



## Effect of Integrated Nutrient Management Practices on Yield and Quality of Sweet Potato [*Ipomoea batatas* (L.) Lam] cv. Kanjangad

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### Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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### ABSTRACT

The investigation was carried out to study the "Effect of integrated nutrient management practices on yield and quality of sweet potato [*Ipomoea batatas* (L.) Lam] cv. Kanjangad" at Elavuvilai village, Kanyakumari District, Tamil Nadu during Kharif season of 2020. The experiment was laid out in randomized block design with nine treatments replicated thrice. Sweet potato vine cuttings of about 15 cm with 4 nodes were used for the study. The treatments comprised of two levels of recommended dose of fertilizers (RDF - 40:80:120 kg NPK ha<sup>-1</sup>) viz., 50 and 100% along with FYM, poultry manure, gibberellic acid and seaweed extract. The treatments comprised of half dose of nitrogen and full doses of phosphorous and potassium were applied as basal and remaining half dose of nitrogen was applied at 60 days after planting. Organic inputs viz., FYM (25 t, 12.5 t ha<sup>-1</sup>), poultry manure (5 t, 2.5 t ha<sup>-1</sup>) as were applied as basal application, gibberellic acid (200 ppm) and seaweed extract (2%) were applied as foliar application at 40, 55 and 70 days after planting were also used. The observations were recorded at 180 days after planting. The results indicated that the maximum values for yield parameters viz., number of tubers plant<sup>-1</sup> (3.02 g), tuber length (19.02 cm), tuber girth (15.58 cm), tuber weight (138.36 g), tuber dry weight (66.73 g), tuber yield [plant<sup>-1</sup> (417.84 g), plot<sup>-1</sup> (12.18 kg), hectare<sup>-1</sup> (30.45 t)], whereas quality parameters such as total soluble

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solid (9.21<sup>0</sup> Brix) and starch content (12.24%) of tuber, post harvest soil available nutrient (245.00 N; 21.93 P and 278.00 K kg ha<sup>-1</sup>), maximum net income (Rs. 5,16,050) and B: C ratio (3.23) were recorded in the plots which received 50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2% (T<sub>9</sub>). This was followed by (T<sub>6</sub>) 50% RDF+ FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + GA<sub>3</sub> 200 ppm.

**Keywords:** NPK; FYM; poultry manure; gibberellic acid; seaweed extract.

## ABBREVIATIONS

% :	per cent
( ) :	Bracket parenthesis
@ :	At the rate of
[ ] :	Square bracket
= :	is equal to
C.D. :	Critical difference
cm :	Centimeter
cm <sup>2</sup> :	Square centimeter
cv. :	Cultivar
Fig. :	Figure
FYM :	Farmyard manure
G :	gram
GA <sub>3</sub> :	Gibberellic acid
ha <sup>-1</sup> :	per hectare
S.E.M. ± :	Standard error of means
NPK :	Nitrogen, Phosphorus and Potassium
Kg :	Kilogram
No. :	Number
Plant <sup>-1</sup> :	per plant
Plot <sup>-1</sup> :	per plot
PM :	Poultry manure
Ppm :	Parts per million
RDF :	Recommended dose of fertilizers
ha <sup>-1</sup> :	per hectare
vine <sup>-1</sup> :	per vine
t :	tonne
viz. :	Namely

## 1. INTRODUCTION

Tuber crops are tolerant to drought and can be grown even on undulated and unfertile soil. Tropical tuber plays a major role in the improvement of the socioeconomic condition of small and marginal farmers of tribal area in context of food and nutritional security [1].

Sweet potato [*Ipomoea batatas* (L.) Lam] is also known as Irish potato or white potato. It is native of South America. It is also known as a famine relief crop as it had played a pivotal role in alleviating the Bengal famine during 1942. In India, Uttar Pradesh, Bihar, Tamil Nadu, Odisha, Kerala, Karnataka, West Bengal, Madhya Pradesh, Assam, Maharashtra and Gujarat are the leading states for sweet potato cultivation [1].

