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Effective combination of nutrient application on growth and yield of Palak

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Abstract
Increasing the use of chemical fertilizer led to high cost in vegetable production and creates pollution of their agricultural environment as well as affects the soil fertility. Farmers use large amount of nitrogen application in the form of urea for effective growth and yield which becomes vulnerable to soil that leads to nutrient imbalance and threat to ecological sustainability. Therefore, it has become essential to use untraditional fertilizers as supplements or substitutes for chemical fertilizers. Keeping this facts in view, A field experiment has been conducted in College of Horticulture, Rajendranagar, Hyderabad, Sri Konda Laxman Telangana State Horticultural University. The ten integrated treatments consisting of inorganic nutrients (75%, 50% and 25% NPK kg/ha), biofertilizers (Azotobacter Phosphorous Solubulizing Bacteria (PSB), Potassium Solubulizing Bacteria (PSB), Arka Microbial Consortium (AMC) and Arka vegetable special @ 5 gm/litre was done for 3 times at 15 days interval with three replications were arranged in a randomized block design. Results revealed that maximum growth and yield obtained in Palak was 50% Recommended Dose of Fertilizers (NPK kg/ha), 50% Biofertilizers (Arka Microbial Consortium + Potassium Solubulizing Bacteria) along with Arka vegetable special (micronutrient spray). Hence, to sustain a higher level of soil fertility and crop productivity, by reducing the levels of inorganic nutrients are very important in the crop production system.

Keywords: Inorganic nutrients, growth, yield, biofertilizers, Arka vegetable special

Introduction

Spinach beet (*Beta vulgaris* var. *bengalensis*; 2n=2x=18) belongs to the family Chenopodiaceae is the most popular vegetable crop grown in India and other parts of the world as leafy vegetable. Other names such as Beet leaf in English and Palak in Hindi originated from Indo-Chinese region (Nath,1976) [8]

According to Indian Council of Medical Research, New Delhi recommends 325 g of vegetables per person per day. Among these leafy vegetables contributes 50 g per day per person for balanced diet. Spinach beet is rich in vitamins especially vitamin-A, Vitamin-C and Vitamin-B. Minerals like Iron and Calcium, Folic acid and some amounts of Pyridoxine, Antioxidants as Carotene, Flavones, Indoles and Isothiocyanates, essential amino acids etc. Hence, it is called “Mines of Minerals” (Thamburaj and Singh, 2015) [11]

India is blessed with diverse agro-climatic zones with distinct seasons, making it possible to grow wide range of vegetables and is second largest producer of vegetables next to China in the world. It is mostly grown for its nutritive, tender and soft succulent leaves and it plays a vital role in daily diet of humans with high nutritional values.

In recent years, as the consumers are becoming more aware about the use of chemical free vegetables particularly leafy vegetables. Hence, it becomes the need to sustain the production level with minimum or no use of chemicals. Continuous application of chemicals deteriorates the soil and cause soil problems. Now-a-days, the producers are taking more interest in the nutritional harvest *i.e.,* quality of the produce in terms of its food value rather than its quantity per hectare. Ignorance of organic manures and random use of chemical fertilizers, soil becomes vulnerable that leads to nutrient imbalance and threat to ecological sustainability. It is also well understood that the ideal soil condition can be created through combination of organic manures for maximum crop yield.

Biofertilizers are biological preparations of efficient microorganisms that promote plant growth by improving nutrient acquisition. They enhance soil productivity by fixing atmospheric nitrogen, solubilizing soil phosphorus, and stimulating plant growth. Among various bio-inoculants Azotobacter, a nonsymbiotic, free-living, aerobic nitrogen fixing bacteria, can be substitute part of inorganic fertilizers. Azotobacter inoculation saves nitrogenous fertilizers by 10-20 percent (Mohandas, 1999) [5]. Phosphate Solubulizing bacteria (PSB) was reported to play a significant role in solubilizing the inorganic phosphates which are largely unavailable to plants and making it available to crop use (Tilak and Singh, 1994) [12]. Potassium solubilizing bacteria (KSB) can solubilize K-bearing minerals and convert the insoluble K to soluble forms of K available to plant uptake (Etesami *et. al.*, 2017) [3]

