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PREPARATION OF ORGANIC FERTILIZER FROM SOLID WASTE AND ITS APPLICATION IN VEGETABLE PRODUCTION

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ABSTRACT

The economics and food security of Asian nations are significantly influenced by agriculture. The gardens, hostels, residential societies and organizations discard a significant amount of solid waste. This research aimed to convert the solid waste into organic fertilizer, to evaluate physiochemical composition of compost and its influence on the growth (germination and proximate analysis) of *Spinacia oleracea* L., *Trigonella foenum-graecum* L., *Brassica campestris* L. The solid waste of gardens, hostels and residential colony of University of Veterinary and Animal Sciences was composted by bin composting method. The compost pH 7.9, EC 1.43 mS/cm, moisture content 39%, total organic carbon (TOC) 5.17% and total nitrogen (TN) 1.51% were recorded. The seeds of three vegetables were sown in pots filled with different ratios of compost and soil; T1-100% soil, T2-25:75, T3-50:50, T4-75:25 and T5-100% compost using Complete Randomized Design (CRD) and three replicates per treatment. The growth of three leafy vegetables was significantly increased in all treatments as compared to control. In T4, maximum plant heights 23.99cm, 34.60cm and 68.38cm were recorded for *T. foenum-graecum* L., *S. oleracea* L. and *B. campestris* L. respectively. The highest number of leaves were 26.83 in *T. foenum-graecum* L. in T5 while in *S. oleracea* L. and *B. campestris* L. maximum leaf number (129.25 and 16.58) were recorded in T4. In T5, root length of 21.90cm and 21.56cm in *T.foenum-graceum* and *S. oleracea* was maximum. while maximum root length of 18.50cm was recorded in T4 in *B. campestris*. The highest plant biomass (48.88g for both *T. foenum-graceum and S. oleracea* and 31.44g in *B. campestris*) were in T4 and T5. The proximate analysis of vegetables showed that concentration of crude protein (14.65% in *S. oleracea* L., 18.81% in *T. foenum -graceum* L., 21.21% in *B. campestris* L.) was maximum in T4. Carbohydrate content in all vegetables decreased with increase in compost quantity. In the present study, the proximate composition of spinach, fenugreek and mustard leaves were first time presented under the influence of different compost and soil treatments that concluded solid waste organic fertilizers (especially at 75% compost + 25% soil) had positive impact on growth parameters as well as nutritional content of used three vegetable crops studied.

Keywords: Compost, Physico-chemical, *Spinacia oleracea* L., *Trigonella foenum-graecum* L., *Brassica campestris* L., Proximate.

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INTRODUCTION

The aim of this research was to assess the effect of compost on the growth, development, proximate composition and yield of spinach, fenugreek and mustard. As cool-season crops, these three vegetables grow well in winter temperatures which makes them ideal for winter trials and ensures natural growth conditions without artificial climate control. The compost produced by biological decaying of organic matter is used as plant fertilizer (Sayara *et al*., 2020). Romans and Greeks were also familiar with compost and during 8th century human manure was utilized to increase plant growth and soil properties (Antonkiewicz and Łabętowicz, 2016). Various forms of raw material are used in the formation of organic compost including food waste and crude sewage (Chen *et al*., 2021), pig manure (Afonso *et al*., 2021; Liu *et al*., 2021), sewage of blue green algae, rice straw, animal feces (Zhang *et al*., 2021), garden left-overs (Jara-Samaniego *et al*., 2017) agricultural waste (Ajmal *et al*., 2020), cereal grasses, olive trimming, alperujo (solid and liquid olive waste) and poultry manure (Toledo *et al*., 2020).

