



Original Research Article

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Effect of Organic Manures on Quality and Shelf Life of Beet Root Cv. Crimson Globe

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ABSTRACT

Keywords

Betanine content, TSS, Reducing sugars, Non-reducing sugars, Total sugars, Storage life

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Beetroot (*Beta vulgaris* L.), also called as garden beet or table beet, is one of the major root vegetable. It is grown in almost all states of India but in small scale only. It produces green tops and a swollen root used both as vegetable and salad. It is highly productive and usually free from pests and diseases (Ado, 1999). A field experiment was conducted during *rabi*, 2014 in alkali soils. The experiment was laid out in a randomized block design with three replicated 11 treatments *viz.*, T₁: FYM (100%), T₂: Vermicompost (100%), T₃: Neem cake (100%), T₄: Poultry manure (100%), T₅: Green manure (100%), T₆: FYM (50%) + Vermicompost (50%), T₇: FYM (50%) + Neem cake (50%), T₈: FYM (50%) + Poultry manure (50%), T₉: FYM (50%) + Green manure (50%), T₁₀: RDF, T₁₁: Control. The data were recorded on betanine content (mg 100g⁻¹), TSS (°Brix), reducing sugars (%), non-reducing sugars (%), total sugars (%), storage life (days). Whereas FYM (50%) in combination with neem cake (50%) recorded maximum values for betanin content, reducing, non-reducing and total sugars. The highest TSS of root was with neem cake (100%). However, the higher net returns and BCR were obtained with poultry manure (100%).

Introduction

Beetroot (*Beta vulgaris* L.), also called as garden beet or table beet, is one of the major root vegetable belongs to the family Chenopodiaceae along with spinach, palak, swiss chard, parsley, celery and it has chromosome number of 2n=18. Beet originated in Western Europe and North Africa where they were grown to feed both humans and livestock. This crop is a biennial grown as a cool season annual. It is grown in northern and southern parts of India. It is

grown in almost all states of India but in small scale only. It produces green tops and a swollen root used both as vegetable and salad. It is highly productive and usually free from pests and diseases (Ado, 1999). It is a rich source of protein, carbohydrate, calcium, phosphorous and vitamin C, hence it is an ideal vegetable for health conscious people (Deuter and Grundy, 2004). Red color of roots is due to presence of betanine pigment.

Beet root helps to reduce blood pressure, prevents plaque formation and reduces bad

cholesterol, keeps diabetes under check, treats anaemia, helps to relieve fatigue, improves sexual health and stamina, protects from cancer, etc. Among the many constraints to increase productivity in beet root, inorganic nutrition is the main limiting factor especially in alkaline soils. The continuous use of inorganic fertilizers is adversely affecting the sustainability of production besides causing environmental pollution. In view of increased awareness about organic manuring, increased availability of organic inputs and sustainability in the farm, investigation on these aspects have thus become imperative to study and assess their effect on quality and shelf-life of beet root. Hence, this investigation is planned to identify effect of organic manures on quality and shelf life of beet root grown in alkali soils.

Materials and Methods

A field experiment was conducted during *rabi*, 2014 in alkali soils, at college farm, College of Horticulture, Dr. Y.S.R. Horticultural University, Mojerla, Mahabubnagar(Dt). The experiment was laid out in a randomized block design with three replicated 11 treatments *viz.*, T₁: FYM (100%), T₂: Vermicompost (100%), T₃: Neem cake (100%), T₄: Poultry manure (100%), T₅: Green manure (100%), T₆: FYM (50%) + Vermicompost (50%), T₇: FYM (50%) + Neem cake (50%), T₈: FYM (50%) + Poultry manure (50%), T₉: FYM (50%) + Green manure (50%), T₁₀: RDF, T₁₁: Control. The data were recorded on betanine content (mg 100g⁻¹), TSS (°Brix), reducing sugars (%), non-reducing sugars (%), total sugars (%), storage life (days).

