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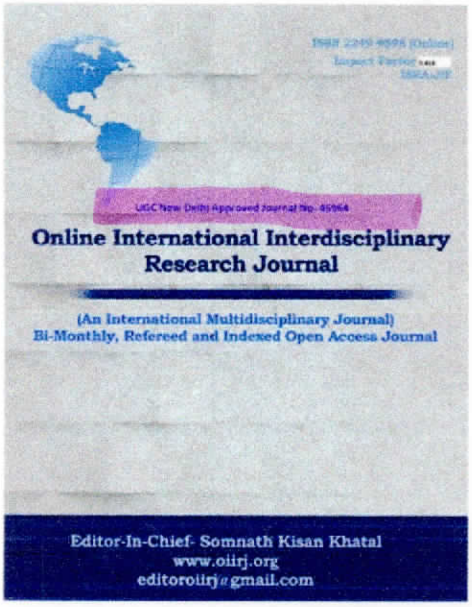


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# Application of Weed Vermicompost to Improve Chlorophyll, Ascorbic Acid and B-Carotene Content in Beet (Beta Vulgaris L.) Crop

**Sangita A. Ghadge**
Head, Dept. Of Botany, Loknete Gopinathji Munde Arts, Commerce and Science College, Mandangad, Dist. Ratnagiri, Maharashtra, India

## Abstract

Ipomoea muricata L., Euphorbia prunifoliaJacq. and Trianthemaportulacastrum L. are some common weeds available abundantly on waste land, road sides and also in crop field. A field experiment was carried out at the research farm of Dr. Babasaheb Ambedkar Marathwada University Aurangabad to investigate impact of vermicompost prepared from weeds on chlorophyll, ascorbic acid and β carotene content of beet root crop. The experimental design was randomized block design (RBD) assigning with six treatments i.e. Ipomoea vermicompost (IPOVC), Euphorbia vermicompost (EUPVC), Trianthemavermicompost (TRIVC), mixed vermicompost (MIXVC) along with NPK (40:30:30kg/ha) and control treatments with four replicate of each. The F1-Lalima Beet variety (Beta vulgaris L.) was cultivated by dibbling ridges and furrow method at the seed rate 10kg/ha in 1.8 x 2.4m plot. Chlorophyll, β carotene, and ascorbic acid contents were estimated from fresh leaves by following standard chemical analysis methods. Results showed that all vermicompost treatments increased Chlorophyll, β carotene, and ascorbic acid contents in beet crop. Leaf area was also enhanced by application of weed vermicomposts. Mix vermicompost showed more increase in content as compared to other treatments. Weeds can be used for preparation of vermicompost which is very useful for enhancing growth of crops.

**KEYWORDS:** growth, leaf area, NPK, vermicomposting, weed.

## INTRODUCTION:

Incessant use of chemical fertilizers is leading reduction in the crop yield and resulted in imbalance of nutrients in the soil, which has adverse effects on soil health. Organic manures provide a good substrate for the growth of microorganisms and maintain a favorable nutritional balance and soil physical properties (Maheshbabu et al.,2008).Environmental degradation due to intensive use of agrochemicals in crop production has created greater interest in the use of vermicompost to supply necessary mineral elements to produce organically grown fruits, vegetables of a high nutritional value, while recycling all wastes, thus minimizing contamination of soils and waterways (Follet et al., 1981; Matson et al., 1997).

The process of composting organic wastes using earthworms is called 'vermicomposting'. Vermicomposthas many good qualities and its application to soil has many benefits (Keith et al., 2006). Vermicomposting, can be a faster alternative for the treatment and decomposition of organic wastes, producing good quality fertilizer with nutrients in slow-release form (natural fertilizer will release its nutrients that over a period of time). The earthworms and microorganisms in the soil convert the organic wastes to rich compost viz.vermicompost a nutrient and microbially-rich material (Christmas B. de Guzman, 2009). Vermicompost are materials characterized by high porosity, aeration, drainage, water holding capacity and microbial activity (Edwards, 1998; Atiyeh et al., 2000). Micronutrients such as Fe, Cu, Zn, Mn, Mo and B assist in the formation of chlorophyll, cell division and growth, carbohydrate formation, as well as the maintenance of the plant's enzyme system (Follet et al., 1981). Therefore, the type of organic or inorganic fertilizers used in agriculture with different quantities of macro and micronutrient has a significant effect on the nutrient value of the plants consumed.

