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Effect of different Fertilizer Levels, Biostimulant and Novel Organic Liquid Nutrient on Quality and Economics of Beet Root (*Beta vulgaris* L.)

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ABSTRACT: To study influence of different fertilizer levels, biostimulant and novel organic liquid nutrient on quality and economics parameters of beet root (*Beta vulgaris* L.), A field experiment was conducted at College Farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan during *rabi* season of 2020-21 and 2021-22. The experiment was laid out in Randomized Block Design with factorial concept with three replications. Present investigation comprising three factors *viz*., three levels of fertilizer *viz*., 40 % RDF (f_1), 60 % RDF (f_2) and 80 % RDF (f_3), biostimulant with three levels *viz*., *Jeevamruta* (b_1), *Panchagavya*(b_2) and Bio NPK Consortium (b_3) and three levels of novel organic liquid nutrient *viz*., 1.0 % (n_1), 1.5 % (n_2) and 2.0 % (n_3). Thus, there were total 27 treatment combinations under study consist. The results indicates maximum values of different quality and economics parameters *viz*., Total soluble solids, total chlorophyll content (mg/g), carotenoid content (mg g^{-1}), marketable shelf life, highest gross returns, net returns and best benefit cost ratio were observed with application of 80 % RDF (f_3), application of *panchagavya*@ 3 % (b_2) and application novel organic liquid nutrient @ 2.0 % (n_3) in both the years. Integrated Nutrient Management is an alternative for sustainable crop production rather than use of inorganic fertilizers only. Now-a-days, consumers are demanding higher quality and safer food. Hence, there is urgent need to improve organic fertilizers with natural minerals through biological processes.

Keywords: Beet root, Biostimulant, Novel organic liquid, *Jeevamruta, Panchagavya* and Bio NPK Consortium.

INTRODUCTION

The beet (*Beta vulgaris* L.) is herbaceous biennial or rarely pereninial plant with leafy stems. The beet plant belongs to the Chenopodiaceae family which is now included in Amaranthaceae family. It is known in numerous cultivated varieties of which the most well known is the purple root vegetable and also called beet root or garden beet. The total area under beetroot cultivation and production in India is about 2164 hectares and 36260 tonnes, respectively with 16.75 t/ha productivity (Anonymous, 2017). The red beet, commonly known as garden beet, is a juicy root vegetable. Beets contain abundance of minerals (potassium, phosphorus, calcium sulphur, iodine, iron, manganese, chlorine and copper) as well as traces of rare metals (rubidium and caesium), vitamins (B_1, B_2, niacin, B_6, B_{12}, C), beta carotene, flavonoids, natural sugar and a good quality and quantity of amino acids. Fresh beet juice mixed with a tablespoonful of honey taken every morning before breakfast helps the healing of gastric ulcer. Beet juice, combined with juices of carrot and cucumber is one of the finest cleansing material for the kidneys and gall bladder. It is highly beneficial in all disorders relating to these two organs.

Beet root is a rich source of folic acid which is useful for pregnant women. Beet root makes an excellent dietary supplement which has unique phyto-constituents. Several parts of this plant are used in medicinal system such as antioxidant, antidepressant, antimicrobial, antifungal, anti-inflammatory, diuretic, expectorant and carminative. Beet root is one of the natural foods which boosts the energy in athletes as it has one of the highest nitrates and sugar contents (Yadav *et al*., 2016). Organic manure helps in decomposing the organic matter and releases the essential plant nutrients (Kumar and Karuppaiah 2008). Biostimulents are natural substances derived from plants and animals that stimulate plant processes at very low concentrations. When applied to the plants and have been found to influence plants metabolic processes such as respiration, photosynthesis, nucleic acid synthesis and ion uptake (Khan *et al.,* 2009). They have been used all over the world to improve crop yields when applied alone or in combination, through directly improving plant metabolic activities or indirectly through soil conditioning (Mancuso *et al*., 2006). The distinctive NOVEL organic liquid nutrient a derivative of banana pseudostems, emerges as a remarkable dietary supplement. This nutrient-rich sap contains essential macro and micro nutrients along with

