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Effect of Different Fertilizer Levels and Biostimulants on Quality and Economics of Cabbage (*Brassica oleracea* var. *capitata*)

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ABSTRACT: To study the influence of different fertilizer levels and biostimulants on quality and economics of cabbage (*Brassica oleracea* var. *capitata*) was carried out on Golden Acre during rabi season of 2021-22 and 2022-23 at College farm, College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Dist. Mehsana, Gujarat, India. Present investigation comprising three factors *viz.*, three levels of fertilizer *viz.*, 60 % RDF (f_1), 80 % RDF (f_2) and 100 % RDF (f_3), biostimulant with three levels *viz.*, *Jeevamrut* (b_1), Vermiwash (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). Among three fertilizer levels of chemical source application of 100% RDF (f_1) helped in obtaining maximum value ofquality parameters *viz.*, diameter of head (cm) and chlorophyll a, b and total chlorophyll at 45 DAT (mg/g), Among three biostimulants application of *jeevamrut*(b_1)showed maximum values for quality parameters *viz.*, diameter of head (cm) and among three different novel culture application of novel organic liquid nutrient @ 2.0 % (n_3) showed maximum values for quality parameters *viz.*, diameter of head (cm). While, interaction effect between fertilizer levels and biostimulant (f × b) shows significantly maximum diameter of head (cm) with the treatment combination of 100 % RDF + *jeevamtut* (f_3b_1). Economically, it can be concluded that treatment combination in application of 100% recommended dose of fertilizer with the soil application of *jeevamrut* and foliar spray of novel organic liquid nutrient in cabbage during *rabi* season which is the better in terms of maximum gross return, net return and benefit: cost ratio. Recently, the concept of integrated nutrient management towards better crop production has paved the way for sustainable horticulture. The basic principles lie in maintenance of soil fertility through judicious use of inorganic fertilizers and organic manures. Organic manures act potential sources of not only for macro nutrients but also micronutrients, but the quantity varies depending upon the nature, sources and extent of decomposition. Hence, there is urgent need to improve organic fertilizers with natural minerals through biological processes.

Key words: Cabbage, Biostimulant, *Jeevamrut*, Vermiwash, Bio NPK Consortium, novel organic liquid nutrient.

INTRODUCTION

Cabbage (*Brassica oleracea* var. *capitata*) is one of the important leafy vegetable crops and used as salad, cooked, pickling as well as dehydrated vegetable. The word "Cabbage" is derived from the French word "coboche" means head. The cabbage belongs to brassicaceae family. It is mostly employed as culinary and dietary article which is used alone or mixed with potatoes & peas for vegetable purpose. It is also used for feeding stock of chicken. The particular flavor in the cabbage head is due to the glycoside 'sinigrin' which contain sulphur. The cabbage head is rich source of vitamin A, B, C and also contains minerals. It has cooling effect and helps in preventing constipation, increase appetite, speed up digestion and very useful for patients of diabetes (Patel *et al.,* 2018). Due to diversified use of productive land, it is necessary to increase the food production to meet the diverse requirement of human beings. To increase the yield of cabbage, application of balanced major-micronutrients and growth regulators may a contribute to achieve the desired goal.

The cultivation of cabbage was limited till the sixties but with the populating of fast food and awareness about high nutritive value, there is tremendous increase in area. It covers about 4 percent of the total area of vegetables. India ranks second next to China in cabbage production (Singh *et al.,* 2021). In India, cabbage is cultivated in about an area of 413.0 thousand hectares with the production 9606 MT and the productivity of

23.27 t/ha. The major cabbage growing states in India are Gujarat, U.P., Orissa, W.B., Assam, Maharashtra and Karnataka. In Gujarat, cabbage crop is cultivated in almost all the districts with major cultivation in Bhavnagar, Anand, Kheda, Junagadh, Sabarkantha, Banaskantha and Ahmedabad. In Gujarat, it is cultivated in about an area of 37.40 thousand hectares with an annual production of 796.73 MT having productivity of 21.30 t/ha (Anonymous, 2021). So, there is tremendous scope to enhance the productivity of cabbage in Gujarat state.

Biostimulants 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). It is an organic products composed of peptides, amino acids, polysaccharides, humic acids and phytohormones for immediate uptake and availability within the plant. Their absorption does not depend on the photosynthetic activity as they are directly absorbed by the plant, resulting in lower energy consumption. The aim of these products is not to supply nutrition, but rather to favour and stimulate the metabolism of the plant, decrease plant stress, *etc*. They are also claimed to enhance crop growth and yield through a series of widely varying mechanisms including activation of soil microbial activity and promotion or augmentation of the activities of critical soil enzymes or plant growth hormones (Parrado *et al.,* 2008). 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).