The nutrient status of vermicompost depends mainly upon the nutrient content of organic wastes provided to the earthworms. Vermicompost is rich in plant nutrients provides the essential nutrient elements and gives excellent effect on overall plant growth. It is free from weed seeds and toxic substances (Rajkhowa, et al., 2005). They are rich in bacteria, actinomycetes and fungi (Edwards, 1983). Effects on microorganisms have also been associated with their capability to suppress soil-borne plant diseases (Hoitink and Fahy, 1986), plant parasitic nematode populations and increased crop yields (Johnston et al., 1995). Vermicomposts are finely divided mature peat like materials with a high porosity, aeration, drainage and water-holding capacity and microbial activity which are stabilized by interactions between earthworms and microorganisms in non-thermophilic process (Edwards and Burrows, 1988).Vermicompost contains most nutrients in plant available form such as nitrates, phosphates and exchangeable calcium and soluble potassium (Edwards, 1998; Orozco et al., 1996). Vermicompost have large particulate surface areas that provide many micro sites for microbial activity and for the strong retention of nutrients (Shi-wei and Fu-Zhen, 1991).

Generally, agricultural systems depend exclusively on inorganic fertilizers to maintainelevated soil fertility since availability of cow manure is limited. Weeds are a part of the agriculturist everyday life. Weeds are available everywhere in large quantity out of which certain weeds species can be used as source of organic manures (Priya 2014). The nutrient status of vermicompost can be increased by feeding the earthworms on weed biomass. Weeds are generally control mechanically and treatment with pre and post emergence herbicides. Chemical herbicides are the most effective immediate solution to most weed problems but increased and indiscriminate use of these resulted in resistant and resurgence in pests. Exploitation of this weed biomass for the production of vermicompost is the cheapest source of nutrient supply to the crop.

Some weeds were used for preparation of organic manures and increased growth and yield of crops. Ghadge et al., (2013) used problematic weeds for preparation of manures and improved yield of fenugreek.Mogle et al (2013) prepared organic manures from Achyranthesaspera L. and Partheniumhysterophorus L. and found that organic manures are not only increase the crop productivity of single crop but also exhibit good residual effect on growth and yield of other successive crops. Organic manures prepared from weeds increases the productivity of crop and show long term effect.Ipomoea muricata L. weed when used for preparation of compost and vermicompost resulted in increased productivity of fodder maize (Naikwade 2014a).

Ipomoea muricataL., Euphorbia prunifoliaJacq.andTrianthemaportulacastrumL. are some common weeds available abundantly on waste land, road sides and also in crop field. In order to utilize the huge amount of weed biomass as a source of vermicompost; a study was conducted to investigate the influence of weed vermicompost on chlorophyll, ascorbic acid and β carotene content of beet root crop.

## MATERIAL AND METHODS:

### Collection of weeds and vermicomposting:

The fresh green foliage of weeds viz. Ipomoea muricata L, Euphorbia prunifoliajacq.,TrianthemaportulacastrumL. was collected from university campus early in the morning at 10-20% flowering stage and chopped in to small pieces (2-3cm). Equal amount of weed biomass 13333 kg / $ha^{-1}$ was used for preparation of various weed vermicompost. For mixed treatment three weeds were taken in 1:1:1 proportion. These weed materials were placed into pits with alternate layer of soil and dung slurry. After partial decomposition (20 days) turning was given, sufficient water was sprinkled to maintain 50-60% moisture and then the exotic African night crawer variety Eudriluseugeniae (80-90 individuals per pit) were released. Identification of earthworm was done by Julka (1988).The vermicompost was completed within 35 days and completely decomposed fine, dark brown colored granular material were obtained which used for field trials.100gm of sample were dried in oven for chemical analyses.

