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Growth and Nutrient Content Variation of Groundnut *Arachis hypogaea* L. under Vermicompost Application

T. Ravi mycin, M. Lenin*, G. Selvakumar and R. Thangadurai

Department of Botany, Annamalai University, Annamalainagar 608 002, Tamil Nadu

ABSTRACT: Plant nutrients are essential for the production of crops and healthy food in the worlds expanding population. Plant nutrients are therefore a vital component of sustainable agriculture. The use of chemical fertilizers, contributes largely depletion of fossils fuels, generation of carbon dioxide and contamination of water resource it leads to loss of soil fertility due to imbalance use of fertilizers that has adversely impacted agriculture productivity and causes of soil degradation. Now there is a growing realization that the adoption of ecological and sustainable farming practices can only reverse the declining trend in the global productivity and environmental protection. So the present study was carried out the impact of vermicompost on groundnut (*Arachis hypogaea* L.). Three experimental plots were prepared control, T1- 1 ton h-1; T2-2 ton h-1; T3- 3 ton h-1 and T4- 4 ton h-1 to test the plant production patterns, under field conditions. The morphological parameters such as root length, shoot length, number of leaves, fresh weight, dry weight and root nodules, yield parameters and the nutrient content viz., nitrogen, phosphorus, potassium were analyzed at 120 days of plants. All the morphological parameters and nutrient contents were higher in T4 treatments, when compared with other treatments.

Key words: *Arachis hypogaea* L., VRI (Gn) 7; Vermicompost, Morphological parameters, Nutrient content

Introduction

In nutrition a new era is emerging that is characterized by search for dietary constituents that have benefits beyond those ascribed to the macro and micronutrients (Das *et al* 2005). Vermicompost are finely-divided fully-stabilized organic materials supporting large microbial numbers and activity. They are produced in a mesophilic process through interactions between earthworms and microorganisms in breaking down organic wastes (Edwards *et al.,* 2010). The vermicompost increase plant germination, growth, flowering and fruiting of a wide range of crops through hormonal effects independent of nutrients (Edwards and Arancon, 2004). The use of organic amendments such as traditional generally as an effective means for improving soil aggregation, structure and fertility, improving the moisture holding capacity and increasing crop yields (Marinari *et al.,* 2000).

The vermicompost is reported to have hormone like activity and this has been hypothesized to result in greater root initiation, increased root biomass, enhanced plant growth and development and altered morphology of plants growth (Bachman and Mazger, 2007). The vermicompost contains most nutrients in plant available calcium and soluble potassium (Orozco *et al.,* 1996). There is accumulating scientific evidence that vermicompost can influence the growth and productivity of plants significantly (Edwards, 1998) and annual application of adequate amounts of some organic manures (vermicompost) led to significant increase in soil enzyme activities such as urease, phospho monoesterase and phosphodiesterase (Albiach *et al.,* 2000). Number of green house and field studies have examined the effects of vermicompost on wide range of crops including cereals and legumes (Kaushik and Garg, 2003), vegetables (Atiyeh *et al.,* 2000) and field crops (Arancon *et al.,* 2004). The biological process earthworm produces humus or humus-like substances the flumes or humates are believed to stimulate plant nutrient uptake and metabolism, have a influence on protein synthesis and show hormone like activity (Barton and Ruoceo, 1981). The earthworm casts are rich in nutrients essential for plant growth. They have been found to contain elevated amounts of NH_4^+, NO_3^-, Mg, K and P relative to surrounding soil (Parkin and Berry, 1994). As microbial activity is increased due to addition of vermicompost, it indirectly enhances endocellular enzymes (Padmavathiamma *et al.,* 2007).

