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Effect of Integrated Nutrient Management on Quality and Economics of Beet Root (*Beta vulgaris* L.) Cv. Crimson Globe under Alkaline Conditions

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A B S T R A C T

A field experiment was carried out at Vegetable research block, College of Horticulture-Mojerla, SKLTS Horticultural University, Mulugu, Siddipet, Telangana during *rabi* season of 2019-20 to study the effect of integrated nutrient management on quality and economics of beetroot (Beta vulgaris l.) Cv Crimson Globe. The experiment was conducted with three sources of nutrients viz. organic, inorganic and biofertilizers combinations in randomized block design with eight treatments and three replications. Among the treatments, T3 treatment 75 % RDNPK + FYM (6 t ha^{-1}) +VC (1.5 t ha^{-1}) + Azatobactor (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) recorded the highest ascorbic acid content (3.4 mg $100g^{-1}$), betanine content (1.92 mg $100g^{-1}$), total soluble solids (9.17^{0} brix), highest gross returns (Rs..2,29,920), net returns (Rs..1,83835) and best benefit cost ratio (3.9:1).

Introduction

Beetroot (Beta vulgaris L.) is one of the important root vegetable crops belongs to the family Chenopodiaceae along with Spinach, Palak, Swiss Chard, Parsley and Celery. It has a diploid chromosome number of (2n=18) and is native to Western Europe. It produces green tops and a swollen root used both as vegetable and salad, and is grown for food uses (pickles, salad, and juice) rather than for sugar production. The intense red colour of beetroot derives from high concentration of betalains. Betalains are used in food industry as natural colorants, antioxidant and anti-inflammatory activities are found in betalains so there is an increase attention towards the health benefits of humans (Georgiev *et al.*, 2010 and Zielinska *et al.*, 2009). Betacyanins and betaxanthins are betalains mainly found in beetroot (Gandia *et al.*, 2010). Now a day, beetroot is grown in worldwide and is regularly consumed as a part of the normal diet. It is commonly used in manufacturing as a food colouring agent known as E162 (Clifford *et al.*, 2015). Beetroot juice on inflammation is strongly involved in the development and progression of several clinical conditions including coronary heart disease and cancer (Jurgen *et al.,* 2015). Integrated Nutrient Management is an alternative for sustainable crop production rather than use of inorganic fertilizers only. Integrated Nutrient Management (INM) is an approach of supplying nutrition to the crop by including organic and inorganic sources of nutrients. The combined use of organic manures, biofertilizers with a reduced dose of chemical fertilizers, helps to reduce pollution problems, increase the yield and quality of the product and also maintain soil health. Keeping these points in view the present work has been proposed to study the effect of integrated nutrient management on quality and economics of beetroot (*Beta vulgaris* L.) Cv. Crimson Globe under alkaline conditions.

Material and methods

The present investigation was conducted at Vegetable Research Block College of Horticulture-Mojerla, SKLTS Horticultural University, Mulugu. The soil was sandy loam texture. The initial soil sample of experimental site had pH 7.52, organic carbon 0.35 % and available N, P and K content of 242.11, 28.2 and 242.3 kg ha^{-1} respectively.

The experiment was laid out in a randomized block design with eight treatments having three replications. The total eight treatments consist of i.e. T1-75 % RDNPK + FYM (12 t ha^{-1}) Azatobactor (10 kg ha^{-1}) + PSB (10 kg ha^{-1}), T2-75 % RDNPK + VC (3 t ha^{-1}) + Azatobactor (10 kg ha^{-1}) + PSB (10 kg ha^{-1}), T3-75 % RDNPK + FYM (6 t ha^{-1}) +VC (1.5 t ha^{-1}) + Azatobactor (10 kg ha^{-1}) + PSB (10 kg ha^{-1}), T4-50 % RDNPK + FYM (12 t ha^{-1}) + Azotobactor (10 kg ha^{-1}) + PSB (10 kg ha^{-1}), T5-50 % RDNPK + VC (3 t ha^{-1}) + Azatobactor (10 kg ha^{-1}) + PSB (10 kg ha^{-1}), T6-50 % RDNPK+ FYM (6 t ha^{-1}) + VC (1.5 t ha^{-1}) + Azatobactor (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) , T7-75 % RDNPK + FYM (12 t ha^{-1}) and T8-50 % RDNPK + FYM (12 t ha^{-1}). The variety under study was Crinson Globe. Seeds were sown at the spacing of 45 x 15cm and thinning was done 10 days after sowing to maintain spacing. Nitrogen, Phosphorus and potassium were given through Urea, SSP and MOP respectively. Full dose of P and K and half dose of N were applied as basal dose, as per treatment before sowing and remaining half dose of N was given 30 DAS. Manures viz., farmyard manure and vermicompost were incorporated as per treatment to respective plots prior to sowing. Prior to sowing of seeds, seeds are treated with biofertilizers (*Azotobacter* and PSB). The data were recorded on five plants per treatment per plot in each replication on growth and yield parameters. Observations were recorded on minimum number of days required for 80 per cent germination of seedlings, plant height, number of leaves per plant, leaf area, chlorophyll content index, root length, root diameter, root yield per plant, root yield per plot, root yield per hectare, root to shoot ratio and harvest index. The data were statistically analysed using analysis of variance (ANOVA) for RBD following the standard procedure as suggested by Panse and Sukhatme (1985).