Arka Microbial Consortium (AMC) is a carrier-based product which contains N Fixing, P and Zn solubilizing and plant growth promoting microbes as a single formulation. Arka vegetable special is a micronutrient formulation contains most of the micronutrients such as Zn, B, Fe, Cu, Mn, Mo and Cl and also contains most of the secondary nutrients such as Ca, Mg, S and K which enhances fruit quality in terms of fruit appearance, fruit keeping quality and taste. It can be mixed with any fungicide or insectide, recommended for all vegetable crops at different doses.

To maintain and sustain a higher level of soil fertility and crop productivity, by reducing the levels of inorganic nutrients are very important in the crop production system. Therefore, it has become essential to use untraditional fertilizers as supplements or substitutes for chemical fertilizers.

Material and Methods

The experiment was carried out at PG research form College of Horticulture, Rajendranagar, Hyderabad, Telangana during *rabi* season. The experimental site is situated at the altitude of the 542.3 m above the mean sea level on 17º 19^1 North latitude and 79º 23^1 East longitude. The experiment was laid out in randomized block design (RBD) with three replications and ten treatments. Treatments consisted of T_1 - 100% RDF @ 100:25:50 kg/ha T_2 -75% RDF + Biofertilizers [Azotobacter + Phosphorous Solubulizing Bacteria (PSB) + Potassium Solubulizing Bacteria (KSB)] (Each @ 1.25 kg/ha) T_3 - 50% RDF + Biofertilizers [Azotobacter + Phosphorous Solubulizing Bacteria (PSB) + Potassium Solubulizing Bacteria (KSB)] (Each @ 2.5 kg/ha) T_4 -25% RDF + Biofertilizers [Azotobacter + Phosphorous Solubulizing Bacteria (PSB) + Potassium Solubulizing Bacteria (KSB)] (Each @ 3.75 kg/ha) T_5 -75% RDF + Arka Microbial Consortium (AMC) @ 2.5 kg/ha + Potassium Solubulizing Bacteria (KSB) @ 1.25 kg/ha T_6 - 50% RDF + Arka Microbial Consortium (AMC) @ 5 kg/ha + Potassium Solubulizing Bacteria (KSB) @ 2.5 kg/ha T_7 - 25% RDF + Arka Microbial Consortium (AMC) @ 7.5 kg/ha + Potassium Solubulizing Bacteria (KSB) @ 3.75 kg/ha T_8 - T_5 + Arka vegetable special @ 5 gm/litre T_9 - T_6 + Arka vegetable special @ 5 gm/litre T_{10} - T_7 + Arka vegetable special @ 5 gm/litre

The field was thoroughly prepared and experimental plots of 2 m x 2 m size were made. Biofertilizers mixed with organic manure were applied as per the rates indicated under the treatments after preparation of layout i.e., FYM, Azotobacter, PSB, KSB and AMC followed by irrigation and fertilizers, full doses of P_2O_5, K_2O were applied respectively through single super phosphate and murate of potash before sowing. While application of nitrogen was made through urea in three equal splits i.e., 50% at the time of sowing and remaining 50% at 30, 45 days after sowing. 3-4 seeds per hill were sown at a spacing of 30×10 cm. Thinning was done at 15 days after sowing and all other cultural and plant protection measures were done as per the recommended package of practices for the healthy crop.

The observations were recorded on Morphological growth parameters like Plant height, Leaf length, Leaf width, Length of leaf petiole and yield parameters like Number of leaves per plant, Leaf weight, Leaf yield per plant and Leaf yield. Statistical significance was tested with 'F' value at 5 per cent level of significance and whenever the F value was found significant, Critical difference was worked out at five per cent level of significance.

Results and Discussions

Morphological growth parameters

1. Plant height (cm)

The effect of different treatments on plant height recorded at 15, 30 and 45 days after sowing is presented in Table 1

Highest Plant height was recorded in treatment T_9 (T_6 + Arka vegetable special @ 5 g L^{-1}) at 15, 30, 45 DAS as (14.94 cm), (26.84 cm) and (35.80 cm). Lowest plant height was recorded in T_4 (25% RDF + Azotobacter + PSB + KSB) (Each @ 3.75 kg ha^{-1}) (7.45 cm), (16.35 cm) and (23.88 cm).