Composting bins are beneficial for transfer of waste into organic fertilizer that helps to conserve energy and natural resources (Mahapatra *et al*., 2022). The composting process encompasses three phases mesophilic (30-39°C), thermophilic (40- 80°C) and maturation phase (25°C). Finally there is a cooling phase in which lack of substrate inhibits microbial growth, oxygen intake and heat production (Palaniveloo *et al*., 2020; Sardar *et al*., 2021)

The concentration of organic matter in soil is normally less than 1 percent in hot climate that makes soil less fertile and reduce its water holding capacity (Civeira, 2010). The introduction of compost as a fertilizer in soil improves buffering capacity of soil, increase plant growth and prevent plants from disease (Palaniveloo *et al*., 2020). In spinach and potato, a mixture of municipal solid waste (MSW) compost and soil (50% and 75% respectively) provided maximum growth as compared to the control. The *Cucurbita* (squash), *Solanum tuberosum* (potato), *Zea mays* (corn) were treated with MSW compost and nitrogen, phosphorus, potassium (NPK) fertilizer. The best growth and yield of potato and corn was obtained in 0.5% MSW and 0.5% NPK while squash showed best growth in the presence of NPK (Ghaly and Alkoaik, 2010). The combined treatment of municipal waste compost (MWC), poultry manure (PM) with phosphorus (P) increased soil properties, spinach growth and its elemental composition (Maftoun *et al*., 2005). The organic compost and inorganic N increased spinach growth and carotenoids concentration while use of inorganic N reduced antioxidant activity of spinach by decreasing amount of phenolic compounds and gallic acid in spinach leaves (Machado *et al*., 2020). The use of composted cow manure and leaf litter also increased spinach growth, nutrient uptake, P and K concentration (Anwar *et al*., 2017).

The highest growth and yield of fenugreek seeds with improved protein and saponin content was obtained in 10 t/fed compost concentration (Abdou and Abdel-Fatah, 2021). Similarly, the germination rate of fenugreek seeds was 90% at all treatments of olive pomace compost (10%, 15%, 20% and 25%). While maximum seed germination rate (100%), improved root length and dry weight of fenugreek seedlings was achieved with 5% compost concentration (Ameziane *et al*., 2020). The utilization of compost water extract with micronutrient solutions increased fenugreek growth and provided better results than chemical fertilizers (Ibrahim, 2019). The yield of mustard seeds in (50% compost/bioF + 50% chemical fertilizer) was increased to 5.34% as compared to control (Haque *et al*., 2010). The collective use of compost, biofertilizer, chemical fertilizer and growth regulators (cycocel) had positive effects on morpho-physiological characteristics of mustard plants, enhanced leaf area index, leaf area duration, crop growth rate and net assimilation rate (Banerjee *et al*., 2012) .

Using different ratios of compost-soil significantly affects the growth, yield and nutritional composition of vegetables. An optimal compost-soil mix will enhance plant performance due to improved nutrient availability and soil structure. Compost improves nutrient supply which support better root development (Zhang *et al*., 2020). Previous studies showed that combination of compost and soil improved soil condition and increased nutritional quality (protein, minerals) of vegetables (Kumar *et al*., 2015). The objectives of this study are to develop organic compost from solid waste, check its physico-chemical composition and to evaluate the effect of different soil-compost ratios on growth, yield and nutritional parameters of three leafy vegetables.

MATERIALS AND METHODS

Collection of raw material used for bin composting method: The solid waste of vegetables, fruits, food waste, grass cuttings and used papers from hostels, gardens and housing colony of University of Veterinary and Animal Sciences Ravi Campus (UVAS-RC) Pattoki were collected.

Preparation of Compost: The collected waste was carried to the Department of Biological Sciences, UVAS-RC and transformed to compost by using bin composting method. The diameter of bin was 30 cm with 56 cm length. The solid waste material was crushed into small pieces using cutter and weighed through weighing scale. The whole raw material was piled into bin. The moisture content of the pile was maintained to 40-60%. Small holes were made in bins for proper aeration and aerobic composting, and no inoculum was given. The turning of composting material was done regularly. The composting was done for three months but maturation process was completed in six months (Ajaweed *et al*., 2022).