growth enhancers (Salunkhe, 2010). Integrated Nutrient Management emerges as a sustainable alternative to exclusive reliance on inorganic fertilizers. Through the synergistic use of organic manures, biostimulants and the NOVEL organic liquid nutrient, coupled with judicious application of chemical fertilizers, not only are higher yields and superior-quality harvests attainable, but also the well-being of the soil is preserved while pollution concerns are mitigated. The advantage of combining organic and inorganic sources of nutrients in integrated nutrient management has been proved superior to the use of each component separately (Palaniappan and Annadurai 2007). Keeping all this point I have done this experiment.

MATERIALS AND METHOD

A field experiment was conducted at College Farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan-384 460, Mehsana (Gujarat) during the years 2020-21 and 2021-22 on beet root. The soil of the experimental location was Loamy Sand with normal pH (7.91), low in available nitrogen (185.25 kg ha^{-1}), medium in available phosphorus (46.29 kg ha^{-1}) and high in available potassium (275.45 kg ha^{-1}). The experiment was laid out in Randomized Block Design with factorial concept (FRBD) keeping three factor *viz*., different fertilizer levels, biostimulants and different concentration of novel organic liquid nutrient. With combination through, making twenty-seven treatments. [**T_1:** 40 % RDF + *Jeevamruta* + 1.0 % Novel organic liquid nutrient, **T_2:** 40 % RDF + *Jeevamruta* + 1.5 % Novel organic liquid nutrient, **T_3:** 40 % RDF + *Jeevamruta* + 2.0 % Novel organic liquid nutrient, **T_4:** 40 % RDF + *Panchgavya* + 1.0 % Novel organic liquid nutrient, **T_5:** 40 % RDF + *Panchgavya* + 1.5 % Novel organic liquid nutrient, **T_6:** 40 % RDF + *Panchgavya* + 2.0 % Novel organic liquid Nutrient, **T_7:** 40 % RDF + Bio NPK consortium + 1.0 % Novel organic liquid nutrient, **T_8:** 40 % RDF + Bio NPK consortium + 1.5 % Novel organic liquid nutrient, **T_9:** 40 % RDF + Bio NPK consortium + 2.0 % Novel organic liquid nutrient, **T_{10}:** 60 % RDF + *Jeevamruta* + 1.0 % Novel organic liquid nutrient, **T_{11}:** 60 % RDF + *Jeevamruta* + 1.5 % Novel organic liquid nutrient, **T_{12}:** 60 % RDF + *Jeevamruta* + 2.0 % Novel organic liquid nutrient, **T_{13}:** 60 % RDF + *Panchgavya* + 1.0 % Novel organic liquid nutrient, **T_{14}:** 60 % RDF + *Panchgavya* + 1.5 % Novel organic liquid nutrient, **T_{15}:** 60 % RDF + *Panchgavya* + 2.0 % Novel organic liquid nutrient, **T_{16}:** 60 % RDF + Bio NPK consortium + 1.0 % Novel organic liquid nutrient, **T_{17}:** 60 % RDF + Bio NPK consortium + 1.5 % Novel organic liquid nutrient, **T_{18}:** 60 % RDF + Bio NPK consortium + 2.0 % Novel organic liquid nutrient, **T_{19}:** 80 % RDF + *Jeevamruta* + 1.0 % Novel organic liquid nutrient, **T_{20}:** 80 % RDF + *Jeevamruta* + 1.5 % Novel organic liquid nutrient, **T_{21}:** 80 % RDF + *Jeevamruta* + 2.0 % Novel organic liquid nutrient, **T_{22}:** 80 % RDF + *Panchgavya* + 1.0 % Novel organic liquid nutrient, **T_{23}:** 80 % RDF + *Panchgavya*+ 1.5 % Novel organic liquid nutrient, **T_{24}:** 80 % RDF + *Panchgavya* + 2.0 % Novel organic liquid nutrient, **T_{25}:** 80 % RDF + Bio NPK consortium + 1.0 % Novel organic liquid nutrient,**T_{26}:** 80 % RDF + Bio NPK consortium + 1.5 % Novel organic liquid nutrient, **T_{27}:** 80 % RDF + Bio NPK consortium + 2.0 % Novel organic liquid nutrient] and replicated thrice during the years 2020-21 and 2021-22. Beet root was sown by hand dibbling method. In this experiment beet root crimson glob cultivar are used. The sowing was carried out after 25 October in both the years. FYM @ 20 t/ha was applied in all the treatments at the time of land preparation. Half dose of N and full dose of P and K was given as per treatment as a basal dose. Remaining half dose of N was applied in two split as a top dressing at 30 and 45 DAS. *Jeevamruta* was applied in soil as per treatment through drenching @ 500 l/ha at the time of sowing and 30 DAS, *Panchgavya* was sprayed as per treatment @ 3 % at 20, 35 and 50 DAS, Bio NPK consortium was applied in soil as per treatment @ 1.5 l/ha at the time of sowing by mix with required quantity of FYM and Novel organic liquid nutrient was sprayed as per treatment (1.0 %, 1.5 % and2.0 %) at 20, 35 and 50 DAS.