Groundnut (*Arachis hypogaea* L.) is an important oil seed crop in India and commonly called as poor man's nut. Groundnut kernels contain 42 per cent to 50 per cent oil, 26 per cent protein, 18 per cent carbohydrates and also rich source of riboflavin, thiamine, nicotinic acid and vitamin E. Groundnuts for edible purpose require considerable processing and sorting to ensure high quality. So, the present study was determine the effects of different rate of vermicompost on the growth and nutrient content of groundnut (*Arachis hypogaea* L.) under field condition.

Materials and Methods

The present research work was carried out during the year 2010 at Vadaku Mangudi, near by from Annamalai University. The seeds of groundnut (*Arachis hypogaea* L.) VRI (Gn) 7 were obtained from the Regional Oil Research Institution, Virudhachalam, Cuddalore district. The seed size and weight were homogenous. They were surface sterilized with (0.1% $HgCl_2$ + 0.2 HCl for 5 min) and finally washed with tap water.

The vermicompost were collected from Ram Vijay Biofertilizer, Puducherry. In this experiments groundnut were shown in the plots, 4m long and 3 m wide ($12m^2$) and was separated by 1 m width from unplanted areas. The vermicompost was applied at the rate of control; T_1 – 1 ton ha^{-1}; T_2 – 2 ton ha^{-1}; T_3 – 3 ton ha^{-1}; T_4 – 4 ton ha^{-1} and it was incorporated into the 10 cm of soil in the whole experimental plots.

The experiments were laid out in RBD with 3 replications. All necessary cultural practices and plant protection measures were followed uniformly for all the plots during the entire period of experimentation. The observations on plant shoot length, root length, root nodules, number of leaves, total leaf area, fresh weight, dry weight, yield parameters and nutrient content such as nitrogen, phosphorus, potassium were analyzed at 110 days of plants.

The Total Nitrogen (TN) was determined after digesting the sample with concentrated H_2SO_4 (1:20, w/v) followed by distillation method (Bremner and Mulvaney, 1982). Total phosphorus (TP) and total potassium (TK) contents of plants were analysed by wet digest method (tri acid (HNO_3 –H_2SO_4 –$HClO_4$) mixture was used for digestion) (Jackson, 1973). In this process, the total phosphorus (TP) was estimated by colorimetric method the and total potassium (TK) was determined by flame photometer method (Bansal and Kappoor, 2000). The manganese (Mn) and calcium (C) was determined by atomic absorption spectrophotometry (Lindsay and Norvell, 1978).

Results and Discussion

The plant growth parameters like shoot length, root length, leaf area, number of root nodules, fresh weight and dry weight, were increased in treatment (T_4) (Table 1) when compared to control plants. The significant influences in plots receiving vermicompost was recorded all the treatments. Such influence of vermicompost on plant growth of groundnut may be attributed to better availability of plant growth regulators and humic acid in vermicompost, which is produced by the increased activity of microbes (Arancon *et al.,* 2004). The earthworm casts application plots, there was an increase in plant height, number of tillers and of leaves, early ear heading, ear head length and dry matter per plant in *Triticum aestivum* than

* *Corresponding Author, Email: leninreegan@gmail.com*

control Singh *et al.* (2008) revealed that substitution of vermicompost can vary according to agro-climatic condition of the production region, but a dose 7.5 t ha^{-1} is sufficient for higher productivity of better quality of strawberries. As demonstrated scientifically that microbes like fungi, bacteria, yeasts, actinomycetes, algae etc., are capable of producing auxins, gibberellins etc. in appreciable quantity during vermicomposting. Cytokinins, ethylene, and abscisic acid, are also in appreciable quantities, (Frankenberger and Arshad, 1995).

The vermicompost is reported to have hormone like activity and this has been hypothesized to result in greater root initiation, increased root biomass, enhanced plant growth and development and altered morphology of plants growth (Bachman and Mazger, 2007). The biological process earthworm produces humus or humus-like substances the flumes or humates are believed to stimulate plant nutrient uptake and metabolism, have a influence on protein synthesis and show hormone like activity (Barton and Ruoceo (1981). Therefore, it is reasonable that vermicompost consisting of an amalgamate of humified earthworm faces and organic matter can also stimulate plant growth as plant extracts. The vermicompost also enriched is certain metabolites and vitamins that belong to the 'B' group or provitamin 'D' which also help to enhance plant growth (Ansari, 2008 a, b).

