:N ratio in farm compost might be due to the presence of crop residues that contain lower proportion of nitrogen and may also be related to lower microbial degradation because of an imbalanced C:N ratio in composting material (48) whereas the combination of nitrogen-rich inputs, diverse organic materials, higher microbial activity and efficient composting practices might be the reason for low C:N ratio in city and blended compost.

Major nutrients

The total nitrogen, phosphorus and potassium content contents were highest in city compost (2.49 %, 0.67 % and 0.67 %, respectively) followed by blended compost (2.47 %, 0.55 % and 0.50 %, respectively) and lowest in farm compost (1.46 %, 0.54 % and 0.46 %, respectively). Higher total nitrogen, phosphorus and potassium content in city compost could be linked to variations in the nutrient content of composting materials used for its preparation (31, 49).

Secondary nutrients

Total calcium and sulphur contents were highest in city compost (2.05 % and 0.40 %, respectively), followed by blended compost (1.42 % and 0.31 %, respectively), while farm compost had the lowest levels (1.07 % and 0.23 %, respectively). The increased calcium and sulphur content might be due to the production of calcium oxides, hydroxides and sulphates during organic matter decomposition. Total magnesium content was highest in farm compost (0.54 %) followed by blended compost (0.48 %) and lowest in city compost (0.28 %). Higher magnesium content might be due to magnesium-rich crop residues added during the preparation of compost (31).

Micronutrients

Farm compost exhibited higher concentrations of iron (9785 mg kg^{-1}), manganese (583 mg kg^{-1}) and nickel (31.09 mg kg^{-1}). Conversely, zinc (389 mg kg^{-1}) and copper (205 mg kg^{-1}) contents were highest in city compost. The concentration of the micronutrients in the raw materials used for the composting could be the reason for the variation in micronutrient content in the composts (31, 50–53).

Heavy metals

Data on heavy metals concentration in composts revealed that cadmium content was highest in city compost (3.11 mg kg^{-1}) followed by blended compost (2.14 mg kg^{-1}) and was not detected in farm compost. The blending of city compost (which contains cadmium) with farm compost (cadmium-free) resulted in a dilution of total cadmium concentration. Since farm compost did not contribute any cadmium, mixing it with city compost proportionally lowered the overall cadmium content in the final blended compost. Chromium content was highest in city compost (33.04 mg kg^{-1}) followed by blended compost (29.46 mg kg^{-1}) and lowest in farm compost (23.14 mg kg^{-1}). The lead content was highest in city compost (51.53 mg kg^{-1}) followed by farm compost (24.96 mg kg^{-1}) and lowest in blended compost (17.16 mg kg^{-1}). Mercury was not detected in any of the three composts, which may be due to its low initial concentration and volatile nature. Comparable ranges of heavy metal concentrations have been reported in previous studies (39).

Biological properties of compost

Enumeration of bacteria, fungi and actinomycetes in the three composts during the experiment revealed that total bacterial ($12 \times 10^7 \text{ CFU g}^{-1}$), fungal ($27 \times 10^4 \text{ g}^{-1}$) and actinomycetes ($18 \times 10^3 \text{ CFU g}^{-1}$) population was more in city compost. Blended compost has moderate level of bacterial ($8 \times 10^7 \text{ CFU g}^{-1}$), fungal ($12 \times 10^4 \text{ CFU g}^{-1}$) and actinomycetes ($14 \times 10^3 \text{ CFU g}^{-1}$) population whereas the lowest population of bacterial ($3 \times 10^7 \text{ CFU g}^{-1}$), fungal ($10 \times 10^4 \text{ CFU g}^{-1}$) and actinomycetes ($15 \times 10^3 \text{ CFU g}^{-1}$) was observed in farm compost. The higher microbial population in city compost might be the result of complex organic matter, high carbon content, lower C:N ratio and more nutrient concentration that acted as a substrate for the growth of microorganisms compared to farm compost (31).

Influence of different compost on seed germination and agrobotanical characters of maize

Incompletely decomposed compost can inhibit seed germination; therefore, biotoxicity testing is essential for assessing compost quality and indexes such as germination percentage are reliable

indicators of phytotoxicity (16, 54, 55). Among the three composts, germination percentage was significantly higher for blended compost (94.33 %) followed by city compost and lowest in farm compost (Fig. 1). The results indicate that none of the three composts exhibited phytotoxicity, as there was no inhibition of germination in maize. A study reported that seed germination is inhibited by phytotoxic substances such as low molecular weight organic acids, heavy metals and inorganic nitrogen in the aqueous extracts of composts (54–56). Blended compost used in this study had balanced nutrient profile, neutral pH, lower heavy metal content, reduced EC and optimal organic carbon concentration that have created more favourable environment for maize seed germination compared to city compost and FYM (57).

Vigor index is an important parameter for determining fast and uniform emergence and seedling establishment under a wide range of field conditions (58, 59). In the present study, the seedling vigour index was calculated based on seedling length and germination percentage. The results showed that blended compost recorded the highest vigour index (2147.33) which was in turn on par with city compost (1701.33). Farm compost exhibited the lowest vigour index (1363.67) and was on par with city compost (Fig. 1).