Determination of physiochemical composition of compost: During composting, the temperature was recorded by inserting thermometer 25 cm deep into the pile (Taiwo and Oso, 2004). The pH of compost was determined by using a pH meter Milwaukee (MW 802). The sample (solid compost) was diluted (1:10 weight by volume) for pH determination (Taiwo and Oso, 2004). The electrical conductivity (EC) was tested using an EC meter Milwaukee (MW 802) from sample solution (1:10 weight by volume) (Jara-Samaniego *et al*., 2017). The moisture content (MC) was checked by oven drying the sample at 105 ºC until a constant weight obtained (Ajmal *et al*., 2020). The total organic carbon (TOC) was analyzed by Walkley and Black method (Schumacher, 2002). Total nitrogen (TN) concentration in compost and soil was determined by using Kjeldahl method. The samples were digested with concentrated sulfuric acid (Abrams *et al*., 2014).

Experimental Design: The experiment was performed in Completely Randomized Design (CRD) in which earthen pots of 22 cm length and 20 cm diameter were used. Treatments applied were T1 (Control)= 100% soil, T2= 50% compost + 50% soil, T3= 25% compost + 75% soil, T4= 75% compost + 25% soil and T5= 100% compost. Tested treatments (T2, T3, T4, T5) and control (T1) experiment were run parallel in triplicates. The experiment was run parallel using 3 vegetables, 5 compost-soil ratios (treatments) and 3 pots per treatment grown in natural light.

Determination of effect of compost on the growth of vegetables: Three winter season vegetables (Spinach, Fenugreek and Mustard) were selected to check the effect of compost as fertilizer. The seeds (10) of each vegetable were sown during 25 October, 2021. The seed germination was observed each day after sowing. The plant height (cm), root length (cm), number of leaves, no. of flowers, and no. of pods were recorded on daily basis taking three plants per treatment. Whereas, biomass (g) was recorded at the end of growing season (Gajalakshmi and Abbasi, 2002). Germination (% age) was calculated according to (Maruthi *et al*., 2008). Germination rate index (GRI) was also determined (Al-Ansari and Ksiksi, 2016).

Determination of proximate composition of vegetables: The ash, crude protein, crude fat, crude fiber and crude carbohydrate contents were determined according to standard methods of AOAC (Abrams *et al*., 2014). The proximate analysis was conducted using vegetable leaves at the stage of maturity at Animal Nutrition Laboratory, central Laboratory Complex, UVAS Ravi Campus Pattoki.

Statistical analysis: The effect of different levels of compost treatments on vegetable growth parameters and proximate composition was analyzed by using One-way analysis of variance (ANOVA). Five treatments were applied to three different crops separately. Five treatments in triplicates applied on one crop is a single factor experiment. Therefore, One-way analysis of variance (ANOVA) was applied on the data of each crop separately. While differences among treatments were analyzed by Duncan Multiple Range test at 5% significance level using SPSS software version 20.0.

RESULTS

The preparation of organic compost, physicochemical analysis of compost and effects of compost on the growth and yield of vegetable were investigated and following results were obtained.

Preparation of organic compost: The compost formed is shown in (Figure 1). The compost was dark brown in color and granular in texture.

Figure1: Compost prepared from solid waste by bin composting

Physicochemical composition of compost: The temperature was increased linearly during initial weeks and highest recorded temperature was 68ºC at the end of 3rd week. After this temperature was decreased sharply and reached to ambient temperature at the end of 12th week (Figure 2). A gradual rise and fall in pH were observed and after 12 weeks recorded pH was 8.8. The pH of final product was 7.9 (Figure 2).