Valdrishi *et al.* (1996) reported that application of humic acids that had been extracted from vermicomposts increased the overall growth of tomatoes and cucumbers significantly in a very similar pattern to the effects of a range of vermicompost (Atiyeh *et al.,* 2002; Arancon *et al.,* 2006a). However, plant growth hormones can become absorbed onto the complex structure of humic acids that are produced very rapidly in vermicomposts and may have acted in conjunction with them to influence plant growth since humates have also been shown to increase plant growth (Canellas *et al.,* 2000). In this situation, plant growth hormones that are absorbed on to humates would persist in soil and would be released slowly from humates and have much more effects on plant growth over a considerably longer period. Identified exchangeable auxin groups attached to humic acid, extracted from the vermicompost, following a detailed structural analysis. These complex enhanced root elongation, lateral roots emergence and plasma membrane H^+ - ATpase activity of maize roots (Arancon *et al.,* 2008). Therefore, it is reasonable that vermicompost consisting of an amalgamate of humified earthworm faces and organic matter can also stimulate plant growth as plant extracts. The vermicompost also enriched is certain metabolites and vitamins that belong to the 'B' group or provitamin 'D' which also help to enhance plant growth (Ansari, 2008 a, b). Applications of range of humic acids, that had been extracted from vermicompost and than added to MM360, with all need nutrients, increased the growth of tomatoes and cucumbers significantly in a very similar pattern to the effect of a range of vermicompost (Atiyeh *et al.,* 2002); Canellas *et al.* (2000) reported that the plant growth hormones can became absorbed onto the complex structure of humic acids that are produced very rapidly in vermicompost and may have acted in conjunction with them to influence plant growth, the hormones are absorbed on to humates would persist in soil would be released slowly from humates and have much more effects on plant growth.

Nitrogen, Phosphorus, Potassium are of the integral components in plant metabolism. These macronutrients are the key constituents of chlorophyll biosynthesis, protein, nucleic acids and other constituents. In this experiment the nutrient contents are higher in treatment 4 (T_4) when compared with all the other treatments and control. It may be due to the vermicompost enhance the growth of nitrogen fixing microorganism and phosphate solubilizing microorganisms in the rhizosphere. It may enhance the growth as well as the nutrient in the plant. The vermicompost assists in introducing the microorganisms into the rhizosphere of plants, helping to increase the N and P availability by making available biologically fixed N and biologically solubilizer P was attributed to the intimate mixing of ingested particles with soil in vermicompost (Mackey *et al.,* 1982).

The number of root nodules was higher in plants which received vermicompost as an organic source (Padmavathiamma *et al.,* 2007). Application of vermicompost as a bioinoculants helps to introduce the beneficial microorganisms into the rhizosphere of plant which stimulates the nitrognease enzyme responsible for N fixation of atmospheric N in legumes. This in turn enriches the N status of soil, thereby increasing the availability of N. Earthworms increase extractable N by feeding on microbial biomass and increasing the mineralization of microbial activity (Bhole, 1992). The vermicompost contain more nitrates. From that, plants can assimilate more readily a large proportion of the nitrates in the substituted mixtures had been lost either through leaching or being taken up by the plants. So the results showed significant increase in nitrogen concentrations of the leaves (Ansari and Sukhraj, 2010). The substitution of increasing proportions of pig manure vermicompost into Metro-mix 360 increased the nutrient content of the leaves, which seems directly attributed to the fact that concentration of these elements was higher in the pig manure vermicompost than in the commercial potting medium (Pinamonti *et al.* 1997). Slight variation in K uptake may be due to the increase in K availability by shifting the equilibrium among the forms of K from relatively unavailable to more available forms in soil (Bhaskar *et al.,* 1992). Similarly the increased uptake of K may be due to better root proliferation due to the improved soil environment after vermicompost application.