The total area under sweet potato cultivation in India is about 0.13 million ha, whereas the productivity is 1638.84 metric tonnes [2]. Asia is the largest producer of sweet potato having 92% of production and 80% of area in the world. China and India are the leading sweet potato growing countries in the world.

The integrated nutrient supply includes the use of chemical fertilizers with organic sources along with biofertilizers helps not only in bridging the existing wide gap between nutrient removal and addition, but also in ensuring balanced nutrient proportion, enhancing nutrient response efficiency add in maximizing crop productivity of desired quality [3]. The package of practices for integrated nutrient management practices of sweet potato need to be standardized to increase its tuber yield.

According to, [4] combined application of FYM @ 10 t ha<sup>-1</sup> + 50:25:50 NPK kg ha<sup>-1</sup> recorded the highest tuber yield. Similarly, [5] reported that treatment combined with FYM @ 10 t ha<sup>-1</sup> + NPK @ 80:60:100 kg ha<sup>-1</sup> resulted in higher yield, the treatment combination with NPK + foliar spray of seaweed had the maximum yield and quality of sweet potato [6]. Similarly, [7] reported that tuber root yield and its components were significantly enhanced with the application of NPK fertilizer, in combination with spraying seaweed. The treatment with 2.5 t ha<sup>-1</sup> poultry manure + 200 kg NPK ha<sup>-1</sup> had resulted highest yield [8]. Similarly, [9] reported combined application of 3 t poultry manure + 100 kg NPK ha<sup>-1</sup> produced highest tuber yield, tuber length and diameter, and also had the highest percentage of marketable tubers.

Sweet potato thrives well in organic manure; there is sufficient scope for organic production in tuber crops. Organic manures were considered valuable, but it was clear that they were not available in adequate amounts to increase food production significantly. Recent study has shown that the root yield and quality of sweet potato improves with the use of inorganic fertilizers. The best solution was to optimize the use of agricultural waste combined with chemical and

biofertilizers in the form of optimize practices. Also, the use of inorganic fertilizers in combination with organic manure is necessary in order to achieve a safe and productive sweet potato yield and quality. Hence an attempt was made to increase the efficiency of organic and inorganic fertilizers.

Therefore in the present investigation role of different organic and inorganic fertilizers on the yield and quality parameters of sweet potato [*Ipomoea batatas* (L.) Lam] cv. Kanjangad were studied.

## 2. MATERIALS AND METHODS

A one year field experiment was carried out at the farmer field of Elavuvilai village, Kanyakumari district, Tamil Nadu during Kharif, 2020. The trial was laid out in randomized block design with 9 treatments replicated thrice by using the cultivar Kanjangad. The experimental field was ploughed thoroughly to break the clods and weeds and stubbles were removed and brought to fine tilth. Then the land was converted into small plots, each measuring the spacing of 2m x 2m. Vine cuttings were planted by keeping approximately two nodes beneath the soil surface and two nodes above the soil surface with of spacing 60 cm x 20 cm.

The details of the treatment and the dosage of the organic and inorganic fertilizers were followed as per the protocol. Organic and inorganic fertilizers were applied in the form of NPK, FYM, poultry manure, gibberellic acid and seaweed extract. NPK was applied in the form of urea, single super phosphate and muriate of potash. The half recommended dose of nitrogen and full doses of phosphorous and potassium were applied as basal and remaining half dose nitrogen was applied at 60 days after planting. Organic inputs viz., FYM (25 t, 12.5 t ha<sup>-1</sup>), poultry manure (5 t, 2.5 t ha<sup>-1</sup>) were applied as basal application, gibberellic acid (200 ppm) and seaweed extract (2%) were applied as foliar application at 40, 55 and 70 days after planting were also used.

The observations on different yield parameters such number of tubers plant<sup>-1</sup>, tuber length, tuber girth, tuber weight, tuber dry weight, tuber yield (plant<sup>-1</sup> plot<sup>-1</sup>, hectare<sup>-1</sup>), whereas quality parameters such as total soluble solid and starch content of tuber were recorded after the harvest. Five plants were randomly selected from each plot and tagged in each replication and the mean

value was calculated for yield and quality parameters. The data recorded were subjected to statistical analysis by adopting the standard procedure [10].