Now a days use of organic nutrients in vegetable crops is a common trend and it increases crop yield without any adverse effects on the environment and soil. The organic manures are bulky in nature but, contain reasonable amount of nutrients. The supply of nutrients through organics alone has failed to maintain yield level in a short period. The combined application of organics such as FYM, compost, green leaf manure, vermicompost *etc*. and liquid organics *viz*., *Jeevamrut*, *Beejamrut*, *Panchagavya*, *Gomutra*, *Angara*, Vermiwash *etc*., which contain microbial count and plant growth promoting substances (PGPR) stimulate growth, yield and quality of crops. Further, it helps to build soil organic matter status besides minimizing the cost of cultivation.

Integrated nutrient supply system has become an accepted strategy to bring about improvement in soil fertility and protecting the environment. It involves the integrated use of mineral fertilizers in combination with organic manures and microbial inoculants to sustain optimum yield to maintain and to improve the soil fertility (Abrol and Katyal 1990). Organic farming is the pathway that leads to achieve sustainability in horticultural production.

MATERIAL AND METHODS

An experiment was carried out at College farm, College of Horticulture, S. D. Agricultural University, Jagudan, Distt. Mehsana (Gujarat), India during *rabi* season of 2021-22 and 2022-23. Present investigation comprising of three factors *viz.*, three levels of fertilizer *viz.*, 60 % RDF (f_1), 80 % RDF (f_2) and 100 % RDF (f_3), biostimulant with three levels *viz.*, *Jeevamrut* (b_1), Vermiwash (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. [T_1: 60 % RDF + Jeevamrut + 1.0 % Novel organic liquid nutrient, T_2 :60 % RDF + Jeevamrut + 1.5 % Novel organic liquid nutrient, T_3: 60 % RDF + Jeevamrut + 2.0 % Novel organic liquid nutrient, T_4: 60 % RDF + Vermiwash + 1.0 % Novel organic liquid nutrient, T_5: 60 % RDF + Vermiwash + 1.5 % Novel organic liquid nutrient, T_6: 60 % RDF + Vermiwash + 2.0 % Novel organic liquid nutrient, T_7: 60 % RDF + NPK consortium + 1.0 % Novel organic liquid nutrient, T_8: 60 % RDF + NPK consortium + 1.5 % Novel organic liquid nutrient, T_9: 60 % RDF + NPK consortium + 2.0 % Novel organic liquid nutrient, T_{10}: 80 % RDF + Jeevamrut + 1.0 % Novel organic liquid nutrient, T_{11}: 80 % RDF + Jeevamrut + 1.5 % Novel organic liquid nutrient, T_{12}: 80 % RDF + Jeevamrut + 2.0 % Novel organic liquid nutrient, T_{13}: 80 % RDF + Vermiwash + 1.0 % Novel organic liquid nutrient, T_{14}: 80 % RDF + Vermiwash + 1.5 % Novel organic liquid nutrient, T_{15}: 80 % RDF + Vermiwash + 2.0 % Novel organic liquid nutrient, T_{16}: 80 % RDF + NPK consortium + 1.0 % Novel organic liquid nutrient, T_{17}: 80 % RDF + NPK consortium + 1.5 % Novel organic liquid nutrient, T_{18}: 80 % RDF + NPK consortium + 2.0 % Novel organic liquid nutrient, T_{19}: 100 % RDF + Jeevamrut + 1.0 % Novel organic liquid nutrient, T_{20}: 100 % RDF + Jeevamrut + 1.5 % Novel organic liquid nutrient, T_{21}: 100 % RDF + Jeevamrut + 2.0 % Novel organic liquid nutrient, T_{22}: 100 % RDF + Vermiwash + 1.0 % Novel organic liquid nutrient, T_{23}: 100 % RDF + Vermiwash + 1.5 % Novel organic liquid nutrient, T_{24}: 100 % RDF + Vermiwash + 2.0 % Novel organic liquid nutrient, T_{25}: 100 % RDF + NPK consortium + 1.0 % Novel organic liquid nutrient, T_{26}: 100 % RDF + NPK consortium + 1.5 % Novel organic liquid nutrient, T_{27}: 100 % RDF + NPK consortium + 2.0 % Novel organic liquid nutrient]

Inorganic fertilizer like NPK applied as per treatment, among them one third dose of N and full dose of P & K was applied at transplanting as basal dose. Remaining dose of N was applied as per treatment into two equal splits through top dressing at 20 and 40 DAT. *Jeevamrut* was applied in soil through drenching @ 500 l/ha at 15, 30, 45 and 60 DAT. Vermiwash (1:5 times dilution) was sprayed at 30 and 45 DAT. Bio NPK consortium was applied in soil @ 2.5 l/ha at the time of transplanting mix with required quantity of water (500 l/ha). Novel organic liquid nutrient was sprayed as per treatment (1.0 %, 1.5 % and 2.0 %) at 20 and 40 DAT.