The increase in plant height might be due to the presence of readily available nitrogen through inorganic nutrients and biofertilizers. This could be attributed to feasibility of nitrogen fixing and phosphorous as a result of microbial inoculation, have led to better root and shoot development. The positive influence of foliar application of Arka vegetable special on crop growth may be due to the improved ability of the crop to absorb nutrients, photosynthesis and better sink source relationship as this play vital role in various biochemical processes. Similar results were reported by Mounika *et al.* (2017) [7] in coriander.

2. Leaf length (cm)

The data pertaining to leaf length at 15, 30 and 45 days after sowing as effected by the inorganic nutrients and biofertilizers is presented in the Table 2

There was significant difference observed among the treatments for leaf length at 15, 30 and 45 DAS. The highest leaf length (10.94 cm, 18.38 cm and 21.59 cm) was found significantly in treatment T_9 (T_6 + Arka vegetable special @ 5 g L^{-1}). The minimum leaf length (4.06 cm, 10.59 cm and 12.01 cm) was observed in T_4 (25% RDF + Azotobacter + PSB + KSB) (Each @ 3.75 kg ha^{-1}).

Highest leaf length may be due to impact of combined application of inorganic nutrients and biofertilizers on growth cell division, cell elongation, cell enlargement and formation of more tissues and vigor of plant. Khadse *et al.* (2021) [4] reported that influence of inorganic fertilizers in combination with biofertilizers might be due to optimum supply of nutrients particularly nitrogen.

Table 1: Effective combination of nutrient application on plant height (cm) in spinach beet Cv. Pusa Bharati

Treatments	Plant height (cm)		
	15 DAS	30 DAS	45 DAS
T_1 – 100% RDF @ 100:25:50 kg/ha	9.21	20.01	28.70
T_2 – 75% RDF + Azotobacter + PSB + KSB (Each @ 1.25 kg/ha)	9.74	21.93	30.56
T_3 – 50% RDF + Azotobacter + PSB + KSB (Each @ 2.5 kg/ha)	9.54	21.14	30.12
T_4 – 25% RDF + Azotobacter + PSB + KSB (Each @ 3.75 kg/ha)	7.45	16.35	23.88
T_5 – 75% RDF + AMC @ 2.5 kg/ha + KSB @ 1.25 kg/ha	10.29	23.21	31.91
T_6 – 50% RDF + AMC @ 5 kg/ha + KSB @ 2.5 kg/ha	12.98	25.57	34.10
T_7 – 25% RDF + AMC @ 7.5 kg/ha + KSB @ 3.75 kg/ha	8.12	17.77	24.85
T_8 – T_5 + Arka vegetable special @ 5 g/litre	11.54	24.28	33.02
T_9 – T_6 + Arka vegetable special @ 5 g/litre	14.94	26.84	35.80
T_{10} – T_7 + Arka vegetable special @ 5 g/litre	8.67	18.91	26.52
S.E (m) ±	0.352	0.364	0.499
CD at 5%	1.04	1.08	1.48

3. Leaf width (cm)

Leaf width was effected by the inorganic nutrients and biofertilizers is presented in the Table 3

Significantly maximum values (4.16 cm, 12.45 cm and 12.45 cm) recorded at 15, 30 and 45 DAS under the treatment T_9 (T_6 + Arka vegetable special @ 5 g L^{-1}). However, the lowest value was observed in treatment T_4 (25% RDF + Biofertilizers [Azotobacter + PSB + KSB] (Each @ 3.75 kg ha^{-1}) (2.41 cm, 9.02 cm and 9.49 cm)

The increase in morphological parameters may be attributed to the meristematic activity for producing more tissues and organs, since nitrogen plays a major role in cell division, cell elongation, cell enlargement (Morschmer, 1986) [6]