## 3. RESULTS AND DISCUSSION

The experiment was laid out during *kharif*, 2020 at the farmer field of Elavuvilai village, Kanyakumari district, Tamil Nadu to assess the role of integrated nutrient management practices on yield and quality of sweet potato [*Ipomoea batatas* (L.) Lam] cv. Kanjangad. The data result of the field experimental yield components has been presented in (Table 2) and (Fig. 1).

### 3.1 Yield Parameters Affected by Integrated Nutrient Management Practices

#### 3.1.1 Number of tubers plant<sup>-1</sup>

The maximum values for number of tubers plant<sup>-1</sup> was recorded under treatment T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) registered with the value of 3.02. However, treatment such as T<sub>4</sub>, T<sub>5</sub> and T<sub>7</sub>, T<sub>8</sub> were statistically on par with each other. The present study involves that comparison of treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with control T<sub>1</sub> (RDF 100% + FYM 25 t ha<sup>-1</sup>) revealed that T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the other treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>6</sub>) and the control (T<sub>1</sub>- 2.74).

#### 3.1.2 Tuber length (cm)

The maximum values for tuber length was recorded under treatment T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) registered with the value of 19.02 cm. The present study involves that comparison of treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with control T<sub>1</sub> (RDF 100% + FYM 25 t ha<sup>-1</sup>) revealed that T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the other treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>) and the control (T<sub>1</sub>- 17.36 cm).

#### 3.1.3 Tuber girth (cm)

The maximum values for tuber girth was recorded under treatment T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> +

Seaweed extract 2%) registered with the value of 15.58 cm. The present study involves that comparison of treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with control T<sub>1</sub> (RDF 100% + FYM 25 t ha<sup>-1</sup>) revealed that T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the other treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>) and the control (T<sub>1</sub> - 14.24 cm).

### 3.1.4 Tuber weight (g)

The maximum values for tuber weight was recorded in T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) registered with the value of 138.36 g. The present study includes comparison of treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with T<sub>1</sub> (RDF 100% + FYM 25 t ha<sup>-1</sup>) revealed that T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the other treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>) and the control (T<sub>1</sub> - 126.70 g)

### 3.1.5 Tuber dry weight (g)

The maximum value for tuber dry weight was recorded in T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry Manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) registered with the value of 66.73 g. The present study includes comparison of treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with T<sub>1</sub> (RDF 100% + FYM 25 t ha<sup>-1</sup>) revealed that T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the other treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>) and the control (T<sub>1</sub> - 55.93 g).

### 3.1.6 Tuber yield plant<sup>-1</sup> (g)

The maximum value for tubers yield plant<sup>-1</sup> was recorded in T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry Manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) registered with the value of 417.84 g. The present study includes comparison of treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with T<sub>1</sub> (100% RDF + FYM 25 t ha<sup>-1</sup>) revealed that T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the other treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>) and the control (T<sub>1</sub> - 347.15 g).

### 3.1.7 Tuber yield plot<sup>-1</sup> (kg)

The maximum value for tubers yield plot<sup>-1</sup> was recorded in T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> +

Poultry Manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) registered with the value of 12.18 kg. The present study involves that comparison treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with T<sub>1</sub> (RDF 100% + FYM 25 t ha<sup>-1</sup>) revealed that T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>) and the control (T<sub>1</sub> - 10.42 kg).

### 3.1.8 Tuber yield hectare<sup>-1</sup> (t)

The maximum value for tuber yield hectare<sup>-1</sup> was recorded in T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry Manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) registered with the value of 30.45 t. The present study involves that comparison treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with T<sub>1</sub> (RDF 100% + FYM 25 t ha<sup>-1</sup>) revealed that T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>) and the control (T<sub>1</sub> - 26.05 t).

