IMPROVING TOTAL CHLOROPHYLL, ASCORBIC ACID AND β CAROTENE IN SPINACH BY APPLYING WEED MANURES

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ABSTRACT

Spinach is one of the most popular green leafy vegetable crops grown throughout the tropics of the world during all seasons. *Trianthema portulacastrum* Linn. commonly known as Desert Horse purslane, it is a creeping, much branched, annual herb. This native plant is an invasive weed in irrigated areas of nearly all states of India. The aim of present investigation was to study the influence of different manures prepared from *Trianthema* weed on total chlorophyll, ascorbic acid, â carotene of spinach. A field experiment was carried out in the Research farm located in the Botanical garden of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad to evaluate the performance of various manures viz. NADEP compost (AC), Banglore pit compost (BC), vermicompost (VC), dry leaf manure (DLM), green manure (GM) and garden leaf vermicompost (GLV). The fertilizers were applied at the recommended levels of 40N:30P:30K Kg/ha as urea: single super phosphate: muriate of potash to fertilizer treatment alone. The analysis was done at 49 days with successive regrowths at 103 and 143 DAS (Days after harvesting). The application of *Trianthema* dry leaf manure was more effective in increasing nutrient contents of spinach followed by, vermicompost, NADEP compost, Banglore pit compost respectively.

Keywords: compost, manure, nutrient, spinach, *Trianthema*, weed.

INTRODUCTION

Decline in soil fertility, increased soil erosion and increasing shortage of food are major factors affecting human health in Asia. Chemical fertilizers are costly and therefore out of reach of most resource poor farmers. There is also increasing evidence that synthetic agrochemicals and fertilizers have caused adverse effects on the environment leading to loss of biodiversity (Ghosh *et al.* 2004). This observation has promoted the need of introducing methods of farming aimed at reducing health risks including the use of weeds for manure preparation.

Weed biomass is one of the easily available sources of organic matter and plant nutrients, which hitherto have not received necessary attention. Economic utilization of this weed biomass for the production of various composts will open a new horizon. Generally weeds like *Cassia, Crotalaria, Achyranthes* are used as green manures (Chamle 2007). *Trianthema portulacastrum* L. commonly known as Desert Horse purslane or *Vasu*, is a weed creating competition to crop plants. Past references on utilization of *Trianthema* as manure are not available.

Composting and vermicomposting are the appropriate biotechnological technique for the degradation, converting waste to wealth resulting in a stable non toxic material with good structure, which has a potentially high economic value as soil conditioner for the growth of the plants (Dhudat *et al.* 1997).

Spinach is a short duration vegetable crop, its growth; yield and quality are largely influenced by the application of fertilizers. It requires proper and sufficient N and K for regular growth (Premsekhar and Rajashree 2009). The vegetables are very good sources of vitamins such as vitamin A, vitamin B6, vitamin C, riboflavin, and folate, and dietary minerals including calcium, iron, magnesium, phosphorus, potassium, zinc, copper, and manganese (Ansari 2008). A pot experiment was conducted to evaluate the role of *Trianthema* weed manures for improving total chlorophyll, ascorbic acid, â carotene content in spinach.

MATERIALS AND METHODS

Experimental site

The experiment was conducted in the Research farm of Dr. Babasaheb Ambedkar Marathwada University's Botanical garden during the period from 14 July 2005 to 4 April. 2006.

Raw material and composting Process:

The fresh vegetation of *Trianthema portulacastrum* was collected and used as raw material for composting. The process of composting was followed as described by Stoffella and Kahn (2001).

Organic amendments and experimental plant

The experiment was conducted in truncated porous earthen pots of approximately 10 liter capacity (h=30.5 cm and d=26.0 cm). The pots were initially filled up to 2.5 cm height with 12.5 mm normal size chips of stone (aggregates), which were then covered with 2.0 cm thick layer of 1 to 5 mm size gravel to ensure proper drainage of excess water. A layer of local soil with 2.0 to 2.5 cm thickness was used above the gravel bed and compost layer. The manures except DLM were then top fed (18 to 20 cm thickness) into the pots at the rate as (1.0 kg /pot). DLM was added as 250 gm/pot.

The eight treatments were: *Trianthema* NADEP compost (AC), *Trianthema* Banglore compost (BC), *Trianthema* vermicompost (VC), *Trianthema* dry leaf manure (DLM), *Trianthema* Green manure (GM), Garden leaf vermicompost (GLV), Fertilizer alone (FER) and absolute control (CO) with four replicates each. The spinach (Spinacea oleracea L. var. All green) seeds produced by Sungro Seeds Ltd., 207 Aradhna Bhavan, Azadpur, Delhi, were sown at a rate of 30 Kg/ha at about 1 - 1.5 cm deep in the soil.