### Experimental site, design and treatments:

The field experiment was conducted on the research farm of Dr. BabasahebAmbedkarMarathwada University Aurangabad. The experimental design was randomized block design (RBD) assigning with six treatments i.e. Ipomoea vermicompost (IPOVC), Euphorbia vermicompost (EUPVC) Trianthema vermicompost (TRIVC), mixed vermicompost (MIXVC) along with NPK (40:30:30kg/ha) and control treatments with four replicate of each. The F1-Lalima Beet variety (Beta vulgaris L.) was cultivated by dibbling ridges and furrow method at the seed rate 10kg/ha in 1.8 x 2.4m plot. The crop received irrigation as per requirement.

### Fertilizer applications:

The fertilizers were applied at the recommended levels of 40N, 30P, 30K kg/ha as urea, single super phosphate and muriate of potash to NPK treatment alone. Entire amount of $P_2O_5$ and $K_2O$ was applied as basal dose for all the plots at the time of cultivation and N was supplied at 23 and 68 days after sowing (DAS) in two equal split doses. In order to assess the effect of treatments, growth analyses were done at 58 and 88 DAS as leaf area, chlorophyll, ascorbic acid and β-carotene.

### Chemical analysis-

The impact of different weed vermicompost and fertilizers was evaluated on productivity and nutrient uptake of beet. The estimation of Chlorophyll (Arnon, 1961), β Carotene (M. Holden), Ascorbic acid (Sadashivam and A. Manickam 1992) was recorded from fresh leaves. Nitrogen (N) was estimated by micro-Kjeldahl method (Bailey,1967).

## RESULT AND DISCUSSION:

### Analysis of weed:

Chemical analysis of different weeds was carried out as shown in Table 1. Amongdifferent types of weeds, Ipomoea muricata weed shows high dry matter 1771 kg/ha followed by Mixed, Euphorbia and less in Trianthema. Similar pattern was observed in Nitrogen which is very important for photosynthesis and growth of plant. Percentage of phosphorus was more in Euphorbia weed followed by Ipomoea, Mixed and less in Trianthema weed. Phosphorous plays a role in increasing water-use efficiency (WUE), a critical factor for plant productivity in drier climates (Vance, 2001), improves leaf expansion, axillary bud growth and shoot canopy, improved photosynthetic surface area and carbohydrate utilization (Ahloowalia et al., 2004).

Potassium percentage was recorded maximum from Trianthema followed by Euphorbia and Mixed weed with similar values and less in Ipomoea weed. Potassium is a nutrient that plays a role in many physiological processes essential for plant growth, including the maintenance for plant water balance and protein synthesis (Fenn, 1940). Ash and Carbon percent was more in Ipomoea followed by Mixed, Euphorbia and less in Trianthema.

**Analysis of weed vermicompost amendment**:

Vermicomposts prepared from different weeds were chemically analyzed (Table 2). Dry matter kg/ha was highest in EUPVC and lowest in TRIVC. Nitrogen amount was more in vermicompost prepared from Ipomoeafollowed by Euphorbia, mixed vermicompost and less inTrianthema. Nitrogen plays a significant role in photosynthesis, cell division and differentiation, growth and somatic embryogenesis, chlorophyll content, rubisco activity, electron transport rate, photosynthetic rate, anthocyanin production and is an important component of proteins required for the metabolic processes that take place during plant growth (Chaplin and Westwood, 1980; Guidi et al., 1998). Phosphorus and potassium percentage was more in TRIVC. Percentage of Ash and Carbon was more in mixed vermicompost. C: N ratio was in the range of 30.70 to 36.30.