Seedling of variety Golden Acre were transplanting during October, 2021-22 and 2022-23 at a spacing of

30 cm × 30 cm in a plot having dimensions of 2.70 m × 1.50 m. The experiment was laid out in Randomized Block Design with factorial concept with three replications. The data were analysed statistically by adopting the standard procedures described by Panse and Sukhatme (1985).

RESULT AND DISCUSSION

Effect on quality parameters. The different quality attributing characters such as diameter of head (cm), compactness of head (kg/cm^2), chlorophyll a, b & total at 45 DAT(mg/g), ascorbic acid (mg/100 g) and calcium content (mg/100 g)were recorded.

Effect of different fertilizer levels . Data described in (Table 1) shows that significantly maximum diameter of head (13.41 cm, 13.46 cm and 13.43 cm) during 2021-22, 2022-23 and in pooled respectively were reported with the application of 100 % RDF (f_3). Higher vegetative growth might have helped in the synthesis of greater amount of food material which was later translocated into developing head resulting in increased head diameter (Singh *et al.,* 2019). This may be also due to nutrients especially nitrogen was easily available for plant in sufficient quantity which increases the production of photosynthates in plant (Gupta *et al.,* 2018).

These results are in conformity with Patel *et al.* (2018) in cabbage; Koppad *et al.* (2019); Pattar *et al.* (2017) in red cabbage.

Significantly maximum chlorophyll a, b and total chlorophyll content (0.375 mg g^{-1}, 0.290 mg g^{-1} and 0.555 mg g^{-1} during 2021-22, 0.373 mg g^{-1}, 0.288 mg g^{-1} and 0.571 mg g^{-1} during 2022-23 and 0.374 mg g^{-1}, 0.289 mg g^{-1} and 0.563 mg g^{-1} in pooled) respectively, were recorded with the application of 100 % RDF (f_3). It might be due to the nitrogen played an important role in the expansion of leaf area and the chlorophyll content of the plant which further might have resulted in increased photosynthetic rates and thus the supply of carbohydrates to the sink was also increased. Activity of auxin also increased with the increase in nitrogen concentration which finally increased the chlorophyll content (Shraddha, 2020). Similar findings were also recorded by Gocher *et al.* (2017) in cauliflower.

Results pertaining to quality parameters *viz.,* compactness of head (kg/cm^2), ascorbic acid (mg/100 g) and calcium content (mg/100 g) were not influence significantly by various treatments.

Effect of different biostimulants. The data enumerated in (Table 1) shows that significantly maximum diameter of head (12.45 cm, 12.40 cm and 12.43 cm) during 2021-22, 2022-23 and in pooled respectively was reported with the application of *Jeevamrut* (b_1). Increasing of the head diameter which might be due to the application of farm yard manure and cow urine which is present in *jeevamrut.* Farm yard manure is responsible for storing the essential nutrients which are released during mineralization and might be helpful in increasing fertilizer use efficiency. With the use of FYM, plant nutrients are readily available due to enhanced activity of beneficial microorganisms in the soil. The process of respiration is increased with the increased cell permeability due to which there is direct increase in yield contributing factors. Similar results are also found by Sharma *et al.* (2022) in cauliflower.

Effect of different levels of novel organic liquid nutrient. Data described in (Table 1) shows that the application of novel organic liquid nutrient @ 2.0 % (n_3) exhibited significantly maximum diameter of head (12.30 cm, 12.31 cm and 12.31 cm) during 2021-22, 2022-23 and in pooled respectively. It might be due to higher carbohydrate accumulation in plant at early stages of growth as a resulted better nutrient supply, which causes an increased in size. Another favorable factor contributing for better head characters might be the involvement of novel organic liquid fertilizer which contained fair amount of macro and micronutrients as well as growth promoting substances which induced better plant growth (Kalariya *et al.*, 2018). These results are in conformity with Patel *et al.* (2018) in cabbage.

