



## Response of Organic Manures, Inorganic Fertilizers and Bio-fertilizers on Qualitative and Quantitative Parameters of Onion (*Allium cepa* L.)

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### Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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### ABSTRACT

**Aims:** To find out the response of combined use of organic, inorganic and bio-fertilizers of nutrients on quality of small onion *Aggregatum* cv. Thengaithittu.

**Study Design:** The experiment was laid out in randomized block design 9 treatment combinations with three replications.

**Place and Duration of Study:** The experiment was conducted for two seasons at Adhiparasakthi Horticultural College farm situated at 12°15'N and 78° 20'E longitude, Vellore, Tamil Nadu, India during the year 2014-2015.

**Methodology:** The treatments comprised of organic manures, inorganic fertilizer and bio-fertilizers with nine treatments viz., T<sub>1</sub>: NPK (60:60:30 kg/ha.), T<sub>2</sub>: Farm yard manure (FYM) (25t/ha.), T<sub>3</sub>: FYM (25t/ha.) + NPK (60:60:30 kg/ha.), T<sub>4</sub>: FYM (25t/ha.) +Azospirillum (2kg/ha.)+ NPK (30:30:15 kg/ha.), T<sub>5</sub>: FYM (25t/ha.) + Phosphobacteria (2kg/ha.) +NPK (60:30:30 kg/ha.), T<sub>6</sub>: FYM (25t/ha.) + Azospirillum (2kg/ha.) + Phosphobacteria (2kg/ha.) +NPK (30:30:15 kg/ha.), T<sub>7</sub>: FYM (25t/ha.)+NPK (60:60:30 kg/ha.) + gypsum (50kg/ha.), T<sub>8</sub>: FYM (25t/ha.) + Azospirillum (2kg/ha.) + Phosphobacteria (2kg/ha.) +NPK (30:30:15 kg/ha.) +gypsum (50 kg/ha.) and T<sub>9</sub>: FYM (25 kg/ha.) + gypsum (50 kg/ha.).

**Results:** The combined application of N, P, K, FYM, Azospirillum, phosphobacteria and gypsum significantly influenced the total soluble solids (15.77B°), ascorbic acid (14.76 mg/100g) and total sugars (14.72%) contents. The combined application of organic manures, inorganic and bio-fertilizers may be recommended to farmers to get good quality onion.

*Keywords: Bio-fertilizers; Inorganic fertilizers; Onion; Organic manures; Quality.*

## 1. INTRODUCTION

Onion (*Allium cepa* L.) is an important bulbous vegetable and cash crop cultivated in India. India occupies the prestigious second largest area in the world and famous for their pungency. This onion crop harvested in India two times (January to May and November to January). Many reports have indicated that onions have a wide range of beneficial properties for human health, such as polyphenols, flavonoids, and antioxidants as well as carbohydrates and sugar [1]. The important inorganic constituent like phosphorus and calcium are rich in Indian onion and used for various culinary purposes [2]. The spicy (flavor) nature of onion is due to the presence of sulphur compounds and quercetin compound responsible for colour of the outer skin of onion.

The application fertilizers like farmyard manure helped in the growth and nutrient content in the onion crops and also improves physical, chemical and biological properties of the soil. This enhance the availability nutrients to the plants and nitrogen absorption is more and the synthesise of chlorophylls and carotenoids is also increased [1]. The introduction of various fertilizers (organic, synthetic and bio inoculants) in the onion field had great significant responses towards onion root and also quality of onion. The main objective of this investigation was to study the response of organic manures, inorganic fertilizers and bio-fertilizers on the content of quantitative and qualitative parameters of onion.

## 2. MATERIALS AND METHODS

The experiment was conducted at Adhiparasakthi Horticultural College farm situated at 12°15'N and 78° 20'E longitude, Vellore, Tamil Nadu, India. The experiment was conducted for two seasons (Rabi and summer) to find out the effect of combined use of organic, inorganic and bio-fertilizers of nutrients on quality of small onion *Aggregatum* cv. Thengaithittu. The soil of the experimental field was red loam and clay loam in texture and having pH of 6.1 to 7.0, low amount of, organic matter, nitrogen, phosphorus and potassium. The experiment was

laid out in randomized block design with three replications. The treatments comprised of organic, inorganic fertilizer and bio-fertilizers with nine treatments (Table 1).