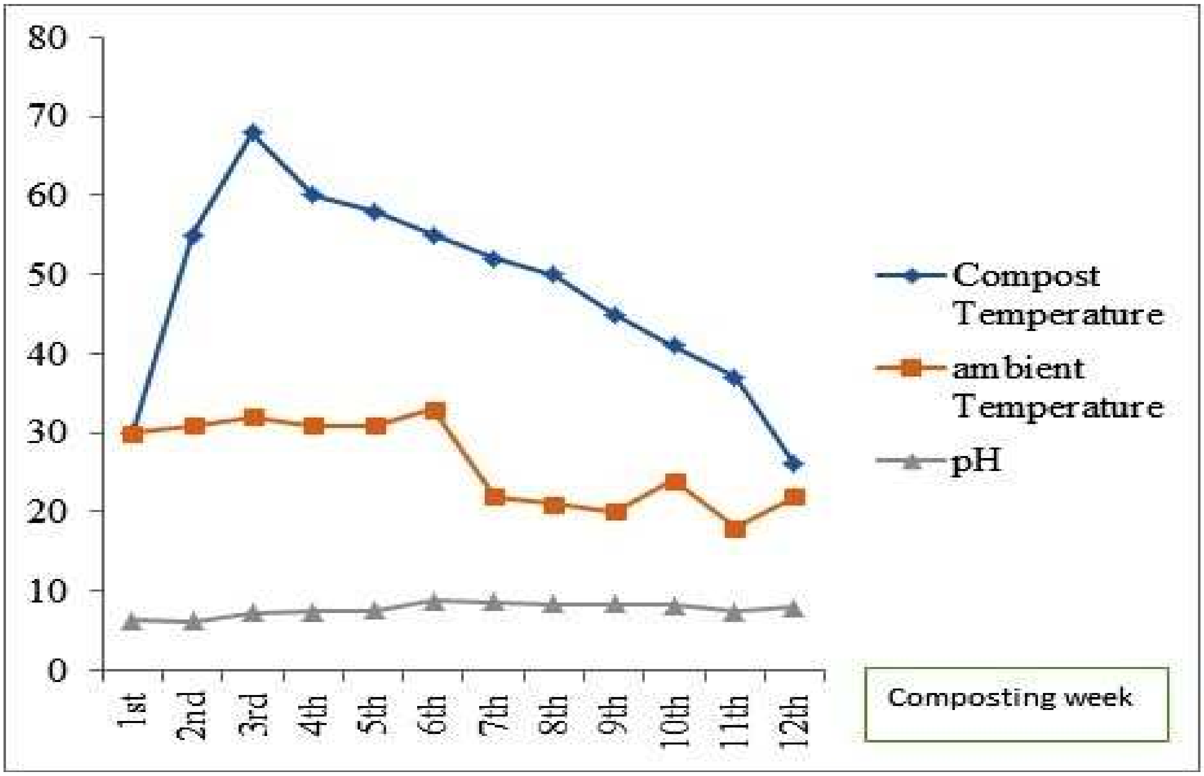

Figure 2. Variation in temperature and PH of compost with time

The results of electrical conductivity (EC), moisture content (MC), total oxygen content (TOC) and total nitrogen (TN) of prepared organic compost and soil are given in (Table 1) that shows high moisture content, organic content and nitrogen concentration in the compost compared to soil.

Table 1. Calculated parameters of compost and soil.

Parameters	Compost	Soil
EC	1.43mS/cm	0.16mS/cm
MC	39%	2%
TOC	5.17%	0.50%
TN	1.51%	0.45%

Effects of compost on vegetable growth

Germination (age %): The seeds of all tested vegetables were germinated and percentage of germination was 100% in all the treatments.

Germination rate index (GRI): The germination rate index values were >100 in all treatments indicated that organic compost was non phytotoxic.