Seedling height and number of leaves influenced by different composts are illustrated in Fig. 2 and 3. Blended compost recorded significantly higher seedling height (22.73 cm) and lowest was recorded in farm compost (16.04 cm) which was on par with city compost (19.35 cm). Number of leaves were more in blended compost (3.00) which was on par with city compost (2.67) with the lowest recorded in farm compost (2.00).

Root characteristics of maize seedlings influenced by different compost are illustrated in Fig. 4. The number of roots in maize seedlings were highest in blended compost (8.66) whereas it was lowest in farm compost (4.67) which was in turn on par with city compost (6.66). The length of longest root was also significantly higher in blended compost (12.83 cm) while the lowest value was recorded in farm compost (6.33 cm) and was on par with city compost (8.73 cm). Leaf, stem and root fresh and dry weight influenced by the composts is graphically shown in Fig. 5. Leaf fresh weight was significantly higher in blended compost (0.794 g) followed by city compost (0.581 g) which was on par with farm compost (0.464 g). A similar trend was observed for stem fresh weight, with blended compost recording the highest value, comparable to city compost (0.460 g), while the lowest was observed in farm compost (0.318 g). Root fresh

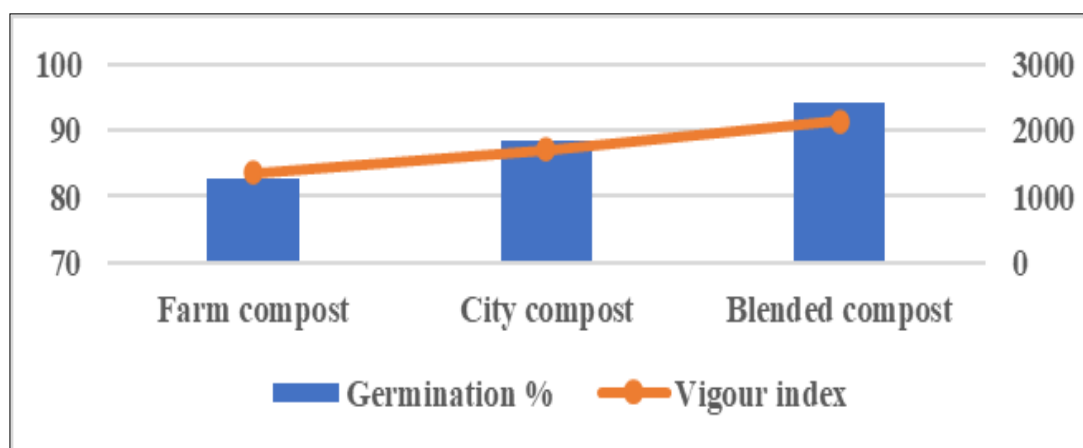


Fig. 1. Germination percentage and vigour index as influenced by different compost ($p \leq 0.05$).



Fig. 2. Seedling performance in different compost ($p \leq 0.05$).

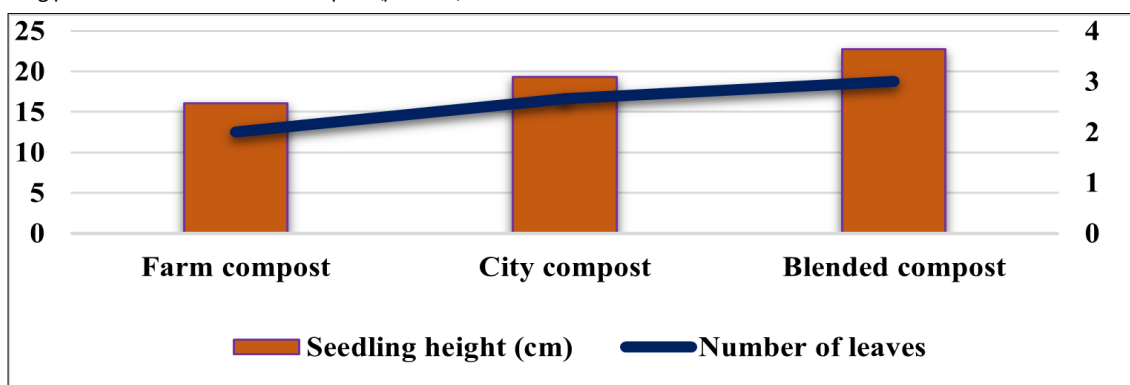


Fig. 3. Seedling height and number of leaves as influenced by different compost ($p \leq 0.05$).

