



Science Arena Publications
Specialty Journal of Agricultural Sciences

Available online at www.sciarena.com

ISSN: 2412-737X

2020, Vol 6 (1):14-27

Effect of Vermicompost, Jeevamrutha and G5- Soil Enricher Granules on the Growth of *Amaranthus caudatus*

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Abstract: *Organic farming is an age old traditional practice evolved by our forefathers where in only organic manures or natural inputs available in the farm are used thus reducing the cost of manufacture against chemical inputs. Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. Nowadays organic farming practices are in advance importance as farmers have realized the benefits in terms of soil fertility, soil health and sustainable productivity. Effect of Vermicompost, Jeevamrutha and G5 soil enricher granules separately and in combination on the growth and yield of Amaranthus caudatus was determined in the present study. Application of Vermicompost and Jeevamrutha enhanced growth parameters (germination percentage, shoot length, root length, wet weight, dry weight, chlorophyll content, and protein content) in A. caudatus while minimum values were noticed in the case of G5-Soil enricher granules.*

Keywords: *Vermicompost, Jeevamrutha, G5 soil enricher granules, Amaranthus caudatus, growth*

INTRODUCTION

Organic waste has traditionally been considered as a source of pollution and has not been sufficiently evaluated as a byproduct of agricultural activity which could produce organic fertilizers by composting and vermicomposting. Furthermore, due to the high cost of substrates and imported inputs, there is a need for stable and quality material produced locally. Vermicompost and compost can meet the nutrient demand of greenhouse crops and significantly reduce the use of synthetic fertilizers (Rodríguez *et al.*, 2008), and for vermicompost in particular, it increases soil fertility without polluting the soil, as well as the quantity and quality of harvested products (Castillo *et al.*, 2002).

Use of chemical fertilizers and pesticides without any scientific intervention has adversely affected the soil quality and the beneficial microbial load which in turn has led to the decreased productivity in intensive agriculture. With growing population, increasing prosperity, changing in food consumption and growing urbanism, waste disposal has become a problem, especially in metropolitan areas (Nouri *et al.*, 2011; Hyun *et al.*, 2011; Thanh and Matsui, 2011; Maqbool *et al.*, 2011; Chen *et al.*, 2011; Arshad *et al.*, 2011). There are mainly three methods for handling organic wastes which are incineration, land filling and composting (Shafieiyoun *et al.*, 2012; Mahmoudkhani *et al.*, 2012; Abdoli *et al.*, 2012; Nada *et al.*, 2012; Rashidi *et al.*, 2012). A growing body of evidence

indicates that secondary plant metabolites play critical roles in human health and may be nutritionally important (Asami *et al.*, 2003). The quality and value of agricultural organic soil amendments are often measured in terms of their contributions on nutrient supplies and soil fertility (Arancon *et al.*, 2006). The cost of inorganic fertilizers is very high and sometimes they are not available in the market for which the farmers fail to apply the inorganic fertilizers in the crop field in optimum time. On the other hand, the organic manure is easily available to the farmers and its cost is low compared to that of inorganic fertilizers (Alam *et al.*, 2007).

The current global scenario firmly emphasizes the need to adopt ecofriendly agricultural practices for sustainable food production. The cost of inorganic fertilizers is increasing enormously to an extent that they are out of reach of small and marginal farmers. The Panchagavya, Jeevamrutha and Beejamurth are ecofriendly organic preparations made from cow products. The use of organic liquid products such as Beejamurth, Jeevamrutha and Panchagavya result in higher yield, growth and quality of crops. These liquid organic solutions are prepared from cow dung, urine, milk, curd, ghee, legume flour and jaggery. They contain macronutrients, essential micronutrients, many vitamins, essential amino acids, growth promoting factors like IAA, and GA, and beneficial microorganisms (Palekar, 2006; Natarjan, 2007; Sreenivasa *et al.*, 2009). Hence the present study has been designed to determine the effect of Vermicompost, Jeevamrutha and G5-soil enricher granules and their combinations on the growth of *A.caudatus*

Materials and Methods

The present study was carried out for testing the effect of Vermicompost, Jeevamrutha, and G5- soil enricher granules and their combinations on the growth of the plant, *Amaranthus caudatus*

Study area

A pot testing was carried out during the growing season of 2016 at Mullai nagar in Madurai to learn the effect of organic manure on the growth of *A.caudatus* grown in red soil. The minimum and maximum temperature during the cropping period was 30 and 35°C respectively. The experimental site had red soil with pH 5.57. Pots (8 pots) with 25cm diameter and 35 cm depth were used in this study. Each pot was filled with 1.5 kg of the used fine soil and planted with 35 of *A.caudatus* seeds. The soil was mixed well, labeled and brought to laboratory for analyses. The soil was mixed with the respective organic manure or combination in each pot.

