Effect of biodegradable urban waste compost on growth and yield of maize (Zea mays L.)

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ABSTRACT
A field experiment was conducted at Zonal Agricultural Research Station, V. C. Farm, Mandya, to study the effect of biodegradable urban waste compost on growth and yield of maize during kharif season of 2014 and 2015. The pooled data of two years indicated that, the grain yield of maize was significantly higher in recommended dose of fertilizer (150:75:40 kg NPK/ha) + Farm yard manure (FYM) @10 t/ha (6995 kg/ha) as compared to no fertilizer application. However, it was on par with application of 50% N as fertilizers + 50% N as urban compost (6954 kg/ha), 25% N as fertilizers + 75% N as urban compost (6815 kg/ha), 100% N as urban compost (6925 kg/ha), 100% N through vermicompost (6644 kg/ha) and 100% N through FYM (6342 kg/ha). Among the urban compost treatments, application of 50% N as a fertilizer and remaining 50% N as urban waste compost recorded significantly higher yield (6954 kg/ha) stover yield (7272 kg/ha), net returns (Rs.50,374/ha) and B:C ratio (2.02).

Key words: Biodegradable urban waste, Compost, Growth, Maize, Yield.

INTRODUCTION
Maize (Zea mays L.) is one of the important emerging cereal crop in Karnataka and its area is increasing year by year due to ease of cultivation, low water requirement as compared to traditional paddy, lower incidence of pest and diseases and increased demand for maize in the market as a poultry feed. However, in Karnataka ranks first in area (1.37 million hectare) and third in production (3.31 million hectare) and has productivity of 24.19 q/ha (Anonymous, 2016). Hence, to increase the productivity, the farmers in the region were in practices of applying excess amount of chemical fertilizers. Though application of chemical fertilizers helps to increase the production of crop; deterioration of natural resources (viz. land, water and air) is also the side effect of such high input intensive cultivation. Over reliance on use of chemical fertilizers has been associated with declines in soil physical and chemical properties and crop yield (Hepperly et al., 2009) and significant land problems, such as soil degradation due to over exploitation of land and soil pollution caused by high application rates of fertilizers and pesticide application. The reduction in the use of chemical fertilizers and supplementing the same through organic manure such as FYM, poultry manure, vermicompost, urban compost have become necessary to sustain productivity, profitability and to maintain soil health. On the other hand, application of FYM is practised for many years but it has become scare due scanty population of livestock therefore urban compost is one of the alternative sources of organic manure. The application of urban compost as one of the source of plant nutrients and also enhances physical, chemical and biological properties of soil. Thiscan able to replenish the nutrients from the soil to the crop.

Production of organic fertilizer from urban solid wastes and its subsequent utilization in crop production and soil rehabilitation and reduce volume of wastes that were brought to dumpsites, minimize environmental pollution and degradation and increase productivity of agricultural land. Fertilizer as a source of plant nutrients for farm production not only reduces cost of fertilizer but serves as ultimate solution for restoring lost fertility of agricultural soils as well as soil health which leads to sustained soil productivity.

Naikwade et al. (2012) evaluated vegetable waste and agricultural waste for preparation of compost, vermicompost and their effect on fodder maize. They found that vegetable waste had great potential as starting material for composting and vermicomposting than agricultural waste and application of these prepared manures lead to enhancement of growth, quality and yield of fodder maize. Simeon and Ambah (2013) conducted a pot experiment in the green house to determine the effect of municipal solid waste on the growth of maize. They found increase in plant height, leaf area and number of leaves per plant at a range of 16.82 cm to 12.87 cm, 5 to 4 and 64.69 cm to 59.88 cm for the dumpsite and control samples, respectively. They concluded that municipal solid waste is beneficial to plant if only proper and careful sorting and separation of hazardous
waste is done before application to crop field. Keeping these in view, there search was carried out to find out the use of urban solid waste compost as a source of nutrients for maize crop.