## 3.2 Quality Parameters Affected by Integrated Nutrient Management Practices

The data result of the field experiment of quality parameters has been presented in (Table 3).

### 3.2.1 Total Soluble Solid (° Brix)

The maximum value for total soluble solid was recorded in T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry Manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) registered with the value of 9.21 °Brix. However, treatment such as T<sub>4</sub>, T<sub>5</sub> and T<sub>7</sub>, T<sub>8</sub> were statistically on par with each other. The present study involves that comparison treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with control T<sub>1</sub> (RDF 100% + FYM 25 t ha<sup>-1</sup>) revealed that the treatment T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the other treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>6</sub>) and the control T<sub>1</sub> - 8.49 °Brix.

### 3.2.2 Starch content (%)

The maximum value for starch content was recorded in T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry Manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) registered with the value of 12.24%. However, treatment such as T<sub>4</sub>, T<sub>5</sub> and T<sub>7</sub>, T<sub>8</sub> were

statistically on par with each other. The present study involves that comparison treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with control T<sub>1</sub> (RDF 100% + FYM 25 t ha<sup>-1</sup>) revealed that the treatment T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the other treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>6</sub>) and the control T<sub>1</sub> - 11.18%.

**Table 1. Nutrient content of the organic inputs used in the experimental study**

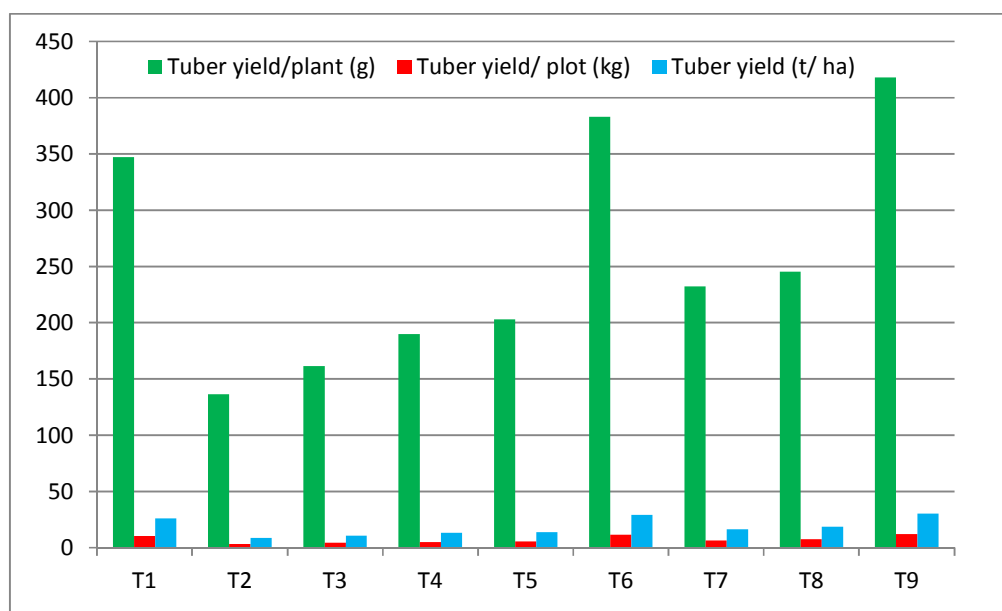
Organic inputs	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Na (%)	Zn (ppm)	Cu (ppm)	Mn (ppm)
FYM [11]	0.5	0.2	0.5	0.11	-	-	-	-	-
Poultry manure [11]	3.03	2.63	1.4	-	-	-	-	-	-
Seaweed extract [12]	0.18	0.48	1.89	0.11	0.01	0.13	11.87	15.62	13.12

**Table 2. Effect of integrated nutrient management practices on yield parameters of sweet potato [*Ipomoea batatas* (L.) Lam] cv. Kanjangad**