Chemical Parameters

Chemical examination of the soil was carried out according to the methods described by Jackson (1973). The chemical properties such as pH, Electrical conductivity, nitrogen, phosphorus, potassium, copper, zinc, iron and manganese were estimated and recorded. Soil organic matter was determined by using Walkley and Black method according to Jackson (1973). The samples were also analyzed for available nitrogen by Micro Kjeldhal method (Bremner and Mulvaney, 1982). Available phosphorus was determined by ascorbic acid method (Jackson, 1962) using atomic absorption spectrophotometer. Available potassium was determined according to Jackson (1962) using flame photometer. The DTPA-extractable micronutrients were measured (Lindsay and Norvell, 1978). Chemical parameters were analysed in soil, Vermicompost, Jeevamrutha and G5-soil enricher granules (Dresboll and Thorupkristensen, 2005).

Vermicompost

Vermicompost was purchased from The Agriculture College and Research Institute at Madurai. Its characteristics were analyzed using the standard methods (Edwards, 2007). The pot was maintained by mixing 2 kg of Garden soil and 1/2 kg of Vermicompost in the treatment pots of T1, T4, T5 and T7.

Jeevamrutha

Jeevamrutha was prepared by mixing 500g cow dung, 500 ml cow urine, 100g of green gram (soaked overnight and ground), 25 g undisturbed soil, 100 ml coconut water and ten liters of water and kept for three days by covering with muslin cloth. Stirring was done twice a day in clockwise direction. Jeevamrutha was stored in plastic vessels covered with muslin cloth in open condition and the superiority analysis was done. Fresh preparation of Jeevamrutha was analyzed for the physical properties such as colour (visual evaluation), odour (sensory evaluation), presence of mould growth and chemical properties such as pH, total macro and micronutrients (Kasbe *et al.*, 2009). 50 ml of Jeevamrutha each was applied in the treatment pots of T2, T4, T6, and T7.

G5 - soil enricher granules

G5 soil enricher granules were purchased from the market. They are multi activity soil enricher granules, and organic certified granule fertilizer for all types of crops. G5 Granules are a blend of seaweed extracts, amino acid blends, herbal extracts and organic antiroot substance. 250 g of G-5 granules was applied per kilogram soil of pot once in a week in the morning. G5 soil enricher granules were applied in T3, T5, T6 and T7 treatments.

Amaranthus caudatus

Amaranthus caudatus is a yearly flowering plant. It goes by common names such as love-lies-bleeding pendant amaranth, tassel flower, velvet flower, foxtail amaranth, and quilete. Many parts of the plant, including the leaves and seeds, are edible, and are frequently used as a source of food in India. *A. caudatus* can grow anywhere from 3 to 8 feet in height, and grows best in full sun. It can handle a variety of conditions, both humid and arid. It is easily grown from seed. In most of its range, it is planted as a summer annual. In temperate regions, these plants can be started indoors in early spring and transplanted outdoors after the last frost with low construction costs. *Amaranth* is one of the cheapest dark-green leafy vegetables in tropical markets and is often described as the poor man's vegetable (Maundu, 2009).

Treatment

The eight treatments were conducted for the seeds of *A. caudatus* (Table 1). For each treatment, thirty five seeds were used in each pot. The seed germination in dissimilar treatments was observed after 96 hours of sowing. Observations were made only when the plumules had come through microphyll of the seed. The germination process was analyzed up to ten days. The shoot length, root length, wet weight, dry weight, protein and chlorophyll content were measured four times, once in ten days. The analysis of protein, and chlorophyll content was carried out using standard procedures (Atiyeh *et al.*, 2000).

Table1. The various types of treatments used in the present study

Treatments	Products used
T1	Vermicompost
T2	Jeevamrutha
T3	G5 soil enricher granules
T4	Vermicompost + Jeevamrutha

T5	Vermicompost + G5 soil enricher granules
T6	Jeevamrutha + G5 soil enricher granules
T7	Vermicompost + Jeevamrutha + G5 soil enricher granules
T8	Control

Seed germination

Seed germination percentage was calculated based on the following formula and recorded up to tenth day after seeding.

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds applied}} \times 100$$

Shoot length and Root length

Shoot length was measured from above the root surface to the tip of the twig and root length was measured from the ground level to the tip of the longest root hair (Danish and Patra, 2004).

Wet weight and Dry weight

The clean plants from each pot individually were weighed on electronic balance to obtain the wet weight. Each of the plant was packed in separate envelope and dried at 80°C in an oven for two days and weighed using electronic balance to obtain dry weight (Devendra *et al.*, 2003).

Preparation of the samples

Green leaves of *A.caudatus* were cleaned, washed with distilled water and allowed to air dry. Two gram portion of the dry sample was weighed and made into paste using pestle and mortar. The juice was extracted and made up to 5ml with distilled water and poured into a centrifuge tube and after centrifugation the aqueous extract collected was packed in polythene pouches and stored in the refrigerator for the estimation of total protein and chlorophyll content.

Total protein estimation

Protein content of leaf extract was determined by Lowry's method using Folin-ciocalteau reagent. The absorbance of each sample was determined using spectrophotometer after 30 minutes and standard graph was prepared using BSA as standard (Singh *et al.*, 2008).