Root quality parameters

Total soluble solids and reducing sugars

The total soluble solids of all the roots of five randomly selected plants from each plot was measured with the help of a hand

refractometer (0-28⁰ B) and the average is expressed in ⁰Brix. Reducing sugars were determined by the method of Lane and Eyon (AOAC, 1965). Ten grams of beetroot cube was taken, ground well and transferred to 250 ml volumetric flask and 2 ml of lead acetate solution (45 %) was added to the flask to precipitate colloidal matter and kept for 24 hrs. Two ml potassium oxalate (22%) was added to this solution to precipitate the lead acetate and the volume was made up to 250 ml using distilled water. The contents were then filtered through Whatman No.1 filter paper after testing a little of filtrate for absence of lead by adding a drop of potassium oxalate. Reducing sugars in the filtrate were estimated by titrating against 10 ml of standard Fehling's solution mixture of A and B (1:1) using methylene blue as an indicator till the end point was indicated by the formation of brick red precipitate.

The titration was carried out by keeping the Fehling's solution boiling on the heating mantle. The results were expressed as per cent reducing sugar.

Reducing sugars (%) =

$$\frac{\text{Titre value} \times \text{Weight of sample}}{\text{Factor value} \times \text{Dilution}} \times 100$$

Total sugars (%)

Total sugars were determined by the method described by Lane and Eyon (AOAC, 1965). A quantity (50 ml) of lead free filtrate was taken in a 100 ml volumetric flask and to it 5 ml of concentrated HCl was added, mixed well and then kept for 24 hours at ambient temperature. Acid was then neutralized with 40% NaOH using a drop of phenolphthalein as an indicator till the pink colour persisted a few seconds. The volume was then made up to 100 ml with distilled water. Total sugars were estimated by titrating against standard

Fehling's solution mixture of A and B (1:1) using methylene blue as an indicator till it turns to brick red colour as an end point. The results were expressed as per cent total sugar.

Total sugars (%) =

$$\frac{\text{Titre value} \times \text{Weight of sample} \times \text{Aliquot}}{\text{Factor value} \times \text{Dilution 1} \times \text{Dilution 2}} \times 100$$

Non-reducing sugars (%)

Non-reducing sugars were estimated by subtracting reducing sugars from total sugars and expressed as per cent. Non-reducing sugars (%) = Total sugars (%) - Reducing sugars (%)

Ascorbic acid (mg 100⁻¹ g)

Ten grams of beetroot cube was ground well with 3 per cent metaphosphoric acid and the volume was made up to 100 ml with 3 per cent metaphosphoric acid. The contents were shaken well and filtered through filter paper. 10 ml of the aliquot was taken and titrated against standard dye solution (2,6-dichlorophenol indophenol dye) till the light pink colour persisted for at least 15 seconds (Ranganna, 1986). The ascorbic acid content was estimated using the given formula and expressed as mg/100g of plant material.

Ascorbic acid (mg 100g⁻¹) =

$$\frac{\text{Titre value} \times \text{dye factor} \times \text{volume made up}}{\text{Aliquot taken} \times \text{weight of the sample}}$$

Betanine (mg 100⁻¹ g)

Betanine content of roots was determined at harvest with the procedure suggested by Nilsson (1970) and was expressed in mg 100 g⁻¹ sample.

Shelf life (days)

The harvested roots were kept for shelf life studies in a laboratory at ambient temperatures. Shelf life of roots was assessed in days based on visual parameters. The number of days was computed from the day of harvest till the root remains in fresh condition and acceptable to the consumer.

Results and Discussion

The effect of different organic manures viz, FYM, vermicompost, poultry manure, neem cake and green manure at various stages of crop growth in Beetroot with respect to quality is studied. The results of the present investigation on the above aspect are presented hereunder.

Quality parameters

Data on various quality parameters of beetroot crop as influenced by the different organic manures and their combinations are presented in Tables 1 and 2.

Betanine content (mg 100g⁻¹)

The Betanine content of beetroot roots was significantly affected by the different treatments applied to the experiment. The results are presented in Table 1.

The highest betanine (1.93) was recorded in T₇ with the application of FYM (50%) + Neem cake (50%) which was on par with T₃ (1.89) with Neem cake (100%), T₆ with FYM (50%) + vermicompost (50%) and T₈ with FYM (50%) + poultry manure (50%) which were significantly superior to all other treatments. The lowest betanine content (4.30) was recorded in control RDF @ 70 kg N; 110 kg P₂O₅; 70 kg K₂O recorded betanine content of 1.61.