Interaction effect of different fertilizer levels, biostimulants and novel organic liquid nutrient. Looking to the interaction effect between fertilizer levels and biostimulant, significantly maximum diameter of head (14.32 cm, 14.69 cm and 14.01 cm) during 2021-22, 2022-23 and in pooled respectively, was found with the treatment combination of 100 % RDF + *Jeevamrut* (f_3b_1).With integrated use of various chemical fertilizers and organic manures there is significant increase in head diameter which might be attributed to increase in photosynthetic activity of plant and increased chlorophyll content. Due to increased chlorophyll content the plant produced more photosynthesis which was diverted for the growth and better nourishment of the head (Sharma *et al.,* 2022). These findings are in close conformity with the findings of Singh *et al.* (2015).

Economics. Data (Table 4) pertaining to the economics of treatments shows that maximum gross income of ₹ 6,63,077 per hectare, net return of ₹ 5,52,408 per hectare and benefit :cost ratio 6.0 were recorded from the treatment combination of $f_3b_1n_3$(100 % RDF + Jeevamrut + 2.0 % Novel organic liquid nutrient), rated as most effective treatment which also recorded maximum yield per hectare (66.31t).

Table 1: Effect of fertilizer levels, biostimulants and novel organic liquid nutrient on diameter of head (cm) and compactness of head (kg/cm^2).

Diameter of head (cm)				Compactness of head (kg/cm^2)			
Treatment	**2021-22**	**2022-23**	**Pooled**	**Treatment**	**2021-22**	**2022-23**	**Pooled**
Fertilizer levels (f)				**Fertilizer levels (f)**			
f_1	10.19	10.21	10.20	**f_1**	5.82	5.84	5.83
f_2	11.89	11.99	11.94	**f_2**	5.97	5.99	5.98
f_3	13.41	13.46	13.43	**f_3**	6.10	6.04	6.07
S.Em. ±	0.18	0.18	0.18	**S.Em. ±**	0.09	0.10	0.09
C.D. at 5%	0.52	0.51	0.36	**C.D. at 5%**	NS	NS	NS
Biostimulant (b)				**Biostimulant (b)**			
b_1	12.45	12.40	12.43	**b_1**	6.06	6.10	6.08
b_2	11.35	11.56	11.42	**b_2**	5.81	5.86	5.84
b_3	11.68	11.76	11.72	**b_3**	6.01	5.90	5.96
S.Em. ±	0.18	0.18	0.13	**S.Em. ±**	0.09	0.10	0.07
C.D. at 5%	0.52	0.51	0.36	**C.D. at 5%**	NS	NS	NS
Novel organic liquid nutrient (n)				**Novel organic liquid nutrient (n)**			
n_1	11.43	11.55	11.49	**n_1**	5.84	5.84	5.84
n_2	11.76	11.79	11.77	**n_2**	6.01	5.91	5.96
n_3	12.30	12.31	12.31	**n_3**	6.04	6.12	6.08
S.Em. ±	0.18	0.18	0.13	**S.Em. ±**	0.09	0.10	0.07
C.D. at 5%	0.52	0.51	0.36	**C.D. at 5%**	NS	NS	NS
CV%	7.98	7.83	7.91	**CV%**	8.18	8.93	8.71

Interaction effect	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**	**Interaction effect**	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**
f × b	0.31	0.89	0.31	0.88	0.22	0.62	**f × b**	0.16	NS	0.17	NS	0.12	NS
f × n	0.31	NS	0.31	NS	0.22	NS	**f × n**	0.16	NS	0.17	NS	0.12	NS
b × n	0.31	NS	0.31	NS	0.22	NS	**b × n**	0.16	NS	0.17	NS	0.12	NS
f × b × n	0.54	NS	0.53	NS	0.38	NS	**f × b × n**	0.28	NS	0.30	NS	0.21	NS

Table 2: Effect of different fertilizer levels, biostimulants and novel organic liquid nutrient on chlorophyll a, b & total at 45 DAT (mg/g).