Estimation of chlorophyll

The estimation of chlorophyll was done in the laboratory. Chlorophyll was extracted from one gram of leaf sample using 20 ml of 80% acetone. The supernatant was transferred to a volumetric flask after centrifugation at 5000 rpm for five minutes. The extraction was frequent until the residue becomes colourless. The volume in the flask was made up to 100ml with 80% acetone. The absorbance of the extract was read in a spectrophotometer at 645 and 663nm against 80% acetone blank. The amount of total chlorophyll in the sample was calculated using the following formulae (Berova and Karanatsidis, 2008).

$$\text{mg chlorophyll a/g tissue} = 12.7 (A_{663}) - 2.69(A_{645}) \times V/1000 \times W$$

$$\text{mg chlorophyll b/g tissue} = 22.9 (A_{645}) - 4.68(A_{663}) \times V/1000 \times W$$

$$\text{mg total Chlorophyll /g tissue} = 20.2 (A_{645}) + 8.02 (A_{663}) \times V/1000 \times W$$

Where,

V = final volume of the extract

W =fresh weight of the leaves

The values are expressed as mg chlorophyll/g sample.

Results

The growth parameters of *A. caudatus* were tested in the present investigation with respect to various treatments like Vermicompost, Jeevamrutha, and G5 soil enricher granules and their combinations. The chemical parameters of soil, Vermicompost, Jeevamrutha, and G5- soil enricher are shown in Table 2, 3, 4 and 5 respectively. The highest value was found for manganese while the lowest value was noticed for iron. Chemical parameters of Vermicompost are shown in Table 3. Organic carbon, Nitrogen, phosphorous, potassium and sodium were observed in Vermicompost. The chemical parameters of Jeevamrutha are shown in Table 4. The highest value was found for nitrogen (770 ppm) and the lowest value was found for zinc (4.29ppm). Chemical parameters of G5-soil enricher granules are shown in Table 5. The highest value was found for magnesium (50 ppm) and the lowest for zinc (3 ppm).

Figure 1 shows the germination percentage of *A. caudatus* in various treatments. It was found to be the maximum in Jeevamrutha+G5-soil enricher granules treatment (T6). The minimum germination percentage was recorded in Vermicompost + G5-soil enricher granules treatment (T5). Figure 2 exhibits the effects of various treatments on the shoot length of *A. caudatus* 10, 20, 30 and 40 days after seeding. The maximum of 94.3cm was recorded in Vermicompost treatment (T1). The minimum shoot length 60.6cm was recorded in Jeevamrutha + G5-soil enricher granules treatment (T6). Figure 3 indicates the effects of various treatments on the root length of *A. caudatus* 10, 20, 30 and 40 days after seeding. Root length was found to be the maximum in Vermicompost treatment (T1). The minimum root length was recorded in Jeevamrutha + Vermicompost treatment (T4). Figure 4 shows the effect of various treatments on the wet weight of *A. caudatus* 10, 20, 30 and 40 days after seeding. Wet weight was found to be the maximum in Jeevamrutha treatment (T2) with 28.86 g/plant respectively. The minimum weight was recorded in Jeevamrutha combined with G5-soil enricher granules treatment (T6) with 17.11 g/plant.

Figure 5 exhibits the effect of various treatments on the dry weight of *A. caudatus* 10, 20, 30 and 40 days after seeding. Dry weight was found to be higher in control treatment (T8). Treatments of Jeevamrutha + G5-soil enricher granules (T6) showed the least weight with 1.88 g/plant. Figure 6 highlights the effect of various treatments on the chlorophyll A content of *A. caudatus* 10, 20, 30 and 40 days after seeding. Chlorophyll A was found to be the maximum in Jeevamrutha treatment (T2) and the minimum in G5-soil enricher granules treatment (T3).

Figure 7 shows the effect of various treatments on the chlorophyll B content of *A. caudatus* 10, 20, 30 and 40 days after seeding. Chlorophyll B was found to be the maximum in Vermicompost + Jeevamrutha treatment (T4) and the minimum in G5-soil enricher granules treatment (T3). Figure 8 indicates the effect of various treatments on the total chlorophyll content of *A. caudatus* 10, 20, 30 and 40 days after seeding. It was found to be higher in Vermicompost + Jeevamrutha + G5-soil enricher granules treatment (T7) while control showed the minimum (T8). Figure 9 divulges the effect of various treatments on the protein content of *A. caudatus* 10, 20, 30 and 40 days after seeding. This was found to be the maximum in Jeevamrutha treatment (T2) with 2.06 mg/g wet weight and treatment of Vermicompost + G5-soil enricher granules (T5) showed the minimum with 1.85mg/g wet weight.

Figure 10 shows the highest count of bacteria in the treatment of Vermicompost + Jeevamrutha (T4). The lowest count was in treatment of Vermicompost + G5-soil enricher granules (T5). The highest count of fungi was found in the treatment of Vermicompost + Jeevamrutha (T4). The lowest count was found in the treatment of Jeevamrutha + G5-soil enricher granules (T6). The highest count of

actinomycetes was found in Jeevamrutha treatment (T2) while the lowest count was noticed in the treatment of Vermicompost + G5-soil enricher granules (T5). Figure 11 highlights the variations due to treatment types being statistically significant at 5% level for the factors germination percentage, wet weight, dry weight, chlorophyll A content, chlorophyll B content and total chlorophyll content.