All weed vermicompost showed high concentration of various nutrients. Similar increase in status of nutrients had been obtained by Dickerson (1999). According to Dutta, (2005) in order to produce a good crop, macronutrients available in the soil should be in the range of N (0.1 to 0.5%), P (0.08 to 0.5%), K (1.5 to 3.0%). The vermicomposts used in this experiment showed it as N (0.71 to 0.83 %) P (0.06 to 0.14 %) and K (0.08 to 0.10%) which shows that Nitrogen percentage in vermicomposts was more than recommended by Dutta, (2005) and phosphorus was in the range however potassium is less than recommended range.Naikwade et al. (2011) showed that manures prepared from Trianthemacontain high percentage of N, P, K, Ca, carbon and desirable C: N ratio.

**Chlorophyll content of Beet-**

Chlorophyll represents the principal class of pigments responsible for light absorption and photosynthesis. Photosynthesis however, is a complex process that is sensitive to environmental factors such as macro and micro nutrients (Marschner, 1995). The incorporated weed vermicompost had significantly influenced the chlorophyll contents of beet leaf. The mean values for chlorophyll content (a, b and total) ranged from 0.227-0.318, 0.135-0.266 and 0.362-0.584 mg $g^{-1}$ leaf fresh weight (fw) for first growth analysis and during second growth analysis varied from 0.403-0.941, 0.0880.403 and 0.491-1.344 mg g-1. During first growth analysis the total chlorophyll content (0.584 mg $g^{-1}$) was highest in MIXVC treatment than that of other treatments (Fig.1).While after 88 days TRIVC show highest (1.344mg/$g^{-1}$) total chlorophyll content followed by NPK, IPOVC, MIXVC, EUPVC and lowest in untreated plots (Fig.2.).Nehraet al., (2001) also reported increased chlorophyll a and b in wheat leaves after the application of vermicompost and farm yard manure.

Reason may be nutrients such as N, P, K, Mg, Fe and Cu, which are readily available through vermicompost, are used in the formation of chlorophyll which is required for light harvesting and subsequent conversion into chemical energy via photoassimilation (Tanaka et al., 1998). For example, N enhances CO2 fixation.

Significant increase in yield and fruit quality of tomatoes was attributed to improved uptake of N, P and K from vermicompost as well as increased chlorophyll production in the leaves.When vermicompost applied to red pepper (C. annuum L.) leaf area was increased and speed of the net photosynthesis was 33% higher in treatments with vermicompost compared with the control plants (Berova and Karanastidis, 2008).

Similar results were reported by Berova and Karanatsidis (2009) who observed increased photosynthetic pigments in red chilli (Capsicum annum L.) due to application of vermicompost.Golchin et al. (2006) also proved that chlorophyll content of the leaves of pistachio increased by vermicompost treatments. In an experiment involving beans, it was observed that addition of vermicompost induced the largest increase in chlorophyll content in the leaves of common bean (Phaseolus vulgaris L.) plants (Fernéndez-Luqueñoet al., 2010). In perennial ryegrass (Loliumperenne L.) grown in soils amended with 10 to 20% vermicompost increased chlorophyll content compared with plants from un-amended soils (Cheng et al., 2007).

**Ascorbic acid :**

Ascorbic acid known as vitamin 'C' is an antiscorbutic, present almost in all fruits and leaves. Ascorbic acid was estimated from fresh leaves after 88 days. The mean values for vitamin 'C' ranged from 0.073 to 0.133 mg/100mg. Highest (0.133mg/100mg) amount of vitamin 'C' was estimated in MIXVC amended plots followed in order by IPOVC, EUPVC, TRIVC and NPK application than control plots (Fig.3). Mahendran and Kumar, 1997 recorded highest ascorbic acid in cabbage treated with 75% of NPK combined with digest organic supplement and vermicompost.

Results from a study conducted by Premuzic et al. (1998) revealed that the fruit of tomato plants grown on vermicompost contained significantly more Ca and vitamin C but less Fe compared with those grown in a hydroponics medium with inorganic fertilization. In a pot experiment when spinach was treated with vermicompost prepared from weeds, it increased ascorbic acid content in spinach for three successive harvesting than control (Naikwade and Jadhav 2012).