Fertilizer application and plant sampling

The fertilizers were applied at the recommended levels of 40N:30P:30K Kg/ha as urea: single super phosphate: muriate of potash to fertilizer treatment alone. Entire amount of P_2O_5 and K_2O was applied as basal dose for all the pots at the time of cultivation and N was supplied 52 and 105 days after sowing (DAS) in two equal split doses. The analysis was done at 49 days with successive regrowths at 103 and 143 DAS. The fresh samples were used for nutrient analysis.

Chemical analyses

The â carotene, Ascorbic acid, total chlorophyll content of each vegetable was estimated in fresh spinach. The leaf chlorophyll contents (a, b and total) were estimated following Arnon (1961), using 80 % acetone as a solvent for extraction of pigments. The amount of â-carotene (Pro- vitamin A) was estimated by extracting it in petroleum ether and acetone (2: 1) following the method described by Knuckles *et al.* (1972). Ascorbic acid was estimated by titration method given by Sadasivam and Manickam (1992).

Statistical analyses -

All the results were statistically analyzed using analysis of variance (ANOVA) test and treatments means were compared using the least significant difference (C.D. p = 0.05) which allowed determination of significance between different applications (Mungikar 1997).

RESULTS AND DISCUSSION

Chlorophyll contents of spinach:

The incorporated *Trianthema* organic manures had significant influence on leaf chlorophyll contents (a, b and total) of spinach. Chlorophyll a, chlorophyll b and total chlorophyll contents varied from 0.21-0.46, 0.26-0.60 and 0.47-1.06 mg g^{-1} leaf fresh weight respectively at first harvest (Table 1). Highest amount of total chlorophyll was found in DLM treated spinach lowest in CON. At the second harvest, chlorophyll a, chlorophyll b and total chlorophyll contents varied from 0.34-0.47, 0.40-0.59 and 0.74-1.06 mg g^{-1} leaf fresh weight respectively. The maximum amount of total chlorophyll was observed in the treatment of TV and minimum in CON. During the third harvest, chlorophyll a, chlorophyll b and total chlorophyll contents varied from 0.27-0.47, 0.24-0.59, and 0.51-1.06 mg g^{-1} leaf fresh weight respectively. The maximum amount of total chlorophyll was observed in the treatment of DLM and least amount in CON.

The higher chlorophyll content of spinach observed in the pots with organic manures as compared to chemical fertilizer could be due to differences in nitrogen uptake of spinach from organic manures and urea. The greater chlorophyll values in leaves on plots treated with organic manure are of importance because photosynthetic activity and crop yield may increase with increased chlorophyll content of leaves (William *et al.* 1990; Ramesh *et al.* 2002).

The minimum chlorophyll in control treatment had been observed to diminish carbohydrate production and a restriction in the assimilating power of the plant (Amany *et al.* 2006). Increase in chlorophyll *a* and *b* contents of the spinach may contribute to increased photosynthetic activity. The synthesis and degradation of the photosynthetic pigments are normally associated with the photosynthetic efficiency of the plants and their growth adaptability to different environments (Beadle 1993). Increase in leaf chlorophyll content could in turn lead to increased protein synthesis of the plants and this could have a direct consequence on the plant growth and photosynthesis (Hendry *et al.* 1987). Our results are on the line of Jacob *et al.* (2006).

Ascorbic acid content of spinach

Among the vitamins, vitamin C (ascorbic acid) is an essential micronutrient required for normal metabolic function of the body (Jaffe 1984). It lowers blood pressure and cholesterol levels (Rath 1993) and is also a major water- soluble antioxidant within the body.

The application of *Trianthema* organic manures had important persuade on ascorbic acid content of spinach. In first harvesting the highest amount was found in DLM amended spinach and lowest in CON (Table 2). In second harvesting the peak amount was found in DLM added spinach and least in CON. During third harvesting maximum amount of ascorbic acid was observed in the treatment of DLM while minimum amount in CON.

Table 1: Chlorophyll contents (mg/gm) of spinach as influenced by *Trianthema* manures at 49,103 and 143 DAS (First, second and third Harvest)

Treatment	First Harvest			Second Harvest			Third Harvest		
	Chl. A	Chl. B	T. Chl.	Chl. A	Chl. B	T. Chl.	Chl. A	Chl. B	T. Chl.
AC	0.37	0.47	0.85	0.43	0.54	0.98	0.40	0.43	0.83
BC	0.35	0.44	0.79	0.40	0.53	0.92	0.37	0.46	0.83
TV	0.43	0.59	1.02	0.47	0.59	1.06	0.47	0.54	1.01
DLP	0.46	0.60	1.06	0.44	0.58	1.01	0.47	0.59	1.06
GLV	0.40	0.51	0.90	0.40	0.51	0.91	0.38	0.44	0.81
GM	0.29	0.33	0.62	0.38	0.48	0.86	0.37	0.37	0.74
FER	0.34	0.35	0.70	0.36	0.44	0.79	0.32	0.39	0.70
CON	0.21	0.26	0.47	0.34	0.40	0.74	0.27	0.24	0.51
S.E.	**0.03**	**0.04**	**0.07**	**0.02**	**0.02**	**0.04**	**0.02**	**0.04**	**0.06**
C.D.	**0.07**	**0.10**	**0.17**	**0.04**	**0.06**	**0.09**	**0.06**	**0.09**	**0.14**