Table 2. Chemical characteristic of soil used in the study

Parameter (unit)	Value	Interpretation
Moisture content (%)	1.35	-
pH	5.57	Acidic
Electrical conductivity (ds/m)	0.30	Harmless
Nitrogen (mg/kg)	476	High
Phosphorus (mg/kg)	50	High
Potassium (mg/kg)	518	High
Organic Carbon (g/kg)	5.14	Medium
Exchangeable Calcium (meq/100g)	3.50	-
Exchangeable Magnesium (meq/100g)	1.50	-
Exchangeable Sodium (meq/100g)	1.25	-
Exchangeable Potassium (meq/100g)	0.81	-

Table 3. Chemical characteristics of Vermicompost

Parameter (unit)	Value
pH	7- 8.2
Organic carbon (%)	17.98
Nitrogen (%)	1.50
Phosphorus (%)	0.30
Potassium (%)	0.56
Sodium (%)	0.30
Calcium and Magnesium (meq/100mg)	22.67
Copper (mg/kg)	9.50
Iron (mg/kg)	9.30
Zinc (mg/kg)	5.70
Sulphur (mg/kg)	128

Table 4. Chemical characteristics of Jeevamrutha

S.No	Parameter (unit)	Value
1	Iron (ppm)	20
2	Magnesium (ppm)	10
3	Sodium (%)	0.8
4	Zinc (ppm)	3
5	Sulphur (%)	0.45
6	Vitamin B (ppm)	13
7	Vitamin E (ppm)	1.71
8	Chromium (ppm)	13
9	Cobalt (ppm)	6

Table 5. Chemical characteristics of G5- soil enricher granules

S.No	Parameter (unit)	Value
1	pH	7.07
2	Soluble salt (%)	3.40
3	Nitrogen (%)	7.70
4	Phosphorus (ppm)	166
5	Potassium (ppm)	126
6	Zinc (ppm)	4.29
7	Copper (ppm)	1.58
8	Iron (ppm)	282
9	Manganese (ppm)	10.7

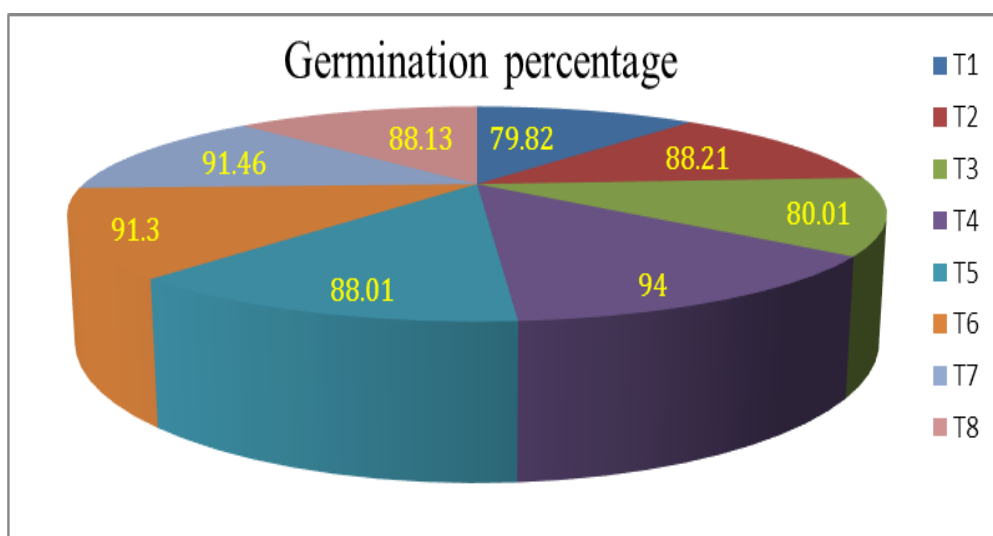


Fig.1. Effects of various treatments on the germination percentage of *Amaranthus caudatus*