Table 2: Effective combination of nutrient application on leaf length (cm) in spinach beet Cv. Pusa Bharati

Treatments	Leaf length (cm)		
	15 DAS	30 DAS	45 DAS
T_1 – 100% RDF @ 100:25:50 kg/ha	5.21	13.09	15.88
T_2 – 75% RDF + Azotobacter + PSB + KSB (Each @ 1.25 kg/ha)	6.46	14.76	17.32
T_3 – 50% RDF + Azotobacter + PSB + KSB (Each @ 2.5 kg/ha)	6.03	14.02	17.01
T_4 – 25% RDF + Azotobacter + PSB + KSB (Each @ 3.75 kg/ha)	4.06	10.59	12.01
T_5 – 75% RDF + AMC @ 2.5 kg/ha + KSB @ 1.25 kg/ha	7.10	15.06	18.26
T_6 – 50% RDF + AMC @ 5 kg/ha + KSB @ 2.5 kg/ha	8.78	17.14	21.59
T_7 – 25% RDF + AMC @ 7.5 kg/ha + KSB @ 3.75 kg/ha	4.26	11.15	13.15
T_8 – T_5 + Arka vegetable special @ 5 g/litre	7.50	15.91	19.76
T_9 – T_6 + Arka vegetable special @ 5 g/litre	10.94	18.38	23.32
T_{10} – T_7 + Arka vegetable special @ 5 g/litre	4.62	12.00	14.94
S.E (m) ±	0.37	0.36	0.45
CD at 5%	1.12	1.08	1.36

4. Length of leaf petiole (cm)

The data on length of leaf petiole as influenced by various treatments are presented in Table 4

The maximum length of leaf petiole at 15, 30 and 45 DAS was recorded in treatment T_9 (T_6 + Arka vegetable special @ 5 g L^{-1}) (7.79 cm, 10.00 cm and 14.94 cm) whereas treatment T_4 (25% RDF + Biofertilizers [Azotobacter + PSB + KSB] (Each @ 3.75 kg ha^{-1}) recorded significantly lower value (3.09 cm, 6.00 cm and 8.16 cm).

Increasing in petiole length might be due to the presence of plant growth promoting substance present in Arka microbial consortium and nitrogen through inorganic nutrients and biofertilizers, where in inorganic source could have exerted positive influence on extended nutrient availability to match the physiological needs of the crop which triggered to produce elevated stature of the growth components.

Table 3: Effective combination of nutrient application on leaf width (cm) in spinach beet Cv. Pusa Bharati

Treatments	Leaf width (cm)		
	15 DAS	30 DAS	45 DAS
T_1 – 100% RDF @ 100:25:50 Kg/ha	2.98	10.55	10.87
T_2 – 75% RDF + Azotobacter + PSB + KSB (Each @ 1.25 kg/ha)	3.19	10.99	11.63
T_3 – 50% RDF + Azotobacter + PSB + KSB (Each @ 2.5 kg/ha)	3.06	10.70	11.27
T_4 – 25% RDF + Azotobacter + PSB + KSB (Each @ 3.75 kg/ha)	2.41	9.02	9.49
T_5 – 75% RDF + AMC @ 2.5 kg/ha + KSB @ 1.25 kg/ha	3.30	11.36	12.00
T_6 – 50% RDF + AMC @ 5 kg/ha + KSB @ 2.5 kg/ha	3.95	12.01	12.67
T_7 – 25% RDF + AMC @ 7.5 kg/ha + KSB @ 3.75 kg/ha	2.63	9.98	10.15
T_8 – T_5 + Arka vegetable special @ 5 g/litre	3.65	11.74	12.15
T_9 – T_6 + Arka vegetable special @ 5 g/litre	4.16	12.45	13.52
T_{10} – T_7 + Arka vegetable special @ 5 g/litre	2.83	10.15	10.51
S.E (m) ±	0.06	0.11	0.20
CD at 5%	0.20	0.33	0.61

Yield Parameters

5. Number of leaves per Plant

The data enunciated on number of leaves per plant as affected by the inorganic nutrients and biofertilizers at 30, 45 and 60 days after sowing are presented in the Table. 5