Chlorophyll a content (mg/g)				Chlorophyll b content (mg/g)				Total chlorophyll content (mg/g)			
Treatment	**2021-22**	**2022-23**	**Pooled**	**Treatment**	**2021-22**	**2022-23**	**Pooled**	**Treatment**	**2021-22**	**2022-23**	**Pooled**
Fertilizer levels (f)				**Fertilizer levels (f)**							
f_1	0.313	0.312	0.312	**f_1**	0.230	0.241	0.236	**f_1**	0.482	0.486	0.484
f_2	0.350	0.348	0.349	**f_2**	0.273	0.276	0.274	**f_2**	0.513	0.513	0.513
f_3	0.375	0.373	0.374	**f_3**	0.290	0.288	0.289	**f_3**	0.555	0.571	0.563
S.Em. ±	0.004	0.004	0.004	**S.Em. ±**	0.002	0.003	0.002	**S.Em. ±**	0.006	0.005	0.006
C.D. at 5%	0.010	0.010	0.007	**C.D. at 5%**	0.007	0.008	0.005	**C.D. at 5%**	0.018	0.015	0.012
Biostimulant (b)				**Biostimulant (b)**				**Biostimulant (b)**			
b_1	0.349	0.346	0.348	**b_1**	0.266	0.270	0.268	**b_1**	0.525	0.530	0.527
b_2	0.342	0.340	0.342	**b_2**	0.263	0.267	0.265	**b_2**	0.511	0.519	0.515
b_3	0.346	0.345	0.345	**b_3**	0.264	0.268	0.266	**b_3**	0.515	0.521	0.518
S.Em. ±	0.004	0.004	0.003	**S.Em. ±**	0.002	0.003	0.002	**S.Em. ±**	0.006	0.005	0.004
C.D. at 5%	NS	NS	NS	**C.D. at 5%**	NS	NS	NS	**C.D. at 5%**	NS	NS	NS
Novel organic liquid nutrient (n)				**Novel organic liquid nutrient (n)**				**Novel organic liquid nutrient (n)**			
n_1	0.342	0.340	0.341	**n_1**	0.262	0.266	0.264	**n_1**	0.509	0.519	0.514
n_2	0.345	0.344	0.344	**n_2**	0.264	0.268	0.266	**n_2**	0.516	0.522	0.519
n_3	0.350	0.349	0.350	**n_3**	0.267	0.272	0.269	**n_3**	0.525	0.530	0.528
S.Em. ±	0.004	0.004	0.003	**S.Em. ±**	0.002	0.003	0.002	**S.Em. ±**	0.006	0.005	0.004
C.D. at 5%	NS	NS	NS	**C.D. at 5%**	NS	NS	NS	**C.D. at 5%**	NS	NS	NS
CV%	5.42	5.34	5.40	**CV%**	4.76	5.24	5.01	**CV%**	6.412	5.168	5.816

Interaction effect	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**	**Interaction effect**	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**	**Interaction effect**	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**
f × b	0.006	NS	0.006	NS	0.004	NS	**f × b**	0.004	NS	0.005	NS	0.003	NS	**f × b**	0.011	NS	0.009	NS	0.007	NS
f × n	0.006	NS	0.006	NS	0.004	NS	**f × n**	0.004	NS	0.005	NS	0.003	NS	**f × n**	0.011	NS	0.009	NS	0.007	NS
b × n	0.006	NS	0.006	NS	0.004	NS	**b × n**	0.004	NS	0.005	NS	0.003	NS	**b × n**	0.011	NS	0.009	NS	0.007	NS
f × b × n	0.011	NS	0.011	NS	0.008	NS	**f × b × n**	0.007	NS	0.008	NS	0.005	NS	**f × b × n**	0.019	NS	0.016	NS	0.012	NS

Table 3: Effect of fertilizer levels, biostimulants and novel organic liquid nutrient on ascorbic acid (mg/100g)and calcium content (mg/100g).

Ascorbic acid (mg/100g)						
Treatment	**2021-22**		**2022-23**		**Pooled**	
Fertilizer levels (f)						
f_1	36.64		37.14		36.89	
f_2	37.58		38.16		37.87	
f_3	37.13		38.19		37.66	
S.Em. ±	0.53		0.42		0.53	
C.D. at 5%	NS		NS		NS	
Biostimulant (b)						
b_1	37.17		38.36		37.77	
b_2	36.76		36.77		36.93	
b_3	37.44		38.02		37.73	
S.Em. ±	0.53		0.42		0.34	
C.D. at 5%	NS		NS		NS	
Novel organic liquid nutrient (n)						
n_1	36.50		37.15		36.82	
n_2	37.18		38.16		37.67	
n_3	37.69		38.18		37.94	
S.Em. ±	0.53		0.42		0.34	
C.D. at 5%	NS		NS		NS	
CV%	7.39		5.74		6.61	
Interaction effect	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**
f × b	0.91	NS	0.72	NS	0.58	NS
f × n	0.91	NS	0.72	NS	0.58	NS
b × n	0.91	NS	0.72	NS	0.58	NS
f × b × n	1.58	NS	1.25	NS	1.01	NS