In vermicompost grown spinach the vitamin C content was recorded 14.42 % more than chemically grown spinach (Sharma and Agarwal 2014).Theunissen et al., (2010) also concluded that organically fertilized plants yielded in higher vitamin C content (6.7- 16.6 mg/100 g) with respect to the conventional ones

**β-carotene**:

β-carotene was estimated from fresh leaves after 88 days. The mean values varied from 1.96 to 4.06 mg/100gm. Highest β-carotene was recorded from EUPVC (4.06mg/100gm) followed in order by MIXVC, TRIVC, NPK and IPOVC then untreated plots (1.96 mg/100gm) (Fig.4).These results are in accordance with Naikwade (2014b) who showed that highest β-carotene content (4.32mg/100gm) was found in fenugreek when treated with compost and lowest in control. Spinach grown on vermicompost showed 12.06 % more β carotene content than chemically grown spinach (Sharma and Agarwal 2014).

The impact of vermicompost on plant components, growth and biochemical changes in groundnut was analysed by Mathivanan et al., (2012). High amount of photosynthetic pigments like chlorophyll and carotenoid content were recorded in groundnut seedlings when vermicompost was applied. Sardoei (2014) showed that 40% vermicompost application increased carotenoid content in marigold crop.

**Leaf area:**

Leaf area is one of the most important growth parameter. Results of leaf area in various treatments are shown in (Fig.5). Leaf area oscillated between 149 to 180 $cm^2$ at 58 days and 211 to 361 $cm^2$ at 88 days stage (Fig.5). The maximum leaf area was recorded from MIXVC (180 $cm^2$) treatment followed by IPOVC, EUPVC and NPK with similar values then TRIVC and minimum in control plots at 58 days. During 88 days expansion of leaf was noticeable, MIXVC (361 $cm^2$) amendment show maximum leaf area and minimum (211 $cm^2$) in control plots.

Asciutto et al. (2006) also reported thattreatments with 75%-100 of vermicompost showed important increases of leaf area, plant height, fresh and dry weight of aerial and subterranean organs.Golchin et al. (2006) reported that leaf area index (LAI) and chlorophyll content of the leaves of pistachio (Pistaciavera L.) seedlings, as well as the photosynthesis rate were better in vermicompost treatments relative to the treatments without vermicompost.

Vermicomposts prepared from weeds showed excellent performance by increasing chlorophyll, ascorbic acid and β-carotene content of beet crop. Vermicompost contains plant nutrients including N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu and B, the uptake of which has a positive effect on plant nutrition, photosynthesis, the chlorophyll content of the leaves and improves the nutrient content of the different plant components (roots, shoots and the fruits)(Theunissen et al.,2010). Nutrients in vermicompost are present in readily available forms for plant uptake; e.g. NO3, exchangeable P, K, Ca and Mg (Edwards and Burrows, 1988) so it may be the probable reason for increased content.

Vermicompost is rich in NPK, micronutrients, beneficial soil microbes and also contain 'plant growth hormones & enzymes'. It is scientifically proving as 'miracle growth promoter & also plant protector' from pests and diseases (Sinha et al.,2009).When manures prepared from Trianthemaweed were applied tofodder maize it was resulted in enhanced growth and yield when compared to chemical fertilizer and control Naikwade and Jadhav (2011). Organic manure has an effective role in improving growth and yield of different field crops, including vegetables, ornamentals, cereals and fruit crops (Kaur et al.,2015).

**CONCLUSION:**

Common weeds like Ipomoea muricataL., Euphorbia prunifoliaJacq. andTrianthemaportulacastrumL. contain proper amount of nutrients so these weeds can be used to prepare vermicomposts. Vermicomposts prepared from these weeds are rich in macronutrients like N, P and K supplies a suitable mineral balance, improves nutrient availability.All vermicompost treatments increased Chlorophyll, β carotene, and ascorbic acid contents in beet crop. Leaf area was also enhanced by application of weed vermicomposts. Mix vermicompost showed more increase in content and in growth as compared to other treatments.