The maximum number of leaves per plant was recorded at 30, 45 and 60 DAS in T_9 treatment (T_6 + Arka vegetable special @ 5 g L^{-1}) (13.16, 16.56 and 19.91) while it was minimum in treatment T_4 **(**25% RDF + Azotobacter + PSB + KSB (Each @ 3.75kg ha^{-1}) (6.11, 6.44 and 9.32)

The production of maximum number of leaves might be due to higher metabolic activity because of optimum N supply resulting in higher production of carbohydrates and phytohormones. These results are in line with Sentiyangla *et al*. (2010) [9] who reported significant increase in number of leaves in radish.

Table 4: Effective combination of nutrient application on length of leaf petiole (cm) in spinach beet Cv. Pusa Bharati

Treatments	Length of leaf petiole (cm)		
	15 DAS	30 DAS	45 DAS
T_1 – 100% RDF @ 100:25:50 Kg/ha	4.26	6.87	10.01
T_2 – 75% RDF + Azotobacter + PSB + KSB (Each @ 1.25 kg/ha)	5.28	7.68	11.16
T_3 – 50% RDF + Azotobacter + PSB + KSB (Each @ 2.5 kg/ha)	5.08	7.07	10.59
T_4 – 25% RDF + Azotobacter + PSB + KSB (Each @ 3.75 kg/ha)	3.09	6.00	8.16
T_5 – 75% RDF + AMC @ 2.5 kg/ha + KSB @ 1.25 kg/ha	5.77	8.37	12.00
T_6 – 50% RDF + AMC @ 5 kg/ha + KSB @ 2.5 kg/ha	6.84	9.11	14.30
T_7 – 25% RDF + AMC @ 7.5 kg/ha + KSB @ 3.75 kg/ha	3.59	6.05	8.68
T_8 – T_5 + Arka vegetable special @ 5 g/litre	6.11	8.60	13.01
T_9 – T_6 + Arka vegetable special @ 5 g/litre	7.79	10.00	14.94
T_{10} – T_7 + Arka vegetable special @ 5 g/litre	4.00	6.17	9.52
S.E (m) ±	0.36	0.24	0.14
CD at 5%	1.08	0.72	0.42

6. Leaf weight (g)

The data pertaining to leaf weight of spinach beet as effected by the inorganic and biofertilizers are presented in the Table 6

Among all the treatments, T_9 treatment (T_6 + Arka vegetable special @ 5 g L^{-1}) (19.38 g, 38.76 g and 36.44 g) recorded maximum leaf weight at 30, 45 and 60 DAS whereas minimum leaf weight (14.69 g, 29.38 g and 25.32 g) was observed in T_4 (25% RDF + Biofertilizers [Azotobacter + PSB + KSB] (Each @ 3.75 kg ha^{-1}).

Maximum leaf weight by T_9 at 30, 45 and 60 DAS might be due to availability of nutrients from inorganic N and biofertilizers in adequate quantities which are essential for growth and development. Nitrogen being a constituent of protoplasm and its favourable effect on chlorophyll content of leaves might have resulted in increased synthesis of carbohydrates (Tisdale *et al*., 1993) [13]

Table 5: Effective combination of nutrient application on number of leaves per plant in spinach beet Cv. Pusa Bharati

Treatments	Number of leaves per plant		
	30 DAS	45 DAS	60 DAS
T_1 – 100% RDF @ 100:25:50 Kg/ha	7.01	9.06	12.42
T_2 – 75% RDF + Azotobacter + PSB + KSB (Each @1.25 Kg/ha)	9.11	11.02	14.92
T_3 – 50% RDF + Azotobacter + PSB + KSB (Each @ 2.5 Kg/ha)	8.06	10.39	14.02
T_4 – 25% RDF + Azotobacter + PSB + KSB (Each @ 3.75Kg/ha)	6.11	6.44	9.32
T_5 – 75% RDF + AMC @ 2.5 kg/ha + KSB @ 1.25 kg/ha	10.59	12.64	16.00
T_6 – 50% RDF + AMC @ 5 kg/ha + KSB @ 2.5 kg/ha	12.58	15.05	18.17
T_7 – 25% RDF + AMC @ 7.5 kg/ha + KSB @ 3.75 kg/ha	6.36	7.54	10.06
T_8 – T_5 + Arka vegetable special @ 5 g/litre	11.02	13.82	17.02
T_9 – T_6 + Arka vegetable special @ 5 g/litre	13.16	16.56	19.91
T_{10} – T_7 + Arka vegetable special @ 5 g/litre	6.94	8.23	11.14
S.E (m) ±	0.36	0.39	0.42
CD at 5%	1.08	1.18	1.25