Chl.A-Chlorophyll A, Chl.B-Chlorophyll B, T. Chl.-Total chlorophyll, AC- *Trianthema* NADEP compost, BC- *Trianthema* Banglore compost, VC- *Trianthema* vermicompost, DLM -*Trianthema* dry leaf manure, GM- *Trianthema* Green manure, GLV -Garden leaf vermicompost, FER-Chemical fertilizer, CO- absolute control, S.E.-Standard error, C.D.-Critical difference at p=0.05.

Table 2. Ascorbic acid contents (mg/100gm) of spinach as influenced by *Trianthema* manures at 49,103 and 143 DAS

Treatment	1 st Harvest	2 nd Harvest	3 rd Harvest
AC	77.65	78.13	76.17
BC	79.55	89.84	78.13
TV	81.44	87.89	82.03
DLM	83.33	91.80	83.98
GLV	79.55	82.03	72.27
GM	73.86	83.98	74.22
FER	75.76	80.08	72.27
CON	68.18	72.27	66.41
S.E.	**1.70**	**2.30**	**2.01**
C.D.	**. 4.02**	**5.46**	**4.77**

Ascorbic acid contents of spinach are increased due to application of organic manures. These results were confirmed as the findings of Lundegardh *et al.* (2008) who showed that organic manures increases ascorbic acid level, compared to chemical fertilizer.

β Carotene content of spinach:

β carotene is a precursor of vitamin A, the most important nutrient for numerous body processes. The application of *Trianthema* organic manures had vital convince on β carotene content of spinach. In first harvesting the highest amount was found in DLM treated spinach and lowest in CON (Table 3). In second harvesting the maximum amount was found in DLM supplemented spinach and least in CON. Lastly in third harvesting maximum amount of â carotene was observed in the treatment of TV and minimum in CON. Singh *et al.*, (2003) also indicated that vermicompost increased Vitamin A content as compared to chemical fertilizer.

All results are statistically significant over control except chemical fertilizer treatment in some cases. Based on these results, it is evident that application of *Trianthema* organic manures increased nutrient contents in spinach in second harvesting as compared to first harvesting. This was accredited due to the effect of less nutrients release from *Trianthema* organic manures in first harvesting.

Table 3. β carotene contents (mg/100gm) of spinach as influenced by *Trianthema* manures at 49,103 and 143 DAS

Treatment	1 st Harvest	2 nd Harvest	3 rd Harvest
AC	4.17	4.97	4.28
BC	4.58	5.65	4.55
TV	4.73	5.35	5.13
DLP	5.04	5.97	4.87
GLV	4.97	5.64	4.28
GM	3.67	4.44	3.78
FER	3.29	4.15	3.89
CON	2.34	3.03	2.44
S.E.	**0.33**	**0.35**	**0.29**
C.D.	**0.79**	**0.82**	**0.69**

The results of this study conclusively indicate that *Trianthema* weed manures can be effectively used as a source of nutrients for spinach as reflected by increased chlorophyll, ascorbic acid, βcarotene content. In the present investigation, DLM and TV performed better than that of the other treatments. Dry leaf manuring (DLM) is the easier, convenient and safer method of utilization of weeds as organic amendments. When the weeds are available in large quantity at that time they may not be required or used but can be utilized in future by drying it.

Trianthema weed manures assist to compensate the deficiency of organic matter content along with nutrients in the soil and acts as ideal substitute against inorganic fertilizers. Organic manures are not only sources of major nutrients but they also provide other micronutrients and plant growth-promoting molecules, which together lead to good crop yields (Mader *et al.* 2002). The reason for increased nutrients could be attributed to solubilisation effect of plant nutrients by the addition of organic manures leading to increased uptake of NPK (Sendurkumaran *et al.* 1998). The significance of organic manuring in sustainable agriculture is well established (Gaur *et al.* 1972 and Subbarao *et al.* 2001).

Use of weed manure amplify chlorophyll, β carotene, ascorbic acid content of vegetables which will be helpful for solving the problem caused by the various vitamin deficiencies. To prevent the environmental pollution from extensive application of chemical fertilizers, the effective use of weed manure could be recommended to farmers to insure the public health and a sustainable agriculture. The local community should be sensitized on the use of *Trianthema* manure to improve farming and thus help alleviate poverty.

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