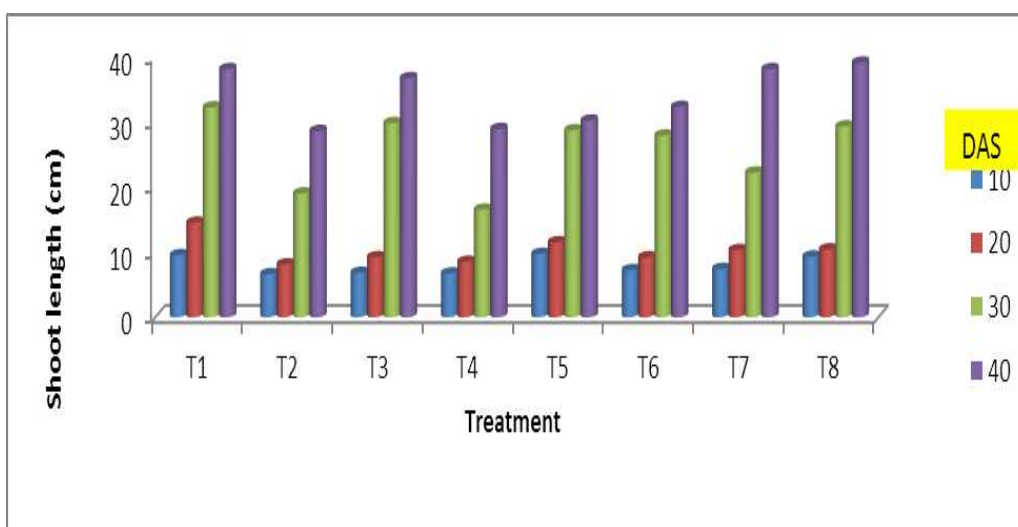


Fig.2. Effects of various treatments on the Shoot length of *Amaranthus caudatus*