Treatments	Numbers of tubers (Plant <sup>-1</sup> )	Tuber length (cm)	Tuber girth (cm)	Tuber weight (g)	Tuber dry weight (g)
T <sub>1</sub> - 100% RDF + FYM 25 t ha <sup>-1</sup>	2.74	17.36	14.24	126.70	55.93
T <sub>2</sub> - 50% RDF + FYM 25 t ha <sup>-1</sup>	1.49	12.18	10.02	91.52	29.01
T <sub>3</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> )	1.66	13.07	10.75	97.40	32.93
T <sub>4</sub> - 50% RDF + FYM (25 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	1.84	13.94	11.47	103.00	36.97
T <sub>5</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	1.86	14.82	12.17	109.16	41.44
T <sub>6</sub> - 50% RDF+ FYM (12.5 t ha <sup>-1</sup> ) + Poultry manure (2.5 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	2.89	18.20	14.92	132.54	61.23
T <sub>7</sub> - 50% RDF+ FYM (25 t ha <sup>-1</sup> ) + Seaweed extract (2%)	2.02	15.68	12.88	115.01	46.06
T <sub>8</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> ) + Seaweed extract (2%)	2.03	16.53	13.57	120.87	50.89
T <sub>9</sub> - 50% RDF + FYM (12.5 t ha <sup>-1</sup> ) + Poultry manure (2.5 t ha <sup>-1</sup> ) + Seaweed extract (2%)	3.02	19.02	15.58	138.36	66.73
S.E.M. ±	0.03	0.20	0.17	1.52	0.65
C.D. (P = 0.05)	0.09	0.62	0.51	4.59	1.96

**Table 3. Effect of integrated nutrient management practices on quality attributes of sweet potato [*Ipomoea batatas* (L.) Lam] cv. Kanjangad**

Treatments	Total soluble solid (°Brix)	Starch content (%)
T <sub>1</sub> - 100% RDF + FYM 25 t ha <sup>-1</sup>	8.49	11.18
T <sub>2</sub> - 50% RDF + FYM 25 t ha <sup>-1</sup>	6.88	8.89
T <sub>3</sub> - 50% RDF + Poultry manure (5t ha <sup>-1</sup> )	7.26	9.46
T <sub>4</sub> - 50% RDF + FYM (25 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	7.31	10.01
T <sub>5</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	7.72	10.06
T <sub>6</sub> - 50% RDF+ FYM (12.5 t ha <sup>-1</sup> ) + Poultry manure (2.5 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	8.86	11.72
T <sub>7</sub> - 50% RDF+ FYM (25 t ha <sup>-1</sup> ) + Seaweed extract (2%)	8.11	10.62
T <sub>8</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> ) + Seaweed extract (2%)	8.13	10.65
T <sub>9</sub> - 50% RDF + FYM (12.5 t ha <sup>-1</sup> ) + Poultry manure (2.5 t ha <sup>-1</sup> ) + Seaweed extract (2%)	9.21	12.24
S.E.M. ±	0.10	0.14
C.D. (P = 0.05)	0.32	0.42



#### Treatment Details

**Fig. 1. Effect of integrated nutrient management practices on tuber yield (plant<sup>-1</sup>, Plot<sup>-1</sup> and hectare<sup>-1</sup>) of sweet potato [*Ipomoea batatas* (L.) Lam] cv. Kanjangad**

### 3.3 Soil chemical properties affected by integrated nutrient management practices

The chemical properties of post-harvest soil of the experimental field were presented in Table 4. The data of the results revealed that there were increases in the soil chemical properties in post harvest soil. The available N, P and K were

slightly increased from (150.52 N; 11.64 P and 163.47 K kg ha<sup>-1</sup> of pre-harvest soil) to (245.00 N; 21.93 P and 278.00 K kg ha<sup>-1</sup>) in T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry Manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>) and the control (T<sub>1</sub> - 224.38 N; 20.05 P and 254.62 K kg ha<sup>-1</sup>).