Effects of different levels of compost and soil on Vegetables: The (Table 2) showed the maximum plant height mean value (23.94 cm) was recorded in T4 of *S. oleracea*. Number of leaves of all compost treatments were significantly higher than T1. The maximum number of leaves (26.83) and highest root elongation rate (21.90 cm) was recorded in T5. Whereas, maximum plant biomass (48.88 g) was recorded in T4 of *S. oleracea*. The height of *T. foenum-graecum* plant was increased with increasing concentration of compost from T2 to T5. The maximum plant height (34.60 cm) and number of leaves (129.25) were recorded in T4. The maximum root length (21.56 cm) and plant biomass (48.88 g) was measured in T5 of *T. foenum-graecum*. In case of *B. campestris,* maximum plant height (68.38 cm) was measured in T4. Highest number of leaves (16.58) and root length (18.50 cm) was measured in T4. The maximum number of flowers 41.66 were recorded in T4. In T5 of *B. campestris* maximum pod number was (121.66) observed. The maximum plant biomass value was (31.44 g) in T4. All obtained values were higher than biomass of plants grown in T1 (2.33g).

Table 2. Effects of different levels of compost on plant height, leaf number, root length, number of flowers, fruits and plant biomass of *S. oleracea*, *T. foenum-graecum* and *B. campestris.*

Growth parameters	Treatments				
	T1	T2	T3	T4	T5
S. oleracea					
Plant height(cm)	13.78 ± 3.71^{a}	19.47 ±7.44^{a}	22.80 ±7.76^{a}	23.94 ± 7.90^{a}	22.89 ± 7.67^{a}
Number of leaves	12.99 ± 3.42^{a}	18.41 ±7.72^{a}	21.24 ±7.91^{a}	24.16 ± 7.72^{a}	26.83 ± 8.31^{a}
Root length (cm)	15.10 ± 1.17^{c}	17.46 ±1.38^{bc}	18.16 ±0.89^{abc}	20.56 ± 0.44^{ab}	21.90 ± 1.52^{a}
Plant biomass (g)	13.33 ± 0.57^{d}	24.44 ±0.80^{c}	36.66 ± 0.38^{b}	48.88 ± 0.29^{a}	37.77 ± 0.86^{b}
T. foenum-graecum					
Growth parameters	**Treatments**				
	T1	**T2**	**T3**	**T4**	**T5**
Plant height(cm)	22.22 ± 7.00^{a}	26.94 ± 10.04^{a}	29.48 ± 9.40^{a}	34.60 ± 11.87^{a}	30.66± 11.31^{a}
Number of leaves	67.41 ± 22.95^{a}	93.74± 40.35^{a}	109.58 ± 50.81^{a}	129.33 ±55.35^{a}	119.58± 52.78^{a}
Root length (cm)	13.30 ± 0.30^{c}	13.43 ± 0.78^{c}	14.23 ± 0.72^{bc}	16.90 ± 1.52^{b}	21.56 ± 0.88^{a}
Plant biomass (g)	17.21 ± 0.80^{e}	21.10 ± 1.46^{d}	26.10 ± 0.77^{c}	31.10 ± 1.35^{b}	36.66 ± 1.07^{a}
Number of flowers	33.33 ± 8.98^{b}	34.33 ± 0.02^{b}	51.00 ± 2.64^{a}	55.00 ± 2.88^{a}	45.00 ± 2.30^{ab}
B. campestris					
Growth parameters	**Treatments**				
	T1	**T2**	**T3**	**T4**	**T5**
Plant height(cm)	30.46 ± 11.22^{a}	56.04 ± 20.70^{a}	63.86 ± 26.37^{a}	68.38 ± 24.97^{a}	59.11 ± 21.68^{a}
Number of leaves	7.165 ± 0.55^{a}	10.58 ± 2.36^{a}	12.99 ± 3.38^{a}	16.58 ± 4.72^{a}	13.66 ± 3.05^{a}
Root length (cm)	10.76 ± 0.39^{c}	12.20 ± 0.68^{bc}	15.40 ± 1.13^{ab}	18.50 ± 1.32^{a}	17.50 ± 1.44^{a}
Plant biomass (g)	2.33 ± 0.50^{c}	21.99 ± 1.34^{b}	30.88 ± 1.28^{a}	31.44 ± 1.78^{a}	25.44 ± 3.27^{ab}
Number of flowers	10.00 ± 4.04^{d}	20.66 ± 2.33^{c}	37.00 ± 4.04^{ab}	41.66 ± 2.18^{a}	31.00 ± 2.08^{b}
Number of fruits (pods)	12.33 ± 3.17^{b}	101.00 ± 19.60^{a}	113.33 ± 26.19^{a}	120.33 ± 6.00^{a}	121.66 ± 38.22^{a}

