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Anand Kumar
Department of Zoology and Aquaculture, Chaudhary Charan Singh Haryana, Agricultural University, Hisar, Haryana, India

RK Gupta
Department of Zoology and Aquaculture, Chaudhary Charan Singh Haryana, Agricultural University, Hisar, Haryana, India

Correspondence
Anand Kumar
Department of Zoology and Aquaculture, Chaudhary Charan Singh Haryana, Agricultural University, Hisar, Haryana, India

The effects of vermicompost on growth and yield parameters of vegetable crop radish (*Raphanus sativus*)

Anand Kumar and RK Gupta

Abstract
An experiment was conducted to study the effect of vermicompost and chemical fertilizers on growth and yield of Radish (*Raphanus sativus*). From this experiment it is clear that vermicompost is better fertilizers than other fertilizers due to the availabilities of nutrients in vermicompost and also help in sustainability of agriculture sector. The sustainabilities of agriculture are more important for food securities of peoples of a country. The plant heights were found to be 50cm in vermicopmost, 41cm in cow dung, 39cm in urea and 17cm in control treatment. Weight of the tuber was observed to be 152gm in vermicompost, 133gm in cow dung, 120 gm in urea, and 49gm in control treatment. The number of fruits/ plant was found to be 44 in vermicompost, 36 in cow dung, 25 in urea and 15 in control treatment. The stem diameters was observed to be 1.40cm in vermicompost, 1.16cm in cow dung, 0.96cm in urea and 0.76cm in control treatment. The dry matters yield was 41.36 gm in vermicompost, 39.92gm in cow dung, 35.25gm in urea and 21.50gm control treatment.

Keywords: agriculture sustainability, vermicompost, cow dung, urea, radish, yield

Introduction
In recent years, increasing consumer concern about issues such as food quality, environmental safety and soil conservation has lead to a substantial increase in the use of sustainable agricultural practices. Sustainable agriculture can be defined as a set of practices that conserve resources and the environment without compromising human needs, and the use of organic fertilizers such as animal manure has been indicated as one of its main pillars (Tilman *et al*., 2002) [23]. Animal manure is a valuable resource as a soil fertilizer because it provides large amounts of macro- and micronutrients for crop growth and is a low-cost, environmentally-friendly alternative to mineral fertilizers. However, the use of manure in agriculture is being abandoned because of increasing transportation costs and environmental problems associated with the indiscriminate and inappropriately-timed application to agricultural fields (Hutchison *et al*., 2005) [12]. Processing of this waste material through controlled bio-oxidation processes, such as vermicomposting, reduces the environmental risk by transforming the material into a safer and more stable product suitable for application to soil (Lazcano *et al*., 2009) [14], and also reduces the transportation costs because of the significant reduction in the water content of the raw organic matter. Composted materials are therefore gaining acceptance as organic fertilizers in sustainable agriculture, and there has been a considerable increase in research dedicated to the study of the effects of compost-like materials on soil properties and plant growth. This enhanced growth in vermicompost might be due to the presence of more amount of available nitrogen, which is essential for the synthesis of structural proteins (Edwards 1988) [7]. The better growth by addition of potassium has been observed by Malakouti and Sepehr (2004) [15]. The increase in number of fruits by addition of nitrogen and phosphorus separately has also been observed by Cheema *et al.*, (2001) [4]. The better growth due to nitrogen fertilizer has also been reported by Hocking *et al.*, (2003) [11]. The results obtained regarding the effect of biofertilizer on the test crop matches with the findings of Gohil *et al.*, (2007) [8]. The maximum root length, shoot length, dry weight of plant, number of fruits and total fruits production was found to be 13.20 cm, 37.56 cm, 12.64 g, 24.16 and 4864 kg/hectare respectively in case of T7 (combination treatment). Similarly, the biochemical characteristics of fruits of okra (*Abelmoschus esculentus)* showed improvement by the addition of fertilizers and vermicompost. (Gupta 2011) [9].

Materials and Method
The present studies carried out in the net house of Zoology department in CCS HAU Hisar. The effect of different treatments of urea, vermicompost and the cow dung were studied on

radish (*Raphanus sativus*). For each of the vegetable crop, four pots (A, B, C & D) were prepared. In Pot A was put the cow dung as fertilizer; In pot B urea was put as fertilizer; In pot C vermicompost was put as fertilizer; the pot D was kept as control. In one pot one plant was grown. Total five growth and yield parameters viz. height of the plants, spread of plants (in east-west and north-south directions), diameter of the main stem, dry weight of the whole plant (except fruit and roots), number of fruits per plant and the total weight of fruits/seeds per plant were recorded.