Total soluble solids (°Brix)

The TSS of beetroot roots was significantly affected by the application of Neem cake (100%). The results are presented in Table 1. The highest TSS (8.64) was recorded in T₃ with the application of neem cake (100%) followed by T₇ (8.29) with FYM (50%) + Neem cake (50%) which were significantly superior to all other treatments. The lowest TSS content (6.23) was recorded in Control (T₁₁).

Ascorbic acid (mg 100⁻¹ g fresh weight)

The Ascorbic acid of beet root roots was significantly affected by the application of vermicompost (100%) and FYM (50%) + Poultry Manure (50%). The results are presented in Table 1. The highest ascorbic acid (3.31) was recorded in T₂ with the application of Vermicompost (100%) which was at par (3.28) of T₈ with FYM (50%) + Poultry Manure (50%) and were significantly superior to all other treatments. The lowest ascorbic acid content (2.50) was recorded in Control (T₁₁).

Reducing sugars (%)

The reducing sugars content of beet root roots was significantly affected by the application of FYM (50%) + Neem cake (50%). The results are presented in Table 2. The highest reducing sugars content (5.15) was recorded in T₇ with the application of FYM (50%) + Neem cake (50%) which was at par with T₆ (5.10) with FYM (50%) + Vermicompost (50%) and were significantly superior to all other treatments. The lowest reducing sugar content (4.58) was recorded in Control (T₁₁).

Non-reducing sugars (%)

The non-reducing sugars content of beetroot roots was significantly affected by the application of FYM, vermicompost, neem

cake, poultry manure and green manure. The results are presented in Table 2. The highest non-reducing sugars content (2.26) was recorded in T₇ with the application of FYM (50%) + Neem cake (50%) which was at par with T₆ (2.23) with FYM (50%) + Vermicompost (50%) and were significantly superior to all other treatments. The lowest non-reducing sugar content (1.78) was recorded in FYM (50%) + green manure (50%) and was on par with T₁₀ (1.81), T₉ (1.78), T₅ (1.86) and T₂ (1.88).

Total sugars (%)

The total sugars content of beetroot roots was significantly affected by the application of FYM, vermicompost, neem cake, poultry manure and green manure. The results are presented in Table 2. The highest total sugar content (7.40) was recorded in T₇ with the application of FYM (50%) + Neem cake (50%) which was at par with T₆ (7.33) with FYM (50%) + Vermicompost (50%) and were significantly superior to all other treatments. The lowest total sugars content (6.43) was recorded in control, which was on par with T₁₀ (6.45), T₉ (6.48), T₅ (6.50) and T₂ (6.54).

Improvement in quality of beetroot with the application of organic manures over inorganic fertilizers was observed. The betanin (1.93 mg 100g⁻¹), TSS (8.64 °Brix), ascorbic acid (3.31) were higher with the application of FYM (50%) + poultry manure (50%) and sole application of neemcake (100%), vermicompost (100%) respectively, Reducing sugars (5.15%), non-reducing sugars (2.26%) and total sugars content (7.40%) were higher with the application of neem cake in combination with FYM. This may be because of better availability and uptake of nitrogen and other nutrients with the application of manures which might have lead to balanced C/N ratio and increased activity of plant metabolism. Similar findings were made by Singh *et al.*, (1970), Matura (1961) and Emura and Hosoya (1979) in carrot.

Table.1 Effect of different organic manures on betanine content (mg 100g⁻¹), TSS (%) and ascorbic acid (mg 100g⁻¹) of Beet root at harvest

Treatments	Betanine	TSS	Ascorbic acid
FYM (100%)	1.76	7.84	2.87
Vermicompost (100%)	1.75	8.05	3.31
Neem cake (100%)	1.89	8.64	2.90
Poultry Manure (100%)	1.72	8.17	2.87
Green Manure (100%)	1.71	7.38	2.90
FYM (50%) + Vermicompost (50%)	1.83	8.09	2.80
FYM (50%) + Neem cake (50%)	1.93	8.29	2.76
FYM (50%) + Poultry Manure (50%)	1.81	7.74	3.28
FYM (50%) + Green Manure (50%)	1.65	7.54	2.81
RDF @ 70 kg N; 110 kg P₂O₅; 70 kg K₂O	1.61	7.01	2.56
Control	1.54	6.23	2.50
CD at 5%	0.14	0.24	0.17
SE(m) ±	0.05	0.08	0.06