**Table 4. Effect of integrated nutrient management practices on post harvest soil available NPK nutrient (kg ha<sup>-1</sup>) in sweet potato [*Ipomoea batatas* (L.) Lam] cv. Kanjangad**

Treatments	N (kg ha <sup>-1</sup> )	P (kg ha <sup>-1</sup> )	K (kg ha <sup>-1</sup> )
T <sub>1</sub> - 100% RDF + FYM 25 t ha <sup>-1</sup>	224.38	20.05	254.62
T <sub>2</sub> - 50% RDF + FYM 25 t ha <sup>-1</sup>	171.32	15.01	184.27
T <sub>3</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> )	172.68	15.21	196.03
T <sub>4</sub> - 50% RDF + FYM (25 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	183.08	16.20	207.77
T <sub>5</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	193.40	17.17	219.49
T <sub>6</sub> - 50% RDF+ FYM (12.5 t ha <sup>-1</sup> ) + Poultry manure (2.5 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	234.70	21.00	266.32
T <sub>7</sub> - 50% RDF+ FYM (25 t ha <sup>-1</sup> ) + Seaweed extract (2%)	203.73	18.15	231.22
T <sub>8</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> ) + Seaweed extract (2%)	214.07	19.11	242.93
T <sub>9</sub> - 50% RDF + FYM (12.5 t ha <sup>-1</sup> ) + Poultry manure (2.5 t ha <sup>-1</sup> ) + Seaweed extract (2%)	245.00	21.93	278.00
S.E.M. ±	2.70	0.24	3.08
C.D. (P = 0.05)	8.11	0.72	9.23

**Table 5. Effect of integrated nutrient management practices on Benefit Cost Ratio in sweet potato [*Ipomoea batatas* (L.) Lam] cv. Kanjangad**

Treatments	Cost of cultivation (Rs. ha <sup>-1</sup> )	Gross income (Rs. ha <sup>-1</sup> )	Net income (Rs. ha <sup>-1</sup> )	B:C Ratio
T <sub>1</sub> – 100% RDF + FYM 25 t ha <sup>-1</sup>	2,31,041	6,51,250	4,20,209	2.81
T <sub>2</sub> - 50% RDF + FYM 25 t ha <sup>-1</sup>	1,91,200	2,13,750	22,550	1.11
T <sub>3</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> )	2,01,567	2,69,250	67,683	1.33
T <sub>4</sub> - 50% RDF + FYM (25 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	2,13,210	3,30,500	1,17,290	1.55
T <sub>5</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	2,15,041	3,53,000	1,37,959	1.64
T <sub>6</sub> - 50%RDF+ FYM (12.5 t ha <sup>-1</sup> ) + Poultry manure (2.5 t ha <sup>-1</sup> ) + GA <sub>3</sub> 200 ppm	2,34,241	4,67,500	4,96,259	3.11
T <sub>7</sub> - 50% RDF+ FYM (25 t ha <sup>-1</sup> ) + Seaweed extract (2%)	2,27,021	4,08,000	1,80,979	1.79
T <sub>8</sub> - 50% RDF + Poultry manure (5 t ha <sup>-1</sup> ) + Seaweed extract (2%)	2,29,021	4,67,500	2,38,479	2.04
T <sub>9</sub> - 50% RDF + FYM (12.5 t ha <sup>-1</sup> ) + Poultry manure (2.5 t ha <sup>-1</sup> ) + Seaweed extract (2%)	2,45,200	7,61,250	5,16,050	3.23
S.E.M. ±	-	-	-	0.02
C.D. (P = 0.05)	-	-	-	0.08

### 3.4 Benefit Cost Ratio Affected by Integrated Nutrient Management Practices

Among the 9 treatments, the maximum net income (Rs. 5,16,050) and B: C ratio (3.23) were recorded in T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry Manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) in Table 5. The present study involves that comparison treatments involving different inorganic and organic manures such as T<sub>2</sub> to T<sub>9</sub> with T<sub>1</sub> (RDF 100% + FYM 25 t ha<sup>-1</sup>) revealed that T<sub>9</sub> (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%) was superior among the treatments (T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>) and net income (Rs. 4,20,209) and B: C ratio (2.81) were recorded in the control (T<sub>1</sub>).