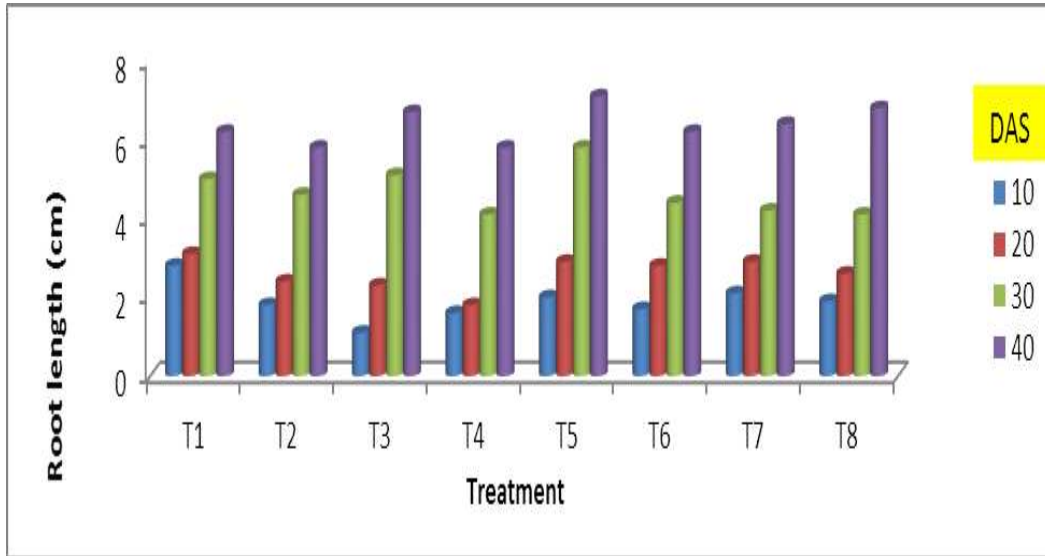


Fig.3. Effects of various treatments on the Root length of *Amaranthus caudatus*

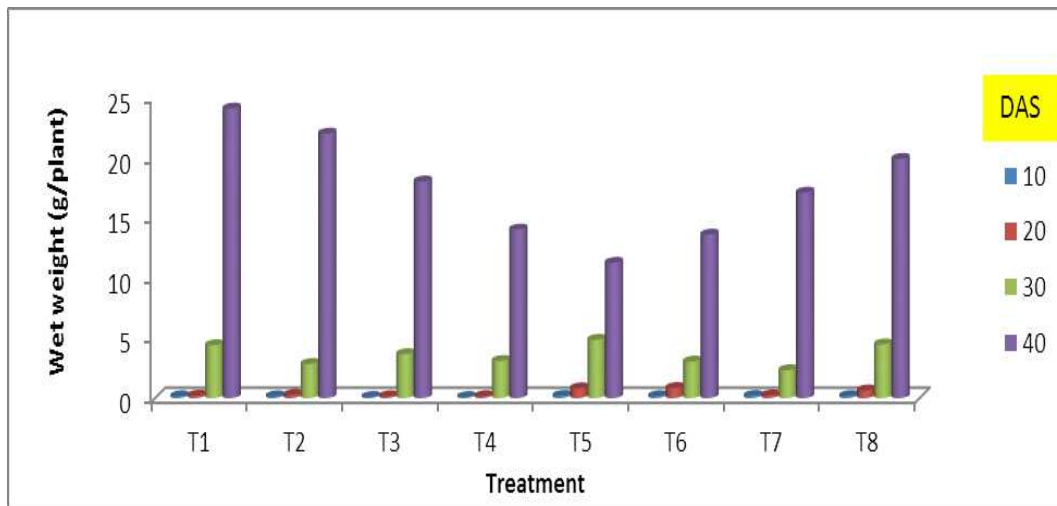


Fig.4. Effects of various treatments on the Wet weight of *Amaranthus caudatus*

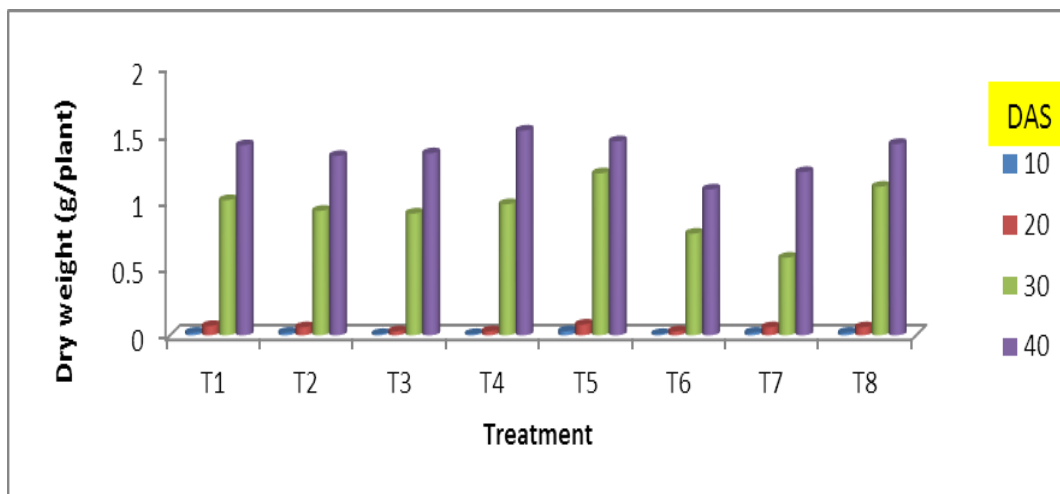


Fig.5. Effects of various treatments on the Dry weight of *Amaranthus caudatus*

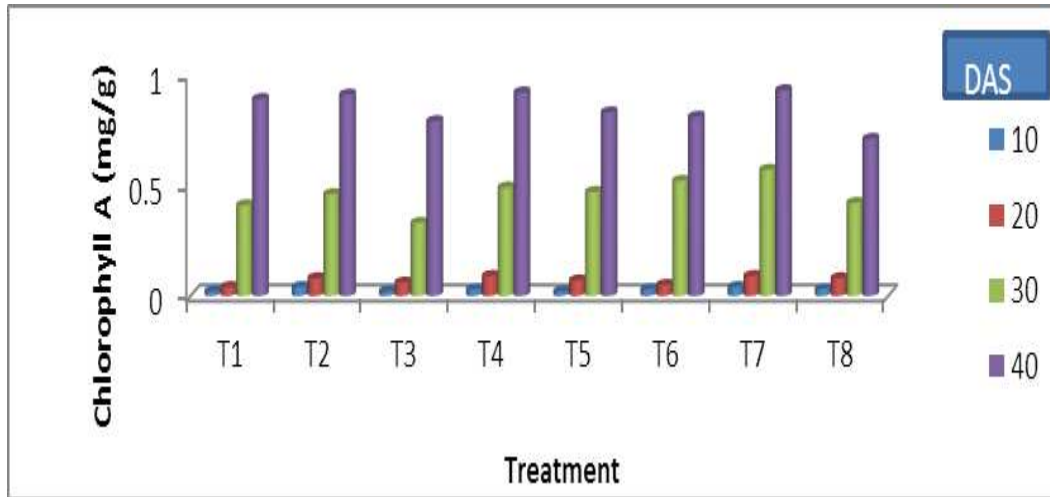


Fig.6. Effects of various treatments on the Chlorophyll A content of the leaves of *Amaranthus caudatus*

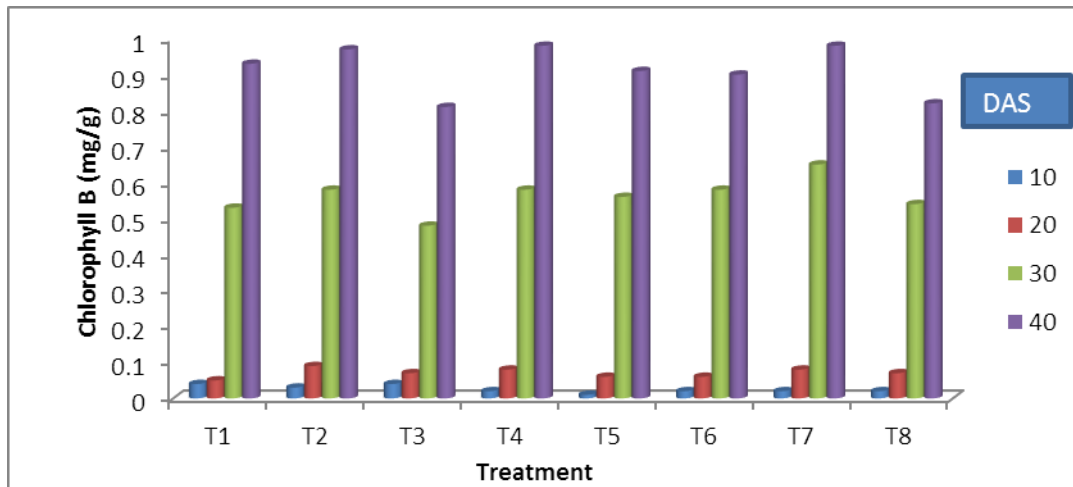


Fig.7. Effects of various treatments on the Chlorophyll B content of the leaves of *Amaranthus caudatus*