7. Leaf yield per plant (g)

The data pertaining to the leaf yield per plant at 30, 45 and 60 days after sowing were recorded and presented in Table 7

Significantly maximum leaf yield $plant^{-1}$ (41.53 g, 47.65 g and 98.11 g) was recorded in T_9 treatment (T_6 + Arka vegetable special @ 5 g L^{-1}) at 30,45 and 60 DAS whereas, the minimum value (28.00 g, 35.00 g and 82.32 g) was recorded in treatment T_4 (25% RDF + Biofertilizers [Azotobacter + PSB + KSB] (Each @ 3.75 kg ha^{-1})

Highest yield in T_9 treatment might be due to increased vegetative growth, balanced C/N ratio and role of co-enzymes directly or indirectly in regulating various physiological processes within plant, which could have ultimately led to greater yield. All these properties in inorganic nutrients, biofertilizers and micronutrient spray might have led to better root proliferation, better translocation of plant nutrients and accelerated carbohydrate synthesis, finally leading to better leaf yield. Similar results were reported by Stancheva and Mithova (2002) [10] and Tosic *et al*. (2016) [14].

8. Leaf yield (ha^{-1})

Effect of inorganic nutrients and biofertilizers on Leaf yield q ha^{-1} is presented in the Table 8

All the treatments differed significantly with respect to leaf yield per hectare. It was observed that, significantly highest yield was recorded in T_9 treatment (T_6 + Arka vegetable special @ 5 g L^{-1}) (412.75 q ha^{-1}) While, the lowest yield

(235.88 q ha^{-1}) was registered in T_4 (25% RDF + Biofertilizers [Azotobacter + PSB + KSB] (Each @ 3.75 kg ha^{-1}).

The increment of yield might be due to application of inorganic nutrients and biofertilizers *i.e.*, Azotobacter, PSB, KSB and AMC which have enhanced the availability of N and P in soil as major plant nutrients. The yield improvement may be attributed to higher yield attributing components such as increased vegetative and yield parameters which were positively affected by the foliar application of micronutrients as reported by Diana and Nehru (2014) [2].

Table 6: Effective combination of nutrient application on leaf weight (g) in spinach beet Cv. Pusa Bharati

Treatments	Leaf weight (g)		
	30 DAS	**45 DAS**	**60 DAS**
T_1 – 100% RDF @ 100:25:50 Kg/ha	16.59	33.15	28.40
T_2 – 75% RDF + Azotobacter + PSB + KSB (Each @1.25 Kg/ha)	17.61	35.23	31.09
T_3 – 50% RDF + Azotobacter + PSB + KSB (Each @ 2.5 Kg/ha)	17.43	34.86	29.59
T_4 – 25% RDF + Azotobacter + PSB + KSB (Each @ 3.75Kg/ha)	14.69	29.38	25.32
T_5 – 75% RDF + AMC @ 2.5 kg/ha + KSB @ 1.25 kg/ha	18.30	36.61	32.14
T_6 – 50% RDF + AMC @ 5 kg/ha + KSB @ 2.5 kg/ha	18.97	37.94	35.24
T_7 – 25% RDF + AMC @ 7.5 kg/ha + KSB @ 3.75 kg/ha	15.74	31.48	26.13
T_8 – T_5 + Arka vegetable special @ 5 g/litre	18.77	37.55	33.69
T_9 – T_6 + Arka vegetable special @ 5 g/litre	19.38	38.76	36.44
T_{10}– T_7 + Arka vegetable Special @ 5 g/litre	16.29	32.59	27.26
S.E (m) ±	0.17	0.18	0.38
CD at 5%	0.51	0.54	1.13