## 4. DISCUSSION

The yield attributes viz. number of tubers plant<sup>-1</sup>, tuber length, girth, tuber weight, tuber dry weight and yield (plant<sup>-1</sup>, plot<sup>-1</sup> and hectare<sup>-1</sup>) were significantly affected by the application of various inorganic and organic inputs.

From the results of the present study that maximum values for number of tubers plant<sup>-1</sup> were recorded in (T<sub>9</sub>) 50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5t ha<sup>-1</sup> + Seaweed

extract 2%, while the least values were recorded in T<sub>2</sub> (50% RDF + FYM 25 t ha<sup>-1</sup>). The present results are in conformation with the findings of [13] in sweet potato, [14] in potato.

There were clear evidence that nutrients from both organic and inorganic fertilizers were a major component for sweet potato production. Application of organic and inorganic fertilizers produces the highest yield and quality. The application of nitrogen enhances higher foliage development and cell division which ultimately led to accumulation of adequate quantity of photosynthate and their partitioning in the formation of more number of tuber initiation; whereas, phosphorus enhances the cell division, root development, tuber formation and the application of potassium also favours translocation of photosynthates and increases the tuber yield [15]. Similar findings reported by [16] and [17].

Organic matters supplied in the form of FYM improves the bulk density, porosity and makes the soil light and friable which favours the underground root formation [18].

Poultry manure that increased the nitrogen constituent in cell sap of the meristamatic tissue ensuring enhanced vegetative growth and

accumulate more carbohydrate for increased root size [19]. Similar results are in accordance with the findings of [20] in radish. Further, the application of poultry manure increased the yield characters by providing more nutrients to the plant; which uptake the nutrients to the upper parts of the plants and prepared the food materials that supplied to plant parts and increased the root development [21].

Seaweed extract application led to increases in root growth which can be ascribed to alginate oligosaccharide induced expression of an auxin related gene leading to higher auxin concentrations, thus promoting root formation and elongation. Moreover, it could also be associated with seaweed extract modified absorption and localization of auxin and cytokinins that initiates lateral and adventitious root development along with heavier root biomass [22].

Application of 50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5t ha<sup>-1</sup> + Seaweed extract 2% (T<sub>9</sub>) recorded the maximum values for quality parameters in tubers which was followed by 50% RDF+ FYM (12.5 t ha<sup>-1</sup>) + Poultry manure (2.5 t ha<sup>-1</sup>) + GA<sub>3</sub> 200 ppm (T<sub>6</sub>). The least values were recorded in 50% RDF + FYM 25 t ha<sup>-1</sup> (T<sub>2</sub>). These results are in conformity with the findings of [23] in potato and [24] in carrot.

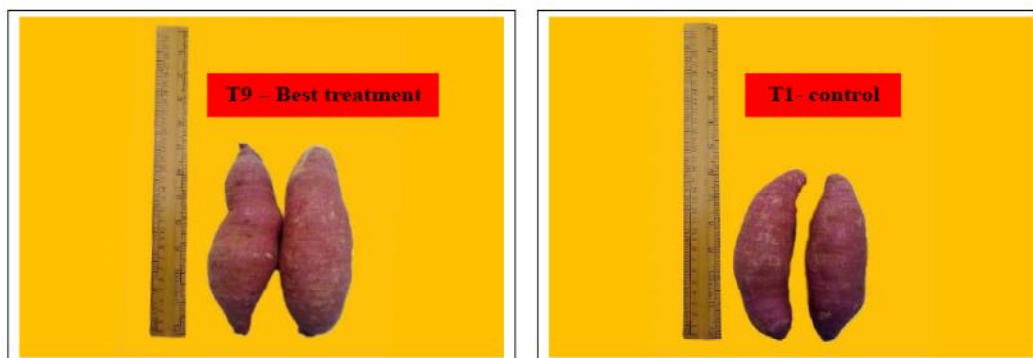
Increased in quality parameters might be due to the presence of sufficient quantities of inorganic fertilizers and more quantities of organic manures increased the more carbohydrates production which resulted in improved physiological and biochemical activities of plant system [25]. Similar results have been noticed by [26] in carrot. Application of inorganic and

organic manure increased in above quality parameter in tubers which might be due to better nutritional availability in the root zone of the crop resulting from its solubilization of organic matter and chelation of available nutrients. It might also be due to the increased activity of nitrate reductase enzyme and enhanced synthesis of certain quality attributes [27].