RESULTS AND DISCUSSION

A. Quality parameters

An assessment of data (Table 1) indicated that application of 80 % RDF (f_3) recorded significantly maximum chlorophyll content (2.46, 2.20 and 2.33 mg g^{-1}) during 2020-21, 2021-22 and in pooled, respectively and maximum carotenoid content (1.26, 1.28 and 1.27 mg g^{-1}) during 2020-21, 2021-22 and in pooled, respectively. Similar findings were also recorded by Vennila and Jayanthi (2008) in okra.

Significantly maximum chlorophyll content (2.27, 2.08 and 2.16 mg g^{-1}) during 2020-21, 2021-22 and in pooled respectively were reported with the application of @ 3 % *panchagavya* (b_2). The results showed increase in chlorophyll content in leaves with foliar application of *panchagavya* in the study might be related with the supply of essential nutrients to the plants. Subsequently chlorophyll synthesis in the plants is directly associated to the obtainability of the physiologically active Fe, N, P and S nutrients. The fermented solutions of *panchagavya* encompass numerous salts rich in N, P, K, S and micronutrients in plant available form. Therefore, availability of these nutrients to plants aid in the development of chlorophyll in the leaves. Improved total chlorophyll in green leaves with foliar application of *panchgavya* has also been reported by Tejada and Gonzalez (2003).

Results pertaining that different fertilizer levels, biostimulant and novel organic liquid nutrient application had non significant influence on Total soluble solids and marketable shelf life.

The result showed in (Table 1) that interaction between different combination of treatments (f × b, f × n, b × n and f × b × n) exhibits non significant effect on different Quality parameters during year 2020-21, 2021-22 and also in pooled analysis.

B. Economics

Maximum gross return of ₹6,63,064/- per hectare, net return of ₹5,73,967/- per hectare were recorded from the treatment combination of $f_3b_2n_3$ and benefit: cost

ratio 6.8 were recorded from the treatment combination of $f_3b_3n_3$. The results are in close conformity with findings of Kondapa *et al*. (2009); Gopakkali and Sharanappa (2014) in chilli.

Table 1: Effect of fertilizer levels, biostimulants and novel organic liquid nutrient on total soluble solids (°Brix), total chlorophyll content (mg g^{-1}), carotenoid content (mg g^{-1}) and marketable shelf life (days).