MATERIALS AND METHODS

The experiment was conducted at Zonal Agricultural Research Station, V.C. Farm, Mandya, Karnataka (situated at 12°45’ to 13°57’ North latitude and 76°45’ to 78°24’ East longitude with an altitude of 695 m above MSL) during monsoon season of 2014 and 2015 on redsandy loam soil with neutral pH (7.5). The soil was low in available nitrogen content (218.0 kg N ha⁻¹), available phosphorous (15.2 kg P₂O₅ ha⁻¹) and available potassium (123.0 kg K₂O ha⁻¹). The rainfall received during both the season was not sufficient to raise the crop hence crop was raised fully under irrigated condition. The experiment comprising of 7 treatments viz., recommended dose of nitrogen (RDN) + FYM, 50% N as fertilizers + 50% N as kitchen waste urban compost 25% N as fertilizers + 75% N as kitchen waste urban compost, 100% N as kitchen waste urban compost, 100% N as FYM, 100% N through vermicompost and absolute control (without any nutrient application). These 7 treatments were replicated thrice in Randomized Complete Block Design. The popular maize hybrid Hema was sown in well prepared field with a spacing of 60 cm X 30 cm. The normal recommended cultural practices were used for establishment of crop. The observations on growth and yield of maize were taken at periodic intervals and analyzed by using Fischer’s method of analysis of variance and interpretation of the data as outlined by Gomez and Gomez (1984). The level of significance used in ‘F’ and ‘T’ tests was p=0.05.

The kitchen waste urban compost was prepared in a compost pit measuring 4.0 m L X 2.0 m W X 0.6 m H. The solid kitchen wastes were collected from boy hostel of V. C. Farm, Mandya. It consists of vegetable and fruits (65%), food and other left over (12%), paper (8%), plastic (6%), glass (6%) and metal (3%). The non-degradable wastes were segregated and removed. The moisture content varies from 70 to 80% and the calorific value varies between 800-1000 k cal/kg (on dry weight basis) while, density varies between 300-500 kg/m³. For faster degradation and enrichment of urban solid wastes, microbial culture (Trichoderma viridae), cow dung and rock phosphate were used. The nutrient composition of finally prepared kitchen waste urban compost, FYM and vermicompost were given in the Table 1. However, kitchen waste urban compost was rich in NPK nutrients (1.43, 0.89 and 1.863%, N, P and K, respectively). These organic manures were applied to respective treatments based on nitrogen content. While, P and K fertilizers were applied as per the recommendation through mineral fertilizers in the form of single super phosphate and muriate of potash, respectively for all the treatments except control.

Table 1: Nutrient composition of various organic manures used in the experiment.

| Bulky organic manure       | pH   | EC (dSm⁻¹) | OC (%) | N (%) | P (%) | K (%) | Mg (%) | Ca (%) | S (ppm) | Zn (ppm) | Cu (ppm) | Fe (ppm) | Mn (ppm) |
|----------------------------|------|------------|--------|-------|-------|-------|--------|--------|---------|----------|----------|----------|----------|
| Vermi-compost              | 7.10 | 1.26       | 48.24  | 0.61  | 0.87  | 0.74  | 4.20   | 1.44   | 0.11    | 0.59     | 0.13     | 0.10     | 3.13     | 2.14     |
| Urban compost –I (Hostel waste) | 8.42 | 1.74       | 48.08  | 1.43  | 0.88  | 1.08  | 4.22   | 2.62   | 0.19    | 0.60     | 0.70     | 0.10     | 3.65     | 2.80     |
| Urban compost –II (Market waste) | 7.44 | 1.26       | 48.16  | 0.61  | 0.82  | 0.92  | 1.30   | 2.70   | 0.12    | 0.38     | 0.21     | 0.08     | 2.97     | 2.06     |
RESULTS AND DISCUSSION