The maximum available NPK nutrient content in post harvest soil was recorded with application of 50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5t ha<sup>-1</sup> + Seaweed extract 2% (T<sub>9</sub>) which was followed by 50% RDF + FYM (12.5 t ha<sup>-1</sup>) + Poultry manure (2.5 t ha<sup>-1</sup>) + GA<sub>3</sub> 200 ppm (T<sub>6</sub>). The least values were recorded in 50% RDF + FYM 25 t ha<sup>-1</sup> (T<sub>2</sub>). These results are in conformity with the finding of [28] in sweet potato.

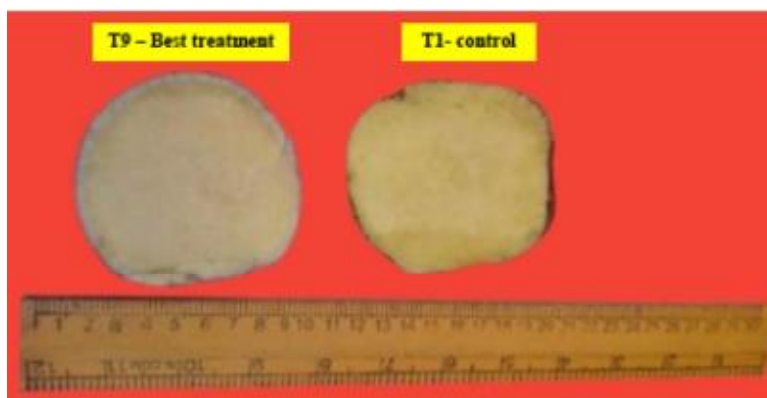
Application of essential nutrients in adequate amount through fertilizer helps in crop growth and also enhances the availability of nutrients in the soil. Generally the availability of nutrient in soil increases with increasing fertilizer levels and might also be due to decomposition of organic matter and mineralization of nutrients [29]. Similar finding was reported by [30] in sweet potato and [31] in potato.

The highest benefit cost ratio in present study showed that the application of 50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5t ha<sup>-1</sup> + Seaweed extract 2% (T<sub>9</sub>) recorded which was followed by application of 50% RDF+ FYM (12.5 t ha<sup>-1</sup>) + Poultry manure (2.5 t ha<sup>-1</sup>) + GA<sub>3</sub> 200 ppm (T<sub>6</sub>). The highest benefit cost ratio may be due to the application of different inorganic and organic manures in increasing the yield attributes, which results in higher net returns.



**Plate 1. Comparison of best treatment with control**  
 T<sub>9</sub> - (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2);  
 T<sub>1</sub> - (RDF 100% + FYM 25 t ha<sup>-1</sup>)





**Plate 2. Tuber cross section comparison of best treatment with control**  
 $T_9$  - (50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2%);  
 $T_1$  - (RDF 100% + FYM 25 t ha<sup>-1</sup>)

## 5. CONCLUSION

Based on the findings of the present investigation, it can be concluded that the combined application of 50% RDF + FYM 12.5 t ha<sup>-1</sup> + Poultry manure 2.5 t ha<sup>-1</sup> + Seaweed extract 2% ( $T_9$ ) can be considered as best inorganic and organic combination to obtain maximum yield and good quality tubers from sweet potato in economically profitable manner, whereas ( $T_2$ ) 50% RDF + FYM 25 t ha<sup>-1</sup> obtain minimum yield and quality of sweet potato tubers. However, application of inorganic and organic manures increase the yield of the sweet potato crop, maintain the quality of plant and also better improvement in the nutrient availability which gives the sustainable yield.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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