Treatment	Total Soluble Solids (°Brix)			Total chlorophyll content (mg g^{-1})			Carotenoid content (mg g^{-1})			Marketable shelf life (days)		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Fertilizer levels (f)												
f_1	11.77	11.53	11.65	1.96	1.76	1.86	1.16	1.21	1.19	4.99	4.85	4.92
f_2	11.92	11.79	11.85	2.16	1.99	2.07	1.21	1.25	1.23	5.09	4.97	5.03
f_3	12.01	11.91	11.96	2.46	2.20	2.33	1.26	1.28	1.27	5.10	5.04	5.07
S.Em. ±	0.14	0.12	0.14	0.02	0.02	0.02	0.01	0.01	0.01	0.07	0.06	0.07
C.D. at 5%	NS	NS	NS	0.06	0.05	0.04	0.03	0.03	0.02	NS	NS	NS
Biostimulant (b)												
b_1	12.11	11.84	11.98	2.12	1.92	2.02	1.21	1.23	1.22	5.00	4.86	4.93
b_2	11.70	11.67	11.67	2.27	2.08	2.16	1.20	1.26	1.23	5.10	5.05	5.08
b_3	11.89	11.75	11.82	2.19	1.98	2.08	1.22	1.26	1.20	5.08	4.95	5.01
S.Em. ±	0.14	0.12	0.09	0.02	0.02	0.01	0.01	0.01	0.01	0.07	0.06	0.05
C.D. at 5%	NS	NS	NS	0.06	0.05	0.04	NS	NS	NS	NS	NS	NS
Novel organic liquid nutrient (n)												
n_1	11.75	11.64	11.70	2.17	1.96	2.06	1.19	1.24	1.22	4.98	4.88	4.93
n_2	11.95	11.74	11.85	2.20	1.99	2.09	1.22	1.25	1.23	5.06	4.97	5.02
n_3	11.99	11.86	11.92	2.21	2.00	2.11	1.23	1.25	1.24	5.13	5.02	5.08
S.Em. ±	0.14	0.12	0.09	0.02	0.02	0.01	0.01	0.01	0.01	0.07	0.06	0.05
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Interaction effect												
f × b	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
f × n	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
b × n	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
f × b × n	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV%	5.92	5.34	5.69	4.95	4.84	4.91	4.93	4.50	4.76	7.07	6.48	6.83

Table 2: Effect of different fertilizer levels, biostimulant and novel organic liquid nutrient on economics of different treatment.

Treatment combination	Yield/hectare (t)	Total cost (₹/ha)	Gross returns (₹/ha)	Net returns (₹/ha)	BCR
f_1 b_1 n_1	26.12	79059	391825	312766	4.0
f_1 b_1 n_2	28.62	79309	429370	350061	4.4
f_1 b_1 n_3	29.61	79559	444153	364595	4.6
f_1 b_2 n_1	29.72	82629	445770	363141	4.4
f_1 b_2 n_2	30.80	82879	462055	379177	4.6
f_1 b_2 n_3	32.26	83129	483911	400782	4.8
f_1 b_3 n_1	28.80	74439	431971	357532	4.8
f_1 b_3 n_2	29.47	74689	442013	367324	4.9
f_1 b_3 n_3	31.10	74939	466522	391583	5.2
f_2 b_1 n_1	33.06	76823	495897	419074	5.5
f_2 b_1 n_2	34.16	82293	512390	430097	5.2
f_2 b_1 n_3	34.76	82543	521382	438839	5.3
f_2 b_2 n_1	36.48	90833	547220	456387	5.0
f_2 b_2 n_2	37.60	85863	564047	478184	5.6
f_2 b_2 n_3	39.18	86113	587762	501649	5.8
f_2 b_3 n_1	32.28	77423	484267	406843	5.3
f_2 b_3 n_2	32.92	77673	493728	416055	5.4
f_2 b_3 n_3	33.85	77923	507731	429808	5.5
f_3 b_1 n_1	33.23	85028	498524	413496	4.9
f_3 b_1 n_2	33.63	85278	504507	419230	4.9
f_3 b_1 n_3	35.56	85528	533460	447932	5.2
f_3 b_2 n_1	39.48	88598	592200	503602	5.7
f_3 b_2 n_2	40.94	88848	614091	525243	5.9
f_3 b_2 n_3	44.20	89098	663064	573967	6.4
f_3 b_3 n_1	39.06	80408	585865	505458	6.3
f_3 b_3 n_2	40.19	80658	602846	522189	6.5
f_3b_3 n_3	42.05	80908	630766	549858	6.8