Table 7: Effective combination of nutrient application on leaf yield $Plant^{-1}$ (g) in spinach beet Cv. Pusa Bharati

Treatments	Leaf yield $plant^{-1}$ (g)		
	30 DAS	**45 DAS**	**60 DAS**
T_1 – 100% RDF @ 100:25:50 kg/ha	31.19	38.36	88.23
T_2 – 75% RDF + Azotobacter + PSB + KSB (Each @1.25 kg/ha)	33.76	41.11	91.62
T_3 – 50% RDF + Azotobacter + PSB + KSB (Each @ 2.5 kg/ha)	32.26	40.02	89.59
T_4 – 25% RDF + Azotobacter + PSB + KSB (Each @ 3.75 kg/ha)	28.00	35.00	82.32
T_5 – 75% RDF + AMC @ 2.5 kg/ha + KSB @ 1.25 kg/ha	35.50	42.51	93.15
T_6 – 50% RDF + AMC @ 5 kg/ha + KSB @ 2.5 kg/ha	38.90	44.21	97.01
T_7 – 25% RDF + AMC @ 7.5 kg/ha + KSB @ 3.75 kg/ha	29.06	36.02	84.83
T_8 – T_5 + Arka vegetable special @ 5 g/litre	36.84	43.65	94.30
T_9 – T_6 + Arka vegetable special @ 5 g/litre	41.53	47.65	98.11
T_{10} – T_7 + Arka vegetable special @ 5 g/litre	30.14	37.12	86.13
S.E (m) ±	0.52	0.36	0.37
CD at 5%	1.56	1.08	1.12

Table 8: Effective combination of nutrient application on leaf yield ha^{-1} (q) in spinach beet Cv. Pusa Bharati

Treatments	1st cut (kg/plot)	2nd cut (kg/plot)	3rd cut (kg/plot)	Total yield (kg/plot)	Total yield (q/ha)
T_1 – 100% RDF @ 100:25:50 kg/ha	4.14	3.94	3.74	11.84	296.19
T_2 – 75% RDF + Azotobacter + PSB + KSB (Each @ 1.25 kg/ha)	4.57	4.43	4.23	13.23	330.75
T_3 – 50% RDF + Azotobacter + PSB + KSB (Each @ 2.5 kg/ha)	4.53	4.17	4.03	12.73	318.25
T_4 – 25% RDF + Azotobacter + PSB + KSB (Each @ 3.75 kg/ha)	3.28	3.14	3.00	9.43	235.88
T_5 – 75% RDF + AMC @ 2.5 kg/ha + KSB @ 1.25 kg/ha	5.07	4.53	4.30	13.90	347.50
T_6 – 50% RDF + AMC @ 5 kg/ha + KSB @ 2.5 kg/ha	5.43	5.07	5.03	15.53	388.25
T_7 – 25% RDF + AMC @ 7.5 kg/ha + KSB @ 3.75 kg/ha	3.74	3.54	3.34	10.62	265.57
T_8 – T_5 + Arka vegetable special @ 5 g/litre	5.23	4.63	4.67	14.53	363.25
T_9 – T_6 + Arka vegetable special @ 5 g/litre	5.77	5.47	5.27	16.51	412.75
T_{10} – T_7 + Arka vegetable special @ 5 g/litre	3.99	3.79	3.59	11.37	284.26
S.E (m) ±	0.07	0.15	0.15	0.28	1.03
CD at 5%	0.20	0.46	0.46	0.89	3.08

Conclusion

In this experiment supplementation of FYM, Azotobacter, PSB, KSB and AMC along with reduced level of inorganic nutrients like urea, SSP and MOP increased the growth and yield of Spinach beet and it is recommended to make integrated use of inorganic 50% RDF, 50% organic (AMC @ 5 kg/ha + KSB @ 2.5 kg/ha) along with micronutrient spray i.e., Arka vegetable special @ 5 g/litre at 15, 30 and 45 days after sowing for spinach beet cultivation.

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