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Influence of vermicompost on kernel yield of Maize (*Zea mays* L.)

P.K. Ramasamy, K. Baskar and S.Ignacimuthu

Entomology Research Institute, Loyola College, Chennai 600 034, TamilNadu, India.

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ABSTRACT

Different concentrations of vermicompost such as 25% (25kg vc: 75 kg red soil), 50% (50kg vc:50 kg red soil), 75% (75kg vc:25 kg red soil), and 100% (100 kg vc) produced by earthworm, *Eudrilus eugeniae*, were added to red soil in polythene bags. Maize plants (*Zea mays* L.) were grown on vermicompost-enriched soil for 90 days. The plants were harvested at the end of 90 days and the kernels were collected. In the present investigation the number of kernels was counted; the length, breadth, and circumference of kernels were measured; the weight of kernel and total weight of all kernels were calculated. The maximum kernel number of 598.55/corn and the highest length of 1.71cm/kernel were noticed in the plants cultivated on 75% vermicompost concentration whereas the maximum kernel breadth of 1.40cm/kernel, circumference of 3.07cm/kernel, weight of 0.41 gm/kernel and total weight of all kernels (232.43gm/corn) were noticed in the plants grown on 50% vermicompost concentration. At the same time minimum kernel number of 69.42/corn, low kernel length of 0.80cm/kernel, breadth of 0.60cm/kernel, circumference of 2.02cm/kernel, weight of 0.08gm/kernel and total weight of all kernels (5.55gm/corn) were found in the control plants. The present investigation clearly revealed that the addition of vermicompost to soil greatly enhanced the kernel yield in maize.

Introduction

In agricultural land depletion of the soil fertility is an important drawback due to continuous cultivation. In order to increase the soil fertility and to reach self-sufficiency in grain production modern agricultural operations were introduced in 1960s. Extensive use of synthetic agrochemicals such as inorganic fertilizers and pesticides and adoption of nutrient-responsive high yielding varieties of crops had boosted productivity and yield.

The success of industrial agriculture and green revolution had its own negative impacts affecting natural resources, environment, human health and agriculture itself (Rao, 1999; Gupta, 2005; Pandit et al., 2008). Moreover the chemical fertilizers do not have sufficient, the effects are more indirect through the amelioration of soil conditions and release of nutrients after mineralization for plant growth. It has been now realized that agriculture does not refer only to crop production but also to various other factors that are responsible for crop production. Factors such as soil destruction, top soil erosion and adverse effect of the prolonged use of chemical fertilizers on the soil health have been neglected (Ismail, 2005).

Earthworm castings improve soil drainage, reduce waterlogging and prevent root rot. The water retention capacity of soil also improves because vermicompost contains absorbent organic matter that holds only necessary amount of water needed by the roots.

Alternate agricultural practices such as organic farming, ecofarming, biodynamic farming and traditional farming practices are considered important alternatives to increase soil fertility and soil health. In organic farming the application of organic manure especially vermicompost is recommended. It is ecofriendly, non-toxic, consumes low energy input for composting and is a recycled biological product (Lourduraj and Yadav, 2005).

Vermicomposts are organic materials broken down by interactions between microorganism and earthworms in a mesophilic process (up to 25°C), to produce fully stabilized organic soil amendments with low C:N ratios. They have a high and diverse microbial and enzymatic activity, fine particulate structure, good moisture-holding capacity, and contain nutrients such as N, P, K, Ca and Mg in forms readily taken up by plants (Lavelle and Martin, 1992; Prabha et al., 2005; Arancon and Edwards, 2009). Vermicompost is a good substitute for commercial fertilizer and has more N, P and K than the normal heap manure (Srivastava and Beohar, 2004). Besides that earthworms release vitamins such as vitamins A, B1, B2, B3, C and E in the vermicompost (Ramasamy, 2009), B group vitamins (Gavrilov, 1963), some provitamin D (Zrazhevwkii, 1957), vitamin B12 (Atlavinyte and Daciulyte, 1969) and free amino acids (Dubash and Ganti, 1964) in the soil. The literature survey revealed that the study on the influence of vermicompost on kernel yield is scanty. Hence, in the present investigation, an attempt was made to study the influence of vermicompost on kernel yield of Maize which is a very important food plant.

Materials and methods

Collection and culturing of earthworms

The earthworm, Eudrilus eugeniae, was collected from worm farm, Kondegoundampalayam village, Pollachi Taluk, Coimbatore District, Tamil Nadu, India and cultured at Kongunadu Arts and Science College premises, Coimbatore, Tamil Nadu, India.The collected earthworms were acclimatized under laboratory conditions for a period of three months by providing predecomposed cow dung as feeding material in the cement tank. Water was sprinkled on alternate days to maintain optimum (60-70%) moisture content and temperature between 25ºC to 30ºC. Care was taken to avoid the entry of natural enemies. At the end of 75 days vermicompost was collected and stored in shade.

Tele: 044 28178348; Fax-044 28174644

E-mail addresses: entolc@hotmail.com

Cultivation of plants

Different concentrations of vermicompost 25% (25kg vc: 75 kg red soil), 50% (50kg vc: 50 kg red soil), 75% (75kg vc: 25 kg red soil), and 100% (100 kg vc) produced by earthworm, Eudrilus eugeniae, were added to red soil (W/W). Various concentrations of vermicompost were packed separately in polythene bags (75cm length x 75cm breadth). Five maize plant seeds were cultivated in each polythene bag with 20cm inter-plant distance. The plants were grown for 90 days. The control plants were grown only in red soil without vermicompost for 90 days. The plants were watered daily and at the end of 90 days the plants were harvested and the kernels were collected. Finally the kernel number was counted; the length, breadth and circumference of kernels were measured in cm; the weight of kernel and total weight of kernel in a corn were weighed in gm.