Plant height was measured with the help of a meter tape from the ground level to the tip of apical shoot/flower of the tallest shoot at maturity. Average height was calculated and expressed in cms. Plant was measured at maturity with the help of a meter tape by spreading of plant from east to west and north to south. Average height of the plant of east-west and north-south was calculated and expressed in cms. Stem diameter was also measured at the maturity stage with the help of a vernier calliper at two and half cm above the ground level and expressed in cm. The dry matter yield of the plants (excluding roots and fruits) was recorded after harvesting. The main stem of plant was cut from ground level and dried in an oven at 60±5ºC and weighed. The well grown fruits/seeds were handpicked, counted and weighed. Number of fruits per plant (in each treatment) and their total weight in grams was recorded after uniform interval of time at maturity. The data was subjected to statistical analysis using completely randomized design (C.R.D.).

Results and Discussions

The growth characteristics of raddish plants cultivated in different fertilizers were studied (Table 1.Plate 1 and Fig. 1). The plant heights were found to be 50cm in vermicopmost, 41cm in cow dung, 39cm in urea and 17cm in control treatment. Weight of the tuber was observed to be 152gm in vermicompost, 133gm in cow dung, 120 gm in urea, and 49gm in control treatment. The number of fruits/ plant was found to be 44 in vermicompost, 36 in cow dung, 25 in urea and 15 in control treatment. The stem diameters was observed to be 1.40cm in vermicompst, 1.16cm in cow dung, 0.96cm in urea and 0.76cm in control treatment. The dry matters yield was 41.36 gm in vermicompost, 39.92gm in cow dung, 35.25gm in urea and 21.50gm control treatment.

These present results are in conformity with the findings of the various researchers. This enhanced growth because of in vermicompost might be due to the presence of more amount of available nitrogen, which is essential for the synthesis of structural proteins (Edwards, 1988) [7]. The increase in the number of fruits by addition of nitrogen and phosphorus separately has also been observed by Cheema *et al.,* (2001) [4]. The better growth due to nitrogen fertilizer has also been reported by Hocking *et al.,* (2003) [11].

Similar results showing the maximum root length, shoot length, dry weight of plant, number of fruits and total fruits production which was found to be 13.20 cm, 37.56 cm, 12.64 g, 24.16 and 4864 kg/hectare respectively in case of vermicompost treatment (combination treatment) (Gupta 2011) [9]. Similarly, the biochemical characteristics of fruits of *Abelmoschus esculentus* showed an improvement by the addition of fertilizers and vermicompost. Natarajan (1990) [17] noticed a higher plant height and the number of branches per plant in chilli when FYM was applied @ 25 t per ha as a basal dose along with 75:33:35 kg NPK per ha. According to Mallanagouda *et al.,* (1995) [16] the application of recommended dose of NPK (100:80:80 kg/ha) + FYM (10 t/ha) improved the growth parameters in chilli. Hower the vermicompost in the present studies show the best results. The results of several long-term studies have shown that the addition of compost improves the physical properties of soil by decreasing the bulk density and increasing the soil water holding capacity (Weber *et al*., 2007). Likewise, some studies show that vermicomposting leachates or vermicompost water-extracts, used as substrate amendments or foliar sprays, also promote the growth of tomato plants (Tejada *et al*., 2008) [22], and strawberries (Singh *et al*., 2010) [20].

These reports hypothesized that the plant growth hormones may become adsorbed on to humic fractions so the plant growth response is a combined hormonal/humic one. The gibberellins and the cytokinins from vermicomposts in aqueous solution have significant effect on the plant growth. However, such substances may be relatively transient in soils and we hypothesize that transient plant growth regulators such as IAA, which are water-soluble and degraded in light, may become adsorbed on to humates and thereby become much more persistent in soils and media and act over a much longer period to influence the plant growth. (Hayes 1997). Vermicompost also has a positive effect on vegetative growth, stimulating the shoot and the root development (Edwards *et al*., 2004) [6]. The effects include alterations in seedling morphology such as an increased leaf area and root branching (Lazcano *et al*., 2009) [14]. Vermicompost has also been shown to stimulate plant flowering, increasing the number and biomass of the flowers produced (Arancon *et al*., 2008) [2].