Different letters in each group show significant difference at $p < 0.05$. T1: 100% soil (control); T2: (25:75); T3: (50:50); T4: (75:25); T5: (100% compost).

Proximate composition of Vegetables: The (Table 3) showed that in T2 of *S. oleracea* maximum ash content (35.9%) and crude fiber content (18.2%) was recorded. The maximum crude protein contents (14.65%) were observed in both T4 and T5. Whereas, crude carbohydrate content was observed maximum (55%) in T1. In *T. foenum-graecum* treatments, highest ash content was found T3 (25.7%). In T4 (20.12%) highest crude protein contents were recorded. The maximum crude fat (2.34%) was in T1. The maximum crude fiber contents (24.8%) were in T3. The maximum crude carbohydrates were in T1 (44.96%). In case of *B. campestris,* maximum ash content (22%) was recorded in T5. In T4 (23.24%) highest crude protein contents were recorded. There was no significant difference in crude fat contents of *B. campestris* in all compost treatments and control, however, maximum crude fat (4.52%) was in T5. The maximum crude fiber contents (23.9%) were recorded in T2 and maximum crude carbohydrates were in T1 (54.79%).

Table 3. Effects of different levels of compost on proximate composition of vegetable *B. campestris*, *T. foenum-graecum* and *S. oleracea*.

Treatment	Ash	Crude protein	Crude fat	Crude fiber	Crude carbohydrate
***B. campestris* (%)**					
T1	19.5	6.56	3.45	15.7	54.79
T2	22.2	7.43	4.12	23.9	42.35
T3	24.5	20.78	4.13	22.7	27.89
T4	21.8	23.24	3.97	17.3	33.69
T5	22	21.21	4.52	20.4	31.87
T. foenum-graecum					
T1	21.9	9.4	2.34	21.4	44.96
T2	23.4	10.93	2.15	25.0	38.52
T3	25.7	11.37	2.09	26.9	33.94
T4	22.8	20.12	2.23	24.2	30.65
T5	23.1	18.81	1.95	24.8	31.34

			S. oleracea		
T1	28.4	2.62	3.08	10.3	55.6
T2	35.9	3.28	3.91	18.2	38.71
T3	30.7	11.15	3.27	13.9	40.98
T4	31.2	14.65	3.18	16.9	34.07
T5	32.9	14.65	3.10	14.5	34.85

T1: 100% soil (control); T2: (25:75); T3: (50:50); T4: (75:25); T5: (100% compost).

DISCUSSION

Composting is a viable method to treat fruit and vegetable waste that is greatly affected by physio-chemical characteristics like pH, EC, moisture content, temperature and quantity of waste material (Ganesh *et al*., 2022). In this study during composting process variations in temperature and pH values were recorded. The high temperature 68.1 °C was obtained at the end of 3rd week and after that temperature was sharply decreased that is an indication of decrease in biodegradation of organic matter. In previous study high temperature played an important role in decomposition of waste during composting. The increase in temperature indicated greater reduction in volume and moisture content of waste material (Mishra and Yadav, 2021). Similar study was conducted by (Taiwo and Oso, 2004), recorded highest temperature was 70ºC during first week of preparation of organic compost in the plastic bin containing 200 kg wet weight of waste material.