Statistical analysis

The experiment was repeated six times. The data were subjected to analysis of variance (ANOVA). Significant differences between treatments were determined by Duncan's multiple range test (DMRT) ($P \leq 0.01$).

Results

The study on the influence of vermicompost on kernel yield of Maize revealed that the maximum kernel number (598.55/corn) and highest kernel length (1.71cm/kernel) were recorded in plants cultivated on 75% vermicompost concentration. At the same time the maximum kernel breadth (1.40cm/kernel), kernel circumference (3.07cm/kernel), individual kernel weight (0.41gm/kernel) and total kernel weight of all kernels in a corn (232.43gm/corn) were found in plants grown on 50% vermicompost concentration. The control plants showed minimum kernel number (69.42/corn), low kernel length (0.80cm/kernel), breadth (0.60cm/kernel), circumference (2.02cm/kernel), individual kernel weight (0.08gm/kernel) and total kernel weight (5.55gm/corn) of all kernels in a corn (Table 1). In the present investigation physico-chemical analysis of different concentrations of vermicompost showed that addition of vermicompost to red soil increased all physico-chemical parameters gradually except for pH. High level of pH was observed in control (red soil). At the same time the addition of vermicompost to soil decreased pH level gradually. Also high levels of all physico-chemical parameters were found in 100% vermicompost concentration than the other concentrations of vermicompost tested except for pH. Very low levels of all physico-chemical parameters except for pH were found in the red soil (control) (Table 2).

Discussion

Vermicompost with a relatively high content of humus-like compounds, active micro organisms and enzymes greatly contribute to the enhancement of the biochemical fertility of soils degraded by intensive – cultivation (Perucci, 1992). The casts of earthworm are most useful and active agents in introducing suitable chemical, physical and microbiological changes in the soil and, thereby, directly increasing the fertility and crop productivity (Joshi and Kelkar, 1951). In the present investigation, maximum kernel number and highest kernel length were recorded in the plants cultivated on 75% vermicompost concentration; however, maximum kernel breadth, kernel circumference, individual kernel weight and total kernel weight were recorded in the plants grown on 50% vermicompost concentration. The kernel number and kernel length increased up to 75% vermicompost concentration; after that the kernel parameters decreased when concentration of vermicompost increased. Similar trend of results was also noticed in kernel breadth, kernel circumference, individual kernel weight and total kernel weight of the maize plant exposed to 50% vermicompost concentration. The control plants showed lower kernel yield compared to vermicompost treated plants. Better kernel yield in maize plants exposed to particular concentration of vermicompost may be due to the influence of combined effect of various ingredients of vermicompost such as macro (N, P, K) and micro (Ca, Mg, Mn, Iron, sulfur, Zinc and Copper) nutrients, plant growth hormones (Indole acetic acid, Indole butyric acid, Naphthalene acetic acid and Gibberellic acid), vitamins (Vitamin A, B1, B2, B3, C and E) (Prabha, 2006; Ramasamy, 2009), enzymes, and many beneficial microbes such as Nitrogen fixing bacteria and hormone synthesizing microbes such as Azospirillum brasilence (Kucey, 1988; Molla, 2001), Azospirillum lipoferum (Lee et al.,1988), Azotobacter paspali (Barea and Brown, 1974) and Pseudomonas putida (Xie et al., 1996). The analysis of physico-chemical parameters showed that though nutritional availability is rich in vermicompost, the plant utilizable quantity differed from one concentration of vermicompost to the other. The higher availability of nutrients especially nitrogen and phosphate in vermicompost and improved soil physical, chemical and biological properties might have contributed to higher yields (More, 1994). Further, the lower kernel yield in the plants cultivated on 100% vermicompost concentration may be due to the presence of high level of inorganic salts (Arancon and Edwards, 2009). The results of the present study correlate with the results in maize yield (Ferreira, 1992), grape yield (Edwards and Steele, 1997), tomato yield (Goswami et al., 2001; Alam et al., 2007) and two varieties of wheat (Garg and Bhardwaj, 2000).

Manivannan et al. (2009) stated that the increased growth and yield of the beans, Phaseolus vulgaris, were due to the application of vermicompost which indirectly influenced the physical conditions of the soil and supported better aeration to the plant roots and absorption of water. The earthworm casts influenced the development of the plants and promoted plant biomass, which suggest the linkage between biological effects of vermicompost and microbial metabolites that influence the plant growth and development (Tomati et al., 1995). The better performance in various characteristics of maize on 50% vermicompost concentration compared to other treatments was not only because of the presence of greater amounts of nutrients but also due to the presence of microbial metabolites, the plant-growth promoting hormone-like substances.

Martens et al. (1992) and Hendrix et al. (1994) revealed that the higher yields in plants may be due to the fact that vermicompost supplies direct available nutrients such as nitrogen to the plants and improves the proportion of water table of the soil. Channabasanagowda et al. (2008) have also shown that the differential action of vermicompost may be because of the fact that the vermicompost has slow release of nitrogen due to slow mineralization which helps in availability of nutrients to the plants throughout the growth of the plant and thus resulting in higher yields. Higher yield in bhendi, chillies, watermelon and paddy and number of canes per hill, internodes distance, stem length, shoot length, cane yield and quality were seen when they were exposed to different concentration of vermicompost than the farm yard manure (Ismail, 1995).

In conclusion our study clearly showed that the addition of vermicompost to soil enhanced kernel yield in maize. Similar strategy can be followed by farmers to increase productivity.

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