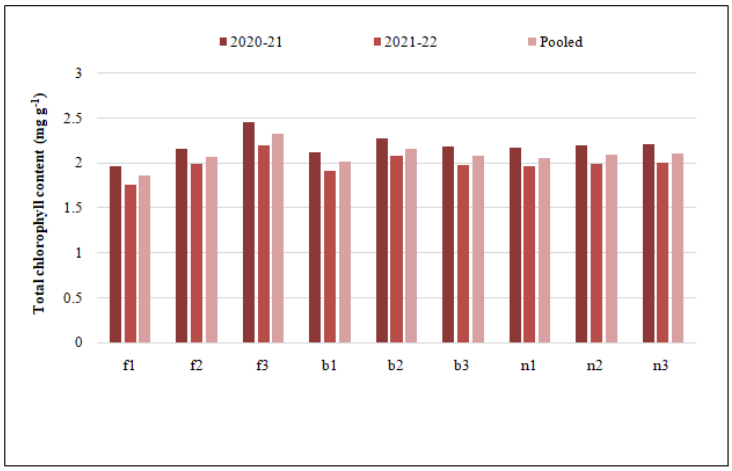

Fig. 1. Total chlorophyll content (mg g^{-1}).

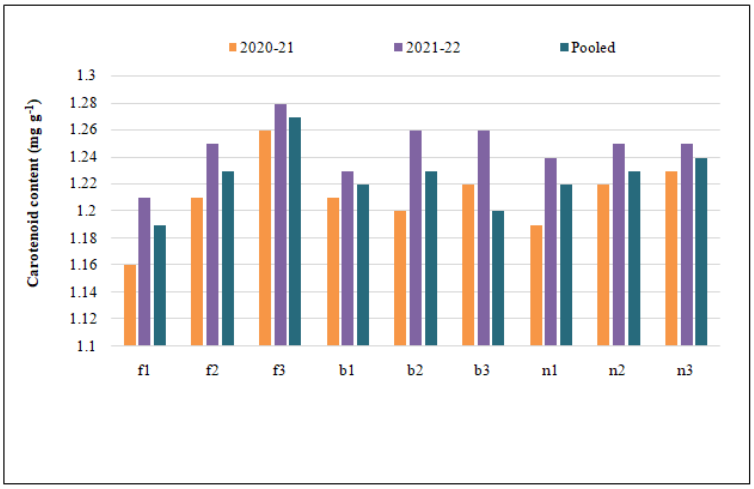

Fig. 2. Carotenoid content (mg g^{-1}).

CONCLUSIONS

On the basis of experimental evidence, higher quality and net return can be obtained through application of 80 % recommended dose of fertilizer and foliar spray of *panchagavya* 3 % at 20, 35 and 50 days after sowing of beet root during *rabi* season.

FUTURE SCOPE

In recent times, consumers are demanding higher quality and safer food and showing interest in organic products. Hence, there is urgent need to improve organic fertilizers with natural minerals through biological processes. However, there is very wide information gap on the efficiency and utilization of biostimulants and banana pseudostem sap as organic liquid fertilizer in India and abroad. Though, much work has been reported on nutrient management in beet root involving inorganic fertilizers, but no systematic investigation has been carried out on the combine use of organic sources along with inorganic fertilizers on production of beet root. Biostimulants can improve the absorption and utilization of nutrients, improved soil structure and overall soil health. It has beneficial impact on reducing the negative impact on water bodies and ecosystem.

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