The pH played crucial role in determination of overall quality and efficiency of composting process. Figure 3 showed that the initial pH value was low while at the start of 3rd week pH was significantly increased that finally reached at maximum value of 8.8 and after that again pH was dropped. Initially drop in pH might be due to release of organic acids while increase in pH value might be due to release of hydrogen ions and ammonia. The 7.9 pH of mature compost was recorded at the end of compost formation in this investigation. Similar results were also reported by (Ghinea and Leahu, 2020), in three different combinations organic compost prepared with fruits, vegetables and sawdust was used. The pH of first compost was 7.9 while pH of second and third compost was 8.2. The standard range of pH of compost is 5.5 to 8.5 (HKORC, 2005). Our result of final pH of compost was according to prescribed standards.

Electrical conductivity (EC) indicates salinity of various substrates and compost maturity (Voběrková *et al*., 2017). The EC of mature compost in current study was 1.43mS/cm. The similar value of EC 1.42mS/cm was also recorded by (Jara-Samaniego *et al*., 2017). Moisture content (MC) plays important role for determining degradability and efficacy of microorganisms during composting. The moisture content of final product in this investigation was 39%. This result was in line with (Tratsch *et al*., 2019). Here, four types of organic composts were prepared from fruits and vegetables waste and moisture content of these composts were reported as compost 1 (55.01%), compost 2 (45.34%), compost 3 (58.34%) and compost 4 (51.17%).

Total organic carbon (TOC) is measure of amount of organic matter in compost (Sharma *et al*., 2019). The TOC of compost was 5.17% in this study. During composting process microorganisms that break down organic molecules, may temporarily hold all available nitrogen in their cell structures as compost development proceeds to completion microbes die off, release nitrogen and making it available to plants (Bhave and Kulkarni, 2019). The recorded total nitrogen of organic compost was (1.51%) in current study. The similar result of TN 1.51% was reported by (Tratsch *et al*., 2019).

The germination percentage is measures of viability of seeds while germination rate is measures of the time course of seed germination. Both germination rate and germination index are used to determine the phytotoxicity and maturity of compost (Rich *et al*., 2018). In this study all three vegetables showed 100% germination rate. In case of all vegetables T2 showed highest germination rate as compared to control T1 and tested treatments T3, T4 and T5 as well that showed lower germination rate. It indicated that T2 was best composition of compost and soil for seed germination of all three vegetables. A similar result was reported in a study carried out on *Spinacia*, *Trigonella*, *Brassica* and *Amaranthus* species grown in poultry waste compost and soil, founded that (1:3) ratio was suitable for seeds germination of all vegetables (Maruthi *et al*., 2008). In this study all values of germination rate indexes were greater than 100% that indicated non phytotoxicity of compost in all treatments. Similar result was reported by (Van Fan *et al*., 2016).

In current work the effects of organic compost on *S. oleracea* growth showed that height and biomass of *S. oleracea* plant increased in T4 while no. of leaves and root length were increased by increasing compost levels from T2-T5. These results are in line with the findings of (Bhardwaj *et al*. 2020). They investigated the effects of 0%, 25%, 50%, 75% and 100% MSW compost on the growth of Spinach and Potato. They reported that the all treatments showed significant effect on Spinach growth but good growth (height, leaves and biomass) was reported in T4 (75% compost) and T5 (100% compost). Similar results were also reported by (Aboyeji, 2022). The higher compost content maximizes nutrient input and organic matter, which is beneficial for nutrient demanding crops as well as useful for poor soil (Oyetunji *et al.,* 2022).

In this research the maximum height, no. of leaves and no. of flowers of *T. foenum-graecum* were founded in T4 while root length and biomass were significantly increased as compost concentration increased. These findings are supported by (Kasthuri *et al*., 2011), evaluated the effects of different levels of municipal solid waste compost and reported that the height of Fenugreek plants increased with increasing compost concentration. Maximum height was reported in T5 (500 g compost) and T6 (750 g) as compared to control but reduction was observed in plant height above T7 (1000g compost). The number of leaves also increased as compost increased up to 750g. The biomass increased up to T5 (500 g compost) while there was no significant change in root length.