Effect of urban waste compost on growth parameters of maize: Growth parameters viz, plant height and number of green leaves at tasselling and silking stage was significantly influenced by application of urban waste compost (Table 2). Among the treatments, application of recommended dose of fertilizers (150:70:40 kg NPK/ha) + FYM (10 t/ha) recorded significantly taller plants during both the years of experimentation and in their pooled data (225.4, 228.9 and 227.2 cm, respectively) as compared to application of 100% N as FYM and absolute control. However, it was on par with application of 50% N as fertilizers + 50% N as urban kitchen waste compost (223.5, 226.3 and 224.9 cm, respectively), 25% N as fertilizers + 75% N as urban kitchen waste compost (218.3, 223.6 and 221.0 cm, respectively), 100% N as urban kitchen waste compost (216.4, 225.8 and 221.1 cm, respectively) and 100% N through vermicompost compost (209.8, 210.2 and 210.0 cm, respectively).

Similarly, significantly more number of green leaves per plant (14.87, 14.60 and 14.74 during 2014, 2015 and their pooled data) was observed with application of recommended dose of fertilizers (150:70:40 kg NPK/ha) + FYM (10 t/ha) as compared to application of 100% N as FYM (12.98, 13.40 and 13.19, respectively) and absolute control (10.12, 9.25 and 9.69, respectively). However, it was on par with application of 50% N as fertilizers + 50% N as urban kitchen wastecompost (14.32, 14.20 and 14.26, respectively), 25% N as fertilizers + 75% N as urban solid wastecompost (13.87, 14.10 and 13.99, respectively), 100% N as urban kitchen compost (13.45, 14.50 and 13.98, respectively) and 100% N through vermicompost compost (13.56, 14.10 and 13.83, respectively). This increased plant growth parameters were mainly attributed to enhanced availability and use of N, water and other associated soil improving benefits from organic Nsources. Similar results with the application of urban kitchen waste compost were also reported by Weber et al. (2007) and Yolou et al. (2015). Application of enriched Urban Compost in combination with mineral fertilizer favoured increase in growth parameters. Similar results are reported by Ali et al. (2003) and Kavitha and Subramanian (2007).

Effect of urban waste compost on yield parameters of maize: Application of urban waste compost had significant influence on maize yield parameters viz., cob length, number of rows per cob, grain weight per cob and 100 seed weight during both the years of experiment and in their pooled data. All the yield attributing parameters were significantly higher in the treatments which were received external nutrients as compared to absolute control. Among the treatments, application of recommended dose of fertilizers (150:70:40 kg NPK/ha) and FYM (10 t/ha) recorded significantly more cob length (14.78, 16.12 and 15.45 cm, respectively), number of rows per cob (15.23, 15.85 and 15.54, respectively), grain

![Table 2: Growth and yield parameters of maize as influenced by urban waste compost application.](image-url)

### Table 2: Growth and yield parameters of maize as influenced by urban waste compost application.

| Treatment                      | 2013 Plant height (cm) | 2014 Plant height (cm) | 2013 Pooled Plant height (cm) | 2014 Pooled Plant height (cm) | 2013 No. of rows/cob | 2014 No. of rows/cob | 2013 Cob length (cm) | 2014 Cob length (cm) | 2013 Pooled Cob length (cm) | 2014 Pooled Cob length (cm) | 2013 Grain weight/cob (g) | 2014 Grain weight/cob (g) | 2013 100 seed weight (g) | 2014 100 seed weight (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RDF (150:70:40 kg NPK/ha) + FYM (10 t/ha) | 225.4 | 228.9 | 227.2 | 225.8 | 15.2 | 15.1 | 14.78 | 14.87 | 228.9 | 227.2 | 15.45 | 15.34 | 13.85 | 13.74 |
| 50% N as fertilizers + 50% N as urban compost + 100% PK as fertilizers | 218.3 | 221.0 | 219.7 | 220.4 | 15.1 | 15.0 | 14.32 | 14.20 | 219.7 | 219.4 | 15.34 | 15.23 | 13.40 | 13.32 |
| 100% N as FYM + 100% PK as fertilizers | 207.5 | 209.8 | 210.2 | 209.8 | 15.0 | 15.0 | 14.20 | 14.00 | 209.8 | 209.8 | 15.10 | 15.00 | 14.35 | 14.20 |
| Absolute Control | 200.8 | 201.0 | 200.9 | 200.9 | 14.9 | 14.9 | 14.00 | 14.00 | 200.9 | 200.9 | 14.50 | 14.50 | 13.19 | 13.19 |