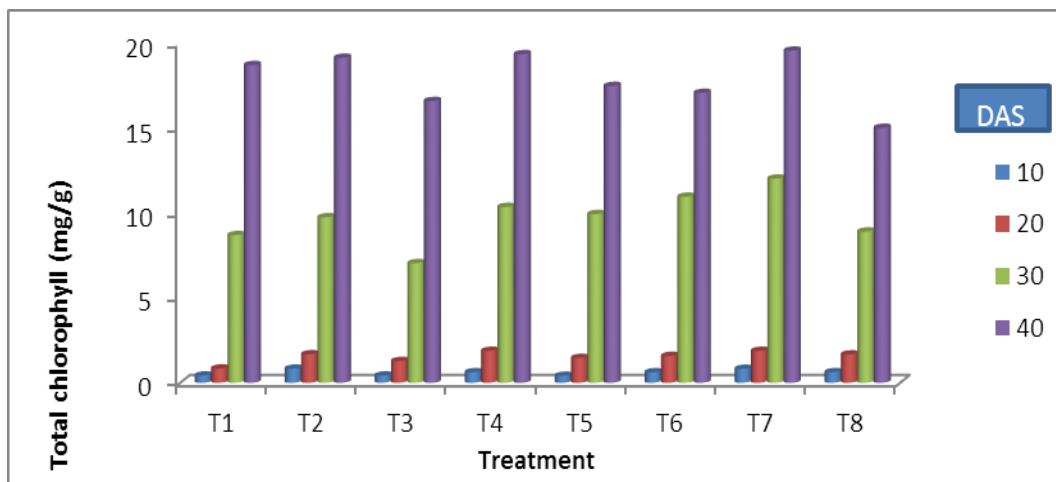


Fig.8. Effects of various treatments on the Total Chlorophyll content of the leaves of *Amaranthus caudatus*

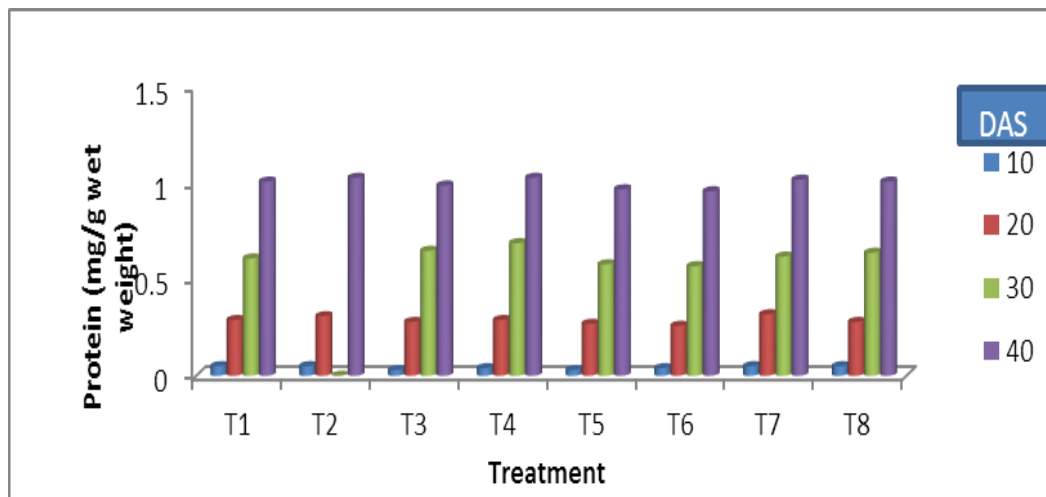


Fig.9. Effects of various treatments on the Protein content of the leaves of *Amaranthus caudatus*

Discussion

In recent years, vermicomposting is emerging as a simple, easily adoptable and effective biotechnology for recycling wide ranges of organic wastes for agricultural production. This can be taken up in small scales at household levels or at large levels as business propositions. The former practice helps an agriculturist or gardener to produce vermicompost from his homestead garbage for the purpose of utilizing the generated vermicompost for own consumption. On the other hand, vermicomposting can also be taken up at commercial level using municipal and/or other sources of wastes and the product be marketed as good quality organic manure.