In case of *B. campestris* increase in the compost concentration enhanced plant height, number of leaves, root length, number of flower and biomass. These findings are in line with (Sari *et al*., 2020). They investigated the effects of different levels of organic compost and soil on the growth of *Brassica* plant. The maximum shoot length was reported in 20% compost after 14, 21, 28 and 35 days. The maximum numbers of leaves were reported in 30% compost after 14 and 21 days, in 15% and 25% compost after 28 and 35 days respectively. The root length was increased as compost concentration increased. Highest root length was reported in 35% compost and lowest was in control. The number of flowers of *T. foenum-grecum* and *B. campestris* were increased in compost treatments than control. Similar results were reported by (Gajalakshmi and Abbasi, 2002), reported that plant height, number of leaves, dry weight, flowering period and number of flowers all were increased in compost and vermicompost.

The current study revealed proximate composition of three vegetables *S. oleracea, T. foenum-graecum* and *B. campestris*. The results indicated that the ash content of three vegetables in all treatments was higher than control which showed high mineral content in compost. The crude protein in all vegetables was increased by increasing concentration of organic compost from T2-T5. Highest crude protein values were reported in T4 of *S. oleracea* (14.65%), *T. foenum-graecum* (20.12%) and *B. campestris* (23.24%). The crude protein of T5, T3 and T2 were also higher in experimental group. The crude fat in all vegetables was not significantly different among treatments. The %age of crude fibers in all vegetables was higher in compost treatments than control. The concentration of crude carbohydrates decreased as compost concentration increased in all vegetables. Similar study was conducted on *T. foenum-graecum* and *Vigna radiata* leaves reported protein, carbohydrates, amino acids and chlorophyll content in different levels of MSW compost with 6kg garden soil. Investigation revealed that protein content increased by increasing compost level up to 500g while carbohydrates concentration was reduced above this level (Kasthuri *et al*., 2011).

The proximate analysis of different vegetables was performed and founded that their reported results of Spinach was similar to T1 treatment of current study. The ash, and crude fibers of present study treatments were significantly higher and concentration of protein was lower than values reported by (Hussain *et al*., 2010). Similarly, in another investigation proximate study of Mustard leaves (raw and cooked) performed and reported the ash 12.3%, fibers 6.55, fats 2.7%, protein 33.1% and carbohydrates 46.1% of raw material. While percentage of ash, fat, fibers in all treatments and carbohydrates in T1 treatment of present *B. campestris* leaves are effectively higher than raw and cooked Mustard leaves (Bembem *et al*., 2014).

Conclusion: The current study showed that bin composting method is an easy and cost-effective method for solid waste composting. All values of physico-chemical parameters were according to standards. The application of compost at varying levels significantly enhanced the growth parameters and proximate composition of vegetables compared to the control (T1: 100% soil). For all three species, compost treatments (T2–T5) improved plant height, number of leaves, root length, number of flowers/fruits, and biomass. Maximum plant growth and yield attributes were generally observed at higher compost ratios. In case of *S. oleracea* biomass, T4 outperformed than T5. *S. oleracea* showed significant increases in ash, crude protein, crude fat, and crude fiber contents with decreasing carbohydrate content as compost level increased. *T. foenum-graecum* and *B. campestris* also had highest protein in T4 while carbohydrate content declined with increased compost. Overall, compost application (especially at 75% compost + 25% soil) significantly enhanced both vegetative growth and nutritional quality of all three vegetables. However, T4 appeared to be the optimal treatment in most cases, providing a balance between maximum growth and nutrient content.

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Authors contributions: MMu, SS and AAS supervised the research activities. SS also helped in statistical analysis. AShabir and IF conducted the research experiments. AAS also helped in proximate composition analysis. MMa and LA assisted in writing the final draft of the article.

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