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Table 3: Yield and economics of maize as influenced by urban waste compost application.

| Treat                          | Grain yield (kg/ha) | Stover yield (kg/ha) | Net returns (Rs./ha) | B:C ratio |
|-------------------------------|---------------------|----------------------|----------------------|-----------|
|                              | 2013    | 2014    | Pooled  | 2013    | 2014    | Pooled  | 2013    | 2014    | Pooled  | 2013    | 2014    | Pooled  | 2013    | 2014    | Pooled  |
| T<sub>1</sub> - RDF (150:70:40 kg NPK/ha) + FYM (10 t/ha) | 6967    | 7023    | 6995    | 7341    | 7459    | 7400    | 52,712  | 52,558  | 52,635  | 2.17    | 2.16    | 2.16    |
| T<sub>2</sub> - 50% N as fertilizers +50% N as urban compost + 100% PK as fertilizers | 7010    | 6954    | 7213    | 7332    | 7272    | 49,087  | 51,662  | 50,374  | 50,374  | 2.03    | 2.02    | 2.02    |
| T<sub>3</sub> - 25% N as fertilizers +75% N as urban compost + 100% PK as fertilizers | 6732    | 6897    | 6815    | 7137    | 7004    | 7070    | 41,753  | 44,765  | 43,259  | 1.79    | 1.78    | 1.79    |
| T<sub>4</sub> - 100% N as urban compost + 100% PK as fertilizers | 6960    | 6925    | 7270    | 7123    | 7196    | 39,840  | 41,603  | 40,721  | 40,721  | 1.64    | 1.67    | 1.67    |
| T<sub>5</sub> - 100% N as FYM + 100% PK as fertilizers | 6231    | 6453    | 6342    | 6897    | 7009    | 6953    | 28,900  | 33,898  | 31,399  | 1.49    | 1.48    | 1.49    |
| T<sub>6</sub> - 100% N through Vermicompost + 100% PK as fertilizers | 6598    | 6690    | 6644    | 6954    | 7057    | 7005    | 23,728  | 25,527  | 24,627  | 1.34    | 1.34    | 1.34    |
| T<sub>7</sub> - Absolute Control | 3890    | 2678    | 3284    | 5143    | 4355    | 4749    | 21,713  | 5,169   | 13,441  | 1.64    | 1.58    | 1.61    |

S. Em±: 654 ± 569 ± 601
CD(p<0.05): 1961 ± 1706 ± 1801

Recommended dose of fertilizer for maize - 150:70:40 Kg NPK/ha and FYM - 10 t/ha.
and reduced wastage of applied nutrients. A similar increased yield of maize due to application of urban kitchen waste compost was reported by Naderi and Ghadiri (2010) and Yolou et al. (2015). Enriched compost in conjunction with inorganic fertilizer produced higher grain and straw yield than the application of chemical fertilizers alone. The treatments could have provided enough nutrients and microbial environment, thus improved soil fertility, which ultimately resulted in higher yield. The results are in conformity with findings reported by Kavitha and Subramanian (2007).

Economics of urban waste compost application: The highest net return was registered in application of recommended dose of fertilizers + FYM (52,558 Rs./ha) as compared to other treatments. The next best treatments which registered higher net returns were integration of urban kitchen waste compost with chemical fertilizers in the ratio of 50:50 (50, 374 Rs./ha), 75:25 (43, 259 Rs./ha) and 100% N as urban kitchen waste compost (40,721 Rs./ha). While, the lowest net return was observed in absolute control (13,441 Rs./ha) (Table 3).

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