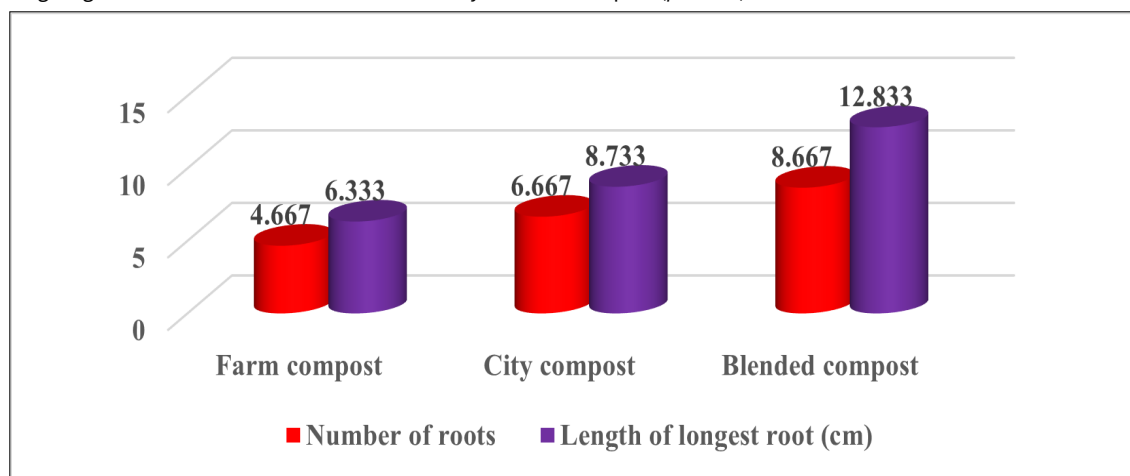


Fig. 4. Number of roots and length of longest root as influenced by different compost ($p \leq 0.05$).

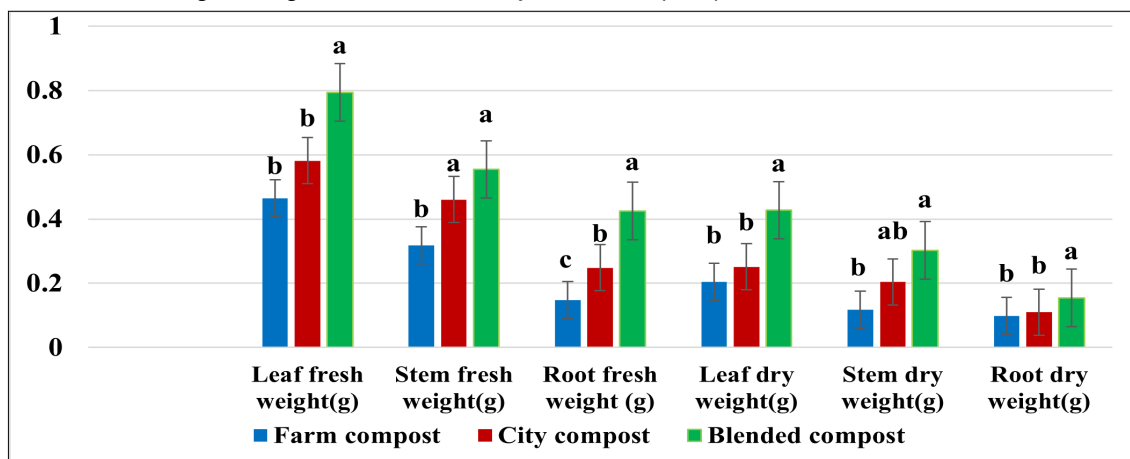


Fig. 5. Leaf, stem, root fresh and dry weight as influenced by different composts ($p \leq 0.05$).

weight was highest in blended compost (0.425 g) followed by city compost (0.248 g) and the lowest in farm compost (0.148 g). Leaf, stem and root dry weight was highest in blended compost (0.427, 0.302 and 0.154 g, respectively). The lowest leaf, stem and root dry weight was recorded in farm compost (0.204, 0.117 and 0.098 g, respectively) and were on par with city compost (0.251, 0.204 and 0.110 g, respectively).

The enhanced growth parameters observed in blended compost can be attributed to its lower bulk density, which improves soil porosity and aeration, thereby creating an optimal environment for root proliferation and development. In addition, the balanced nutrient composition of blended compost ensures a steady supply of essential macro- and micronutrients required for vigorous seedling growth. Overall, the findings indicate that blending different composts is more effective than using them individually, as it helps mitigate potential phytotoxic effects associated with elevated pH, electrical conductivity, bulk density and heavy metal content.

Conclusion

The findings of the present study indicate that city compost was more nutrient-dense compared to farmyard manure (FYM). The combined application of FYM and city compost in appropriate proportions significantly improved seedling emergence, vigour and overall seedling health, highlighting its potential to enhance germination quality. Characterisation of the composts played a crucial role in identifying nutrient levels and potential phytotoxic effects, ensuring the safe and effective use of composts for seed germination. The study emphasised that the absence of phytotoxicity in the compost blends contributed to the superior seedling performance, making it a valuable approach for promoting healthy seedling development in germination studies.

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Authors' contributions

SNS conceptualised the idea, conducted the literature search, prepared the original draft and contributed to writing, reviewing, editing and drafting the manuscript. BB contributed to conceptualised the idea, the literature search and manuscript review, resource acquisition and supervised the editing of manuscript. SA reviewed and drafted the manuscript. VR reviewed and drafted the manuscript. All authors have read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interest to declare.

Ethical issues: None

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