Table 6. Two way analysis of variance (ANOVA): Variation due to treatment types and treatment period for the various factors of *Amaranthus caudatus*

S. No	Factor	Source of variation	ss	df	MSS	Calculated F value	Table F value at 5% level	Level of significance at 5% level
1	Germination percentage	Treatment types	65.90976	7	9.41568	0.619686	2.35926	NS
		Treatment period	21.02606	4	5.256515	0.345954	2.714076	NS
2	Shoot length	Treatment types	235.8222	7	33.68888	4.075114	2.487578	S
		Treatment period	3755.991	3	1251.997	151.997	3.072467	S
3	Root length	Treatment types	3.442188	7	0.491741	2.508019	2.487578	S
		Treatment period	99.96594	3	33.32198	300.07	3.072467	S
4	Wet weight	Treatment types	33.94147	7	4.848782	0.937954	2.487578	NS
		Treatment period	1615.385	3	538.4617	104.1606	3.072467	S

5	Dry weight	Treatment types	0.187822	7	0.026832	2.508019	2.487578	S
		Treatment period	10.57421	3	3.524736	329.465	3.07467	S
6	Chlorophyll A content	Treatment types	0.0362447	7	0.005178	2.363124	2.487578	NS
		Treatment period	3.537359	3	1.17912	538.111	3.072467	S
7	Chlorophyll B content	Treatment types	0.0221	7	0.003157	2.302083	2.48778	NS
		Treatment period	4.3069	3	1.435633	1046.816	3.072467	S
8	Total chlorophyll	Treatment types	15.71244	7	2.244634	2.98676	2.487578	S
		Treatment period	1565.844	3	521.9481	1987.786	3.072467	S
9	Protein content	Treatment types	0.012522	7	0.001789	4.68655	2.487578	S
		Treatment period	4.185359	3	1.39512	3655.051	3.0724467	S

The gradually expanding market of organic foods for sustaining human health presents significant opportunities for undertaking such activity on commercial basis. In the present work, the effect of organic substances like vermicompost, Jeevamrutha and G5- soil enricher were studied using *A. caudatus* as model plant. The combination of Vermicompost and Jeevamrutha produced the highest germination percentage rate for *A. caudatus* compared to G5-soil enricher granules. The vermicompost contains humified organic matter characterised by high molecular weight and enzymatically active humic fraction which stimulates seed germination and plant growth (Garcia-Gomez *et al.*, 1992; Atiyeh *et al.*, 2000). Using Jeevamrutha exhibited the maximum shoot length compared to other manures. The second maximum shoot length was achieved by using the combination of Vermicompost + Jeevamrutha. Shoot length was the maximum when using vermicompost compared to other organic manures. Shoot and root length were reported in chilli and tomato grown in Vermicompost amended soil compared to those grown in control red soil (Jose, 2005). In *A. caudatus* root lengths were found to be higher in Jeevamrutha(T2), and Vermicompost (T1) treatments because of addition of jaggery, pulse flour coupled with continuous stirring while preparing Jeevamrutha which may help in proliferation of N fixing bacteria at a faster rate (Joshi, 2009). Among the organic sources of nutrients, application of Jeevamrutha and vermicompost exhibited higher wet weight and dry weights in the treatments of T1 and T2 in *A. caudatus*. The higher yield parameters might be due to higher dose of nitrogen, phosphorus and potassium through organic sources which might have helped in inducing growth parameters (Siddaram, 2009).

Increase in chlorophyll content due to nitrogen application could be due to greater availability and uptake of nitrogen and phosphorous by plants. Phosphorus might have increased the uptake of nitrogen by the plants due to which the chlorophyll content increased. Similar results were also reported in *Heliconia*. Vermicompost is a good source of nutrients and growth promoting substances. The higher uptake of nutrients namely nitrogen, phosphorous, potassium and sulphur in this particular treatment might be attributed to higher content of these nutrients, presence of beneficial microflora such as N-fixers and P- solubilizers, in the vermicompost. The findings are in line with those of Jagtap *et al.* (2007). The Jeevamrutha contains kinetin which has a role in enhancing

chlorophyll content in plant leaves, thus in turn enhance photosynthetic activity, growth and yield (Muthuvel *et al.*, 2002).

The reason for higher protein may be due to more availability of nutrients particularly nitrogen which is an integral part of protein. The protein content was higher in the treatments of Vermicompost + Jeevamrutha. Protein is one of the reserve food materials utilized by plants for the growth of their seedlings. An increase in protein content was recorded in the crop grown in vermicompost treatment. Among all treatments, the highest protein content was observed in the plants grown in Vermicompost applied pots and Jeevamrutha applied pots and lower in G5-soil enricher granules treatment. This might be due to the lower availability of organic matter and lesser microbial activity. Increased nitrogen might have increased seed protein content. The higher yield parameters might be due to higher dose of nitrogen, phosphorus and potassium through organic sources which might have helped in inducing growth parameters (Siddaram, 2009). Increase in chlorophyll content due to nitrogen application could be due to greater availability and uptake of nitrogen and phosphorus by plants. Aira *et al.* (2002) stated that earthworms are important drivers of the process, conditioning the substrate and altering its biological activity.

Conclusion

In agriculture, Vermicompost and Jeevamrutha can be used to enhance growth and yield of crops like *A. caudatus*.

Acknowledgments

The authors thank the authorities of The American College, Madurai for the facilities and encouragement during this study.

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