Results and Discussion

Quality parameters

Integrated nutrient management had significant effect on quality parameters and eonomics of beetroot Cv Crimson Glonbe presented in table 1 and 2.

Ascorbic acid content (mg 100 g^{-1})

Among the treatments, T_3 treatment (75 % RDNPK +FYM (6 t ha^{-1}) + VC (1.5 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10 kg ha^{-1})

recorded significantly maximum ascorbic acid content value (3.4 mg 100 g^{-1}). Similar results were also reported by Meena *et al.*, (2014) in tomato who reported that application of biofertilizers along with vermicompost enhanced the atmospheric nitrogen fixation, resulted in more carbohydrates production led to higher ascorbic acid content. The present investigation was inconsistent with other reports of Kushwah *et al.*, (2019) in radish

Betanine content (mg 100 g-1)

The data enunciated on betanine content revealed that, T_3 treatment (75 % RDNPK +FYM (6 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10 kg ha^{-1}) recorded the highest value which was due to accumulation of more reserve substances in root portion. The present investigations were inconsistant with other reports of Felczynski and Elkner (2008) in red beet.

Total soluble solids (0 Brix)

Among the treatments, T3 treatment (75 % RDNPK +FYM (6 t ha^{-1}) + VC (1.5 t ha^{-1}) + Azatobactor (10 kg ha^{-1}) + PSB (10 kg ha^{-1}), recorded the maximum TSS value (9.17 ^{o} Brix) which might be due to the same reason studied for the betanine content parameter. The present findings are comparable with that of Sunandarani and Mallareddy (2007) in carrot.

Table.1 Effect of integrated nutrient management on ascorbic acid content (mg 100 g^{-1}) betanine content (mg 100 g^{-1}) and total soluble solids (^{0} brix) of beet root Cv. Crimson Globe

Treatments	Ascorbic acid content (mg 100 g^{-1})	Betanine content (mg 100g^{-1})	Total soluble solids (^{0}brix)
T_1-75 % RDNPK + FYM (12 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10 kg ha^{-1})	2.4^{c}	1.72^{bc}	7.40^{c}
T_2-75 % RDNPK + VC (3 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10kg ha^{-1})	3.2^{ab}	1.83^{ab}	8.47^{ab}
T_3-75 % RDNPK + FYM (6 t ha^{-1}) +VC (1.5 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10 kg ha_{-1})	3.4^{a}	1.92^{a}	9.17^{a}
T_4-50 % RDNPK + FYM (12 t ha^{-1}) + *Azotobactor* (10 kg ha^{-1}) + PSB (10 kg ha^{-1})	2.2^{c}	1.68^{bc}	7.11^{c}
T_5-50 % RDNPK + VC (3 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10 kg ha^{-1})	2.2_{c}	1.77_{ab}	8.13_{b}
T_6-50 % RDNPK+ FYM (6 t ha^{-1}) + VC (1.5 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10 kg ha_{-1})	3.1^{b}	1.84^{ab}	8.70^{ab}
T_7-75 % RDNPK + FYM (12 t ha^{-1})	2.4_{c}	1.68_{bc}	6.74_{cd}
T_8-50 % RDNPK + FYM (12 t ha^{-1})	2.1^{c}	1.58^{c}	6.31^{d}
SEm±	0.11	0.24	0.24
CD at 5%	0.32	0.71	0.71

Table.2 Effect of integrated nutrient management on economics of beet root Cv. Crimson Globe

Treatments (T)	Total cost of cultivation (Rs. ha^{-1})	Gross returns(₹ ha^{-1})	Net Returns (₹ ha^{-1})	B:C ratio
T1-75 % RDNPK + FYM (12 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10 kg ha^{-1})	44,585	1,89,000	1,44,415	3.23
T2-75 % RDNPK + VC (3 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10kg ha^{-1})	48,585	2,10,480	1,61,895	3.33
T3-75 % RDNPK + FYM (6 t ha^{-1}) +VC (1.5 t ha^{-1}) + *Azatobactor* (10 kg ha-1) + PSB (10 kg ha-1)	46,085	2,29,920	1,83835	3.9
T4-50 % RDNPK + FYM (12 t ha^{-1}) + *Azotobactor* (10 kg ha^{-1}) + PSB (10 kg ha^{-1})	42,251	17,19,60	1,29,709	3.06
T5-50 % RDNPK + VC (3 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10 kg ha^{-1})	45,851	1,90,800	1,44,949	3.16
T6-50 % RDNPK+ FYM (6 t ha^{-1}) + VC (1.5 t ha^{-1}) + *Azatobactor* (10 kg ha^{-1}) + PSB (10 kg ha^{-1})	45,751	2,20,920	1,75,169	3.82
T7-75 % RDNPK + FYM (12 t ha^{-1})	40,585	1,51,200	1,10,615	2.72
T8-50 % RDNPK + FYM (12 t ha^{-1})	34,117	1,23,720	89,603	2.62

Economics

From the table 2 T3 treatment (75 % RDNPK +FYM (6 t ha^{-1}) + Vermicompost (1.5 ha-1) + *Azatobactor* (10 kg ha-1) + PSB (10 kg ha-1) recorded the highest gross returns (₹ 2,29,920), net returns (₹ 1,83,835) and benefit cost ratio (3.9:1), which was due to the same treatment recorded higher root yield per hectare over other treatments . These findings are in line with the reports of Shanu *et al.*, (2019) in carrot.

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