Table 1. Effect of different concentration of vermicompost of groundnut (*Arachis hypogaea* L.) VRI (Gn) 7 on 110th day

Treatments	Shoot length (cm/plant)	Root length (cm/plant)	Fresh weight (mg/fr. wt.)	Dry weight (mg/dry wt.)
Control	24.4 ± 1.22	13.1 ± 0.65	31.4 ± 1.57	13.6 ± 0.68
1 ton ha^{-1} VC	26.5 ± 1.32	14.8 ± 0.74	34.6 ± 1.73	16.1 ± 0.80
2 ton ha^{-1} VC	28.7 ± 1.43	16.9 ± 0.84	38.6 ± 1.93	19.0 ± 0.95
3 ton ha^{-1} VC	30.4 ± 1.52	19.4 ± 0.97	43.3 ± 2.16	21.3 ± 1.06
4 ton ha^{-1} VC	33.4 ± 1.67	26.6 ± 1.33	46.1 ± 2.30	22.8 ± 1.14

± standard deviation

Table 2. Effect of different concentration of vermicompost of groundnut (*Arachis hypogaea* L.) VRI (Gn) 7 on 110th day

Treatments	Number of Root nodules	Number of leaves	Total leaf area (cm^2)
Control	186.0 ± 9.3	118.0 ± 5.9	14.6 ± 0.73
1 ton ha^{-1} VC	254.0 ± 12.7	126.0 ± 6.3	18.8 ± 0.94
2 ton ha^{-1} VC	310.0 ± 15.5	138.0 ± 6.9	19.3 ± 0.96
3 ton ha^{-1} VC	325.0 ± 16.2	149.0 ± 7.4	22.1 ± 1.10
4 ton ha^{-1} VC	363.0 ± 18.1	158.0 ± 7.9	24.6 ± 12.3

± standard deviation

Table 3. Effect of different concentration of vermicompost on nutrient content of groundnut (*Arachis hypogaea* L.) VRI (Gn) 7 on 110th day

Treatments	*Nitrogen (mg/g dr. wt.)*	Phosphorus (mg/g dr. wt.)	Potassium (mg/g dr. wt.)	Calcium (mg/g dr. wt.)	Magnesium (mg/g dr. wt.)
Control	10.43 ± 0.52	5.81 ± 0.29	3.84 ± 0.19	2.31 ± 0.11	2.41 ± 0.12
1 ton ha^{-1} VC	12.83 ± 0.64	7.13 ± 0.35	5.18 ± 0.25	3.68 ± 0.18	4.00 ± 0.20
2 ton ha^{-1} VC	13.61 ± 0.68	8.76 ± 0.43	6.13 ± 0.30	4.16 ± 0.20	5.13 ± 0.25
3 ton ha^{-1} VC	15.19 ± 0.75	9.43 ± 0.47	7.81 ± 0.39	4.98 ± 0.24	5.98 ± 0.29
4 ton ha^{-1} VC	17.13 ± 0.85	10.34 ± 0.51	8.00 ± 0.40	5.83 ± 0.29	6.78 ± 0.33

± standard deviation

Table 4. Effect of different concentration of vermicompost on nutrient content of groundnut (*Arachis hypogaea* L.) VRI (Gn) 7 on 110th day

Treatments	Number of pods/plants	Number of seeds/plants
Control	38.0 ± 1.9	76.0 ± 3.8
1 ton ha^{-1} VC	44.0 ± 2.2	88.0 ± 4.4
2 ton ha^{-1} VC	49.0 ± 2.4	98.0 ± 4.9
3 ton ha^{-1} VC	53.0 ± 2.6	106.0 ± 5.3
4 ton ha^{-1} VC	55.0 ± 2.7	110.0 ± 5.5

± standard deviation

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