Table.2 Effect of different organic manures on Sugars (%) and storage life (days) of Beet root at harvest

Treatments	Reducing Sugars	Non-reducing	Total Sugars	Shelf life
FYM (100%)	4.70	2.01	6.70	3.10
Vermicompost (100%)	4.66	1.88	6.54	4.43
Neem cake (100%)	4.93	2.10	7.02	2.76
Poultry Manure (100%)	4.87	2.00	6.87	3.20
Green Manure (100%)	4.65	1.86	6.50	3.43
FYM (50%) + Vermicompost (50%)	5.10	2.23	7.33	4.10
FYM (50%) + Neem cake (50%)	5.15	2.26	7.40	3.76
FYM (50%) + Poultry Manure (50%)	4.88	2.09	6.97	3.10
FYM (50%) + Green Manure (50%)	4.71	1.78	6.48	3.43
RDF @ 70 kg N; 110 kg P₂O₅; 70 kg K₂O	4.64	1.81	6.45	3.10
Control	4.58	1.85	6.43	2.60
CD at 5%	0.14	0.16	0.25	0.51
SE(m) ±	0.05	0.06	0.09	0.17

Indumati (2000) reported an increase in TSS content with the application of vermicompost besides other organic manures and with recommended dose of fertilizers in radish. Kolodziej and Kostecka (1994) also observed better root quality when carrot was grown with vermicompost than mineral fertilizers. Increase in carotene content with the increasing dosage of vermicompost was also reported by Ravindrababu (1999). Hallmann (2012) showed an increase in the total content of sugars and in a higher sugar to organic acids ratio in organic tomatoes when compared to these produced conventionally. Rembiałkowska *et al.*, (2012) confirmed a higher content of total sugars in organic fruits and vegetables, including carrots, beets, potatoes, spinach, kale, cherries, black currants and apples, which contribute to an increase in the technological and sensory quality (taste) of organic products.

Kale *et al.*, (1992) observed that vermicompost application enhanced the activity of beneficial microbes and colonization of mycorrhizal fungi which play an important role in mobilization of nutrients by plants. Thus, leading to better availability of nutrients and uptake by plants and resulting in better quality.

Storage life (days)

The storage life of Beetroot was significantly affected by the application of FYM, vermicompost, neem cake, poultry manure and green manure. The results are presented in Table 2. The highest storage life (4.43) was recorded in T₂ with the application of vermicompost (100%) followed by T₆ (4.10) with vermicompost (50%) + FYM (50%) which were significantly superior to all other treatments. The lowest storage life (2.60) was recorded in control. The higher storage life of Beetroot with the application of vermicompost may be because of low respiration rate.

In conclusion, all the quality parameters were improved significantly with the organic manures over inorganic fertilizers. The highest betanine (1.93) content was recorded with FYM (50%) + neem cake (50%) which was at par (1.89) with neem cake (100%), FYM (50%) + vermicompost (50%) (1.83) and FYM (50%) + poultry manure (50%) (1.81). The highest total soluble solids (8.64) was recorded with neem cake (100%) which was at par with FYM (50%) + neem cake (50%) (8.29). The highest ascorbic acid (3.31) was recorded with vermicompost (100%) which was at par with FYM (50%) + poultry manure (50%) (3.28). The highest reducing sugars (5.15) was recorded with FYM (50%) + neem cake (50%) which was at par (5.10) with FYM (50%) + Vermicompost (50%). The highest non reducing sugars (2.26) was recorded with FYM (50%) + neem cake (50%) which was at par (2.23) with FYM (50%) + Vermicompost (50%). The highest total sugar content (7.40) was recorded with FYM (50%) + neem cake (50%) which was at par (7.33) with FYM (50%) + Vermicompost (50%). Storage life was maximum (4.43 days) with the application of vermicompost (100%) which was at par with FYM (50%) + vermicompost (50%) (4.10 days).

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