Vermicomposting also leads to decrease the environmental problems arising from their disposal. It should be realized that vermicomposting can be a useful cottage industry for the underprivileged and the economically weak class of the society as it can provide them with a supplementary income. With the global trend moving towards the production of organic food crops, organic waste material processed by the naturally occurring earthworm may be used to produce vermicompost which will supply nutrients and other soil stimulants for plant growth and improved productivity.

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## TABLES AND FIGURES

**Table 1. Chemical analyses of weeds**

**Table 2. Analyses of weeds vermicompost**

| Treatments | DM | | N | | Percentage | | | | C/N Ratio |
|---|---|---|---|---|---|---|---|---|---|
| | % | kg/ha | % | kg/ha | P | K | Ash | C | |
| **IPOVC.** | 67.01 | 3877 | 0.83 | 32.30 | 0.08 | 0.09 | 43.93 | 25.48 | 30.70 |
| **EUPVC** | 68.50 | 4123 | 0.71 | 29.20 | 0.06 | 0.08 | 44.18 | 25.62 | 36.08 |
| **TRIVC** | 65.00 | 3686 | 0.75 | 27.64 | 0.14 | 0.10 | 38.85 | 25.16 | 33.55 |
| **MIXVC** | 66.00 | 3972 | 0.71 | 28.13 | 0.07 | 0.10 | 46.93 | 25.77 | 36.30 |

**Fig.1. Chlorophyll contents of Beet as influenced by weed vermicompost at 58 DAS**

**Fig.2. Chlorophyll contents of Beet as influenced by weed vermicompost at 88 DAS**

| Treatments | Fresh wt. | DM | | N | | Percentage | | | | C/N Ratio |
|---|---|---|---|---|---|---|---|---|---|---|
| | kg/ha | % | kg/ha | % | kg/ha | P | K | Ash | C | |
| **Ipomoea** | 13333 | 13.29 | 1771 | 2.50 | 43.28 | 0.53 | 0.54 | 15.50 | 8.99 | 3.60 |
| **Euphorbia** | 13333 | 10.59 | 1411 | 2.17 | 30.57 | 0.60 | 0.47 | 12.92 | 7.49 | 3.46 |
| **Trianthema** | 13333 | 10.55 | 1406 | 1.96 | 27.51 | 0.11 | 0.49 | 12.62 | 7.32 | 3.74 |
| **Mixed** | 13333 | 11.47 | 1529 | 2.12 | 32.48 | 0.47 | 0.47 | 13.65 | 7.92 | 3.73 |