Calcium content (mg/100g)						
Treatment	**2021-22**		**2022-23**		**Pooled**	
Fertilizer levels (f)						
f_1	70.14		69.15		69.64	
f_2	70.77		69.76		70.27	
f_3	72.06		70.93		71.49	
S.Em. ±	0.74		0.78		0.74	
C.D. at 5%	NS		NS		NS	
Biostimulant (b)						
b_1	71.90		70.92		71.41	
b_2	70.19		69.00		69.58	
b_3	70.88		69.95		70.41	
S.Em. ±	0.74		0.78		0.54	
C.D. at 5%	NS		NS		NS	
Novel organic liquid nutrient (n)						
n_1	70.20		68.93		69.57	
n_2	71.05		69.93		70.49	
n_3	71.71		70.98		71.35	
S.Em. ±	0.74		0.78		0.54	
C.D. at 5%	NS		NS		NS	
CV%	5.38		5.80		5.60	
Interaction effect	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**	**S.Em. ±**	**C.D. at 5%**
f × b	1.27	NS	1.35	NS	0.93	NS
f × n	1.27	NS	1.35	NS	0.93	NS
b × n	1.27	NS	1.35	NS	0.93	NS
f × b × n	2.20	NS	2.34	NS	1.61	NS

Table 4: Effect of different fertilizer levels, biostimulant and novel organic liquid nutrient on economics of different treatment.

Treatment combination	Yield (t/ha)	Gross returns (₹/ha)	Total cost (₹/ha)	Net returns (₹/ha)	BCR
$f_1 b_1 n_1$	38.18	381836	106905	274931	3.6
$f_1 b_1 n_2$	40.87	408741	107495	301246	3.8
$f_1 b_1 n_3$	40.77	407685	108082	299603	3.8
$f_1 b_2 n_1$	35.86	358605	111822	246783	3.2
$f_1 b_2 n_2$	37.26	372591	112412	260179	3.3
$f_1 b_2 n_3$	37.79	377871	112999	264872	3.3
$f_1 b_3 n_1$	38.01	380137	100710	279427	3.8
$f_1 b_3 n_2$	38.91	389080	101300	287779	3.8
$f_1 b_3 n_3$	40.99	409930	101887	308043	4.0
$f_2 b_1 n_1$	45.67	456669	108199	348470	4.2
$f_2 b_1 n_2$	47.30	473036	108789	364248	4.3
$f_2 b_1 n_3$	47.27	472702	109376	363327	4.3
$f_2 b_2 n_1$	45.32	453243	113116	340128	4.0
$f_2 b_2 n_2$	46.26	462627	113706	348921	4.1
$f_2 b_2 n_3$	47.10	470984	114293	356692	4.1
$f_2 b_3 n_1$	46.93	469347	102004	367344	4.6
$f_2 b_3 n_2$	47.73	477314	102594	374720	4.7
$f_2 b_3 n_3$	48.79	487946	103181	384766	4.7
$f_3 b_1 n_1$	56.51	565123	109492	455631	5.2
$f_3 b_1 n_2$	63.02	630203	110082	520121	5.7
$f_3 b_1 n_3$	66.31	663077	110669	552408	6.0
$f_3 b_2 n_1$	49.53	495254	114409	380845	4.3
$f_3 b_2 n_2$	50.97	509717	114999	394718	4.4
$f_3 b_2 n_3$	52.13	521276	115586	405690	4.5
$f_3 b_3 n_1$	53.69	536854	103297	433557	5.2
$f_3 b_3 n_2$	55.24	552410	103887	448523	5.3
$f_3 b_3 n_3$	61.50	615011	104474	510537	5.9

CONCLUSIONS

On the basis of experimental evidence, best quality and profitable income from cabbage cultivation can be obtained with the combined application of 100% recommended dose of fertilizer with the soil application of *jeevamrut* @ 500 l/ha drenching at 15, 30, 45 and 60 DAT and foliar spray @ 2.0 % of novel organic liquid nutrient at 20 and 40 DAT.

FUTURE SCOPE

There is a vast scope to do research with such type of integrated through fulfill the growing demands of vegetables. Integrated Nutrient Management refers to the maintenance of soil fertility and supply plant nutrient at optimum level for sustaining the desired productivity through optimization of the benefits from all possible sources of organic, inorganic and biological components in an integrated manner.

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