A large beneficial microbial population and biologically active metabolites, particularly the gibberellins, cytokinins, auxins and group B vitamins were observed with the application of vermicompost alone or in combination with the organic or the inorganic fertilizers. It resulted in a better yield and quality of the diverse crops (Bano and Kale 1987) [3]. Bano and Kale (1987) [3] reported that the application of vermicompost along with chemical fertilizers recorded a higher yield of brinjal. Among the various organic manures, the compost produced by earthworms (vermicompost), is a rich source of macro and micronutrients. Curry and Byrne (1992) [5] found to be that the nitrogen derived from earthworms could supply 30 per cent of the total crop requirement as it is a potential source of readily available nutrients for plant growth. It not only supplies a good amount of different nutrient elements but also contains beneficial microbes like nitrogen fixing bacteria, mycorrhizae and growth promoting substances.

Field experiments have already been conducted to study the influence of different organic manures on the growth, yield and quality of *okra*. The experiments were conducted in a Randomized Block Design replicated thrice with eleven treatments involving different organic manures along with no manure control. The results showed that FYM 20t ha-1 recorded the highest yield of 10.39 t/ ha. The crude fibre content of fruits under this treatment was also less when compared to control. (Premsekhar, and Rajashree, 2009) [19]. Where as the vermicompost showed the heighst yield in the present studies. There was a positive and significant effect of compost (vermicompost) along with cow dung or inorganic fertilizers on radish yield. The effect of different fertilizers on radish have been made in the present studies also which reveals vermicompost to be most effective. Likewise Kropisz (1992) reported that the application of different sources of the composts and FYM (@ 25 t/ha) in three year field trials with cabbage, onion and carrot, the combination of FYM + NPK registered the highest yield of all the three crops as compared to the application of either FYM or the inorganic fertilizers individually.

Perumala and Vatsala (2005) [18] studied the different vegetable crops such as carrot, okra and brinjal cultivated in soil amended with different manures such as organic amendments and biodynamic forms. The vegetable cultivated in experimental plots with organic and biodynamic manures recorded fewer pests and disease attack and produced a high yield. A field experiment was conducted by Sureshi *et al.*, (2007) [21] at Tamil Nadu, India during October 2004 to assess the effect of nutritional manipulation on brinjal shoot and fruit borer. FYM, biofertilizers oil cakes of neem, pungum and poultry manures were used as organic source of nutrient. The result indicated that per cent of fruit and shoot borer damage was significantly less and fruit yield was maximum.

The tuber yield of potato was increased significantly due to the effect of vermicompost and NPKS fertilizers. The tuber yield in different treatments ranged from 8.58 to 25.56 t/ha. The height tuber yield was recorded to be 25.56 t/ha by the application of vermicompost. It was indicated that 100% NPKS with vermicompost produced a higher tuber yield. (Alam *et al.*, 2007) [1] The dry matter or dry weight (kg/ha) of shoot was significantly influenced by the application of different treatments. The dry matter varied from 197.90 to 599.80 kg/ha. The highest dry weight was recorded 599.80 kg/ha. The lowest dry weight of potato shoot was recorded in control pot.

Table 1: Growth characteristics of *Raphanus sativus* (Radish) plants cultivated in different fertilizers.

Treatments	Plants height(cm)	Weight of fruits(gm)	No. of fruits / plant	Stem diameter (cm)	Dry matter yields(gm)
Vermicompost	50.00	152.30	44.38	1.40	41.36 a
Cow dung	41.00	133.67	36.65	1.16	39.92 a
Urea	39.00	120.21	25.30 a	0.96	35.23
Control	17.00	49.00	15.00 a	0.76	21.58
C.D. (P = 0.05)	1.91	5.05	5.32	0.13	2.25

Value denoted by similar letter in each column do not differ significantly.

Plate 1: The growth of *Raphanus sativus* (Radish) plants in different fertilizers viz. vermicompost (1), cow dung (2), urea (3), and control (4)

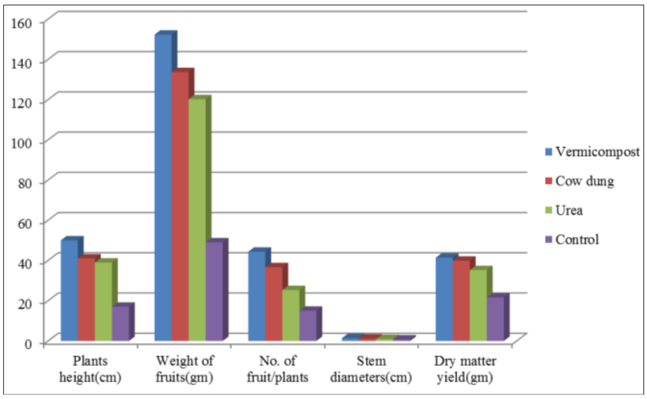

Fig 1: Growth characteristics of *Raphanus sativus* (Radish) plants cultivated in different fertilizers.

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