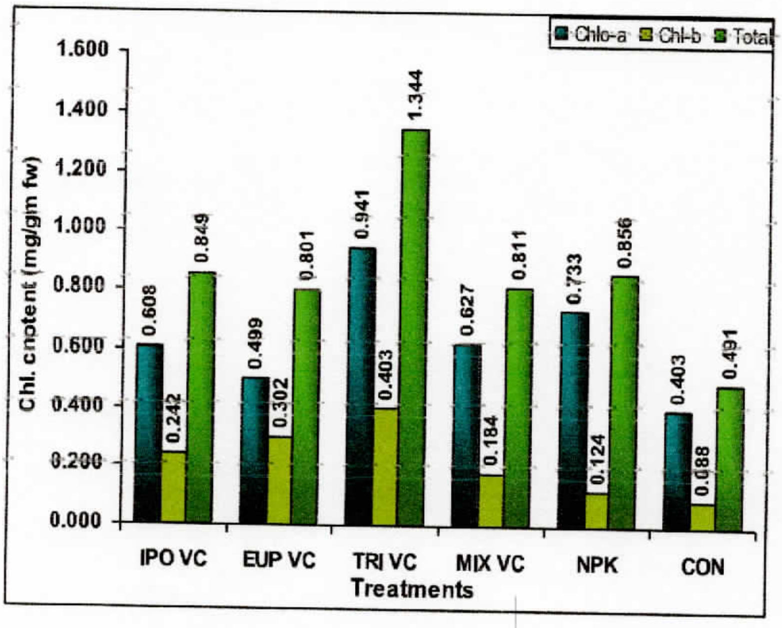


**Fig.3. Ascorbic acid contents in Beet leaf as influenced by weed vermicompost at 88 DAS**

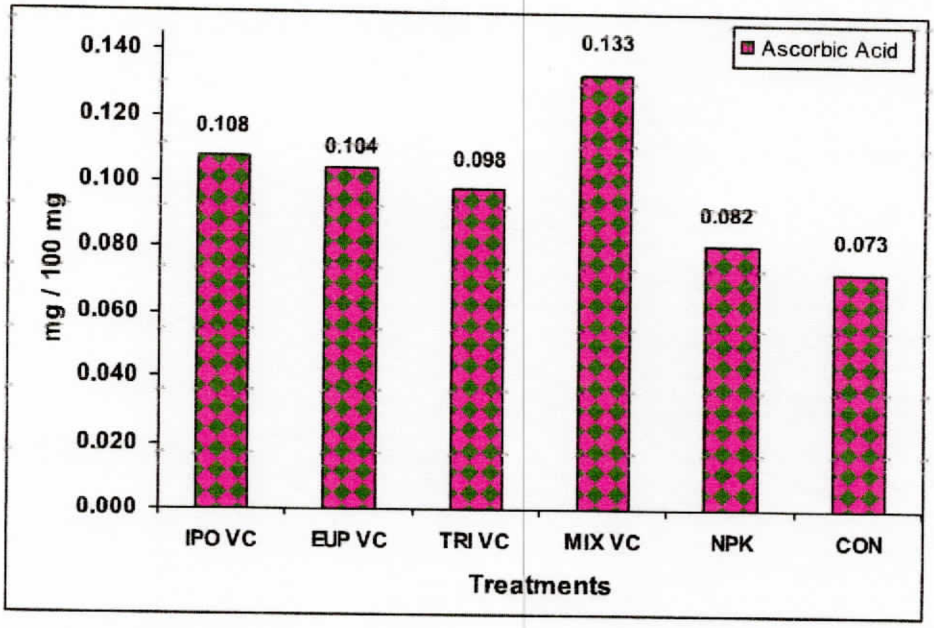


**Fig.4. β-carotene contents in Beet leaf as influenced by weed vermicompost at 88 DAS**

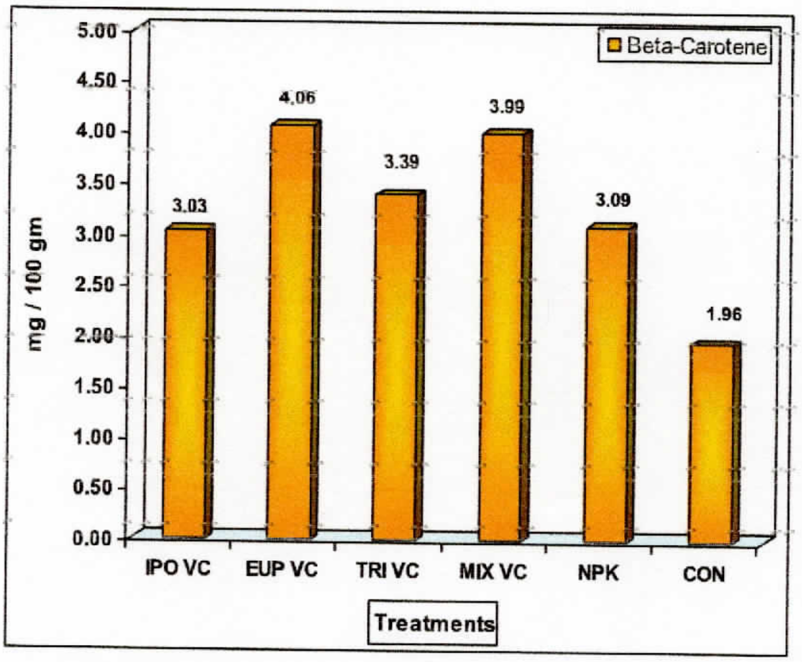


**Fig.5. Leaf area of Beet as influenced by weed vermicompost at 58 and 88 DAS**