The treatments of organic manure, chemical fertilizers and bio-fertilizers were applied as per treatment in respective plot. FYM was incorporated in the soil after the formation of individual plots according to the treatments. The uniform basal application of potassium was applied at the rate of 30kg/ha. The entire phosphorus as per treatment was applied basally at planting. Nitrogen was applied in two equal split doses as per treatments. The first dose was applied basally at planting followed by top dressing at 30 days after transplanting. The bio-fertilizers were mixed with FYM of ten times of their volume and incorporated into the soil at the rate of 2 kg/ha. depending upon the treatments. The fertilizers were weighed separately for each treatment and mixed thoroughly with the respective treatments and applied in bands on the side of the ridges of the experimental plots and incorporated in the soil with hand hoe.

The seed of onion variety Thengaithittu was raised in the nursery of 1.5 m length, 1.0 m width and 15 cm height was prepared. The seed rate is 8 kg/ha. The seeds were sown at 1cm depth in the rows and covered with thin layer of sand and then covered with dry grass mulch. The seed bed was watered daily during evening hours. The seedling of 45 days old (uniform size) were transplanted with a spacing of 10 x 15 cm. The seedlings were transplanted and harvesting of onion was done on 90 days after transplanting.

### 2.1 Quality Analysis

The total soluble solids of bulbs in each treatment were read through automatic hand refractometer and expressed in degree brix. The ascorbic acid content was determined as per AOAC (1970) [3] method and expressed as mg/100 g of fresh sample. The total sugars were estimated following the calorimetric method as per Somogyi (1952) and expressed in percentage. The obtained experiments results

were statistically analyzed for arriving the conclusions [4].

### 3. RESULTS AND DISCUSSION

#### 3.1 Total Soluble Solids (TSS)

In general, all the chemical constituents studied were increased by organic, inorganic and bio-fertilizers as compared to control. The combined application of organic, inorganic and bio-fertilizers were highly effective than other treatments. The data on TSS at harvesting stage under the influence of different levels of N, P, K, FYM, Azospirillum, Phosphobacteria and gypsum for two different seasons are presented in Table 2. In Rabi season, the results showed that different treatments significantly influenced the TSS which ranged from 11.68 to 15.30°B. The maximum content of TSS was recorded in the treatment T<sub>8</sub> (15.30°B), it was on par with treatment T<sub>6</sub> (14.82°B) whereas the lowest in (11.68 °B) treatment T<sub>2</sub>.

In summer season, the TSS of various treatments showed statistically significant differences. The TSS ranged from 10.44 to 14.24°B. Among various treatment, the highest content of TSS was recorded in T<sub>8</sub> (14.24°B) and it was on par with treatment T<sub>6</sub> (13.64°B). The least amount of TSS was obtained in the treatment T<sub>2</sub> (10.44°B). In pooled data, significant differences among various treatments were observed. The highest content of TSS was recorded in T<sub>8</sub> (14.77°B) which was on par with T<sub>6</sub> (14.23°B) and lowest value was obtained in T<sub>2</sub>(11.06°B).

#### 3.2 Ascorbic Acid

The data on ascorbic acid at harvesting stage under influence of various treatment levels of organic manure, inorganic fertilizers and bio-

fertilizers for rabi and summer seasons are presented in Table 3. The concentration vitamin C in onion is improved by the presence of organic manures which involves oxidize enzyme activity [2]. The ascorbic acid content was significantly influenced by various treatments in rabi and summer seasons. It ranged from 10.63 to 14.76 and 9.34 to 12.80 mg/100g of fresh bulbs for rabi and summer season, respectively. The maximum ascorbic acid content (14.76 and 12.86 mg/100 g) was found with treatment T<sub>8</sub>, while the minimum ascorbic acid content (10.63 and 9.34 mg/100 g) was observed in treatment T<sub>2</sub> for rabi and summer seasons, respectively. Pooled data recorded significant difference among the various treatments. Among them, the highest of ascorbic acid was recorded in T<sub>8</sub> (13.81 mg/100g) which was followed by T<sub>6</sub> (13.30 mg/100g) and least content of ascorbic acid was recorded in T<sub>2</sub> (9.99mg/100g).

#### 3.3 Total Sugars

The data on total sugars at harvesting stage of onion bulb under the influence of organic, inorganic and bio-fertilizers for rabi and summer seasons were presented in Table 4. The overall total sugar content ranged from 11.04 to 14.72 and 9.43 to 12.64% for rabi and summer seasons, respectively. The maximum total sugar (14.72 and 12.64% for rabi and summer season respectively) was found under treatment T<sub>8</sub> followed by T<sub>6</sub> with the concentration of 14.28 and 12.28% for rabi and summer season, respectively. The minimum total sugar (11.04 and 9.43%) was found under treatment T<sub>2</sub> for their respective seasons. Pooled data recorded significant differences among various treatments with the maximum content of 13.68% in T<sub>8</sub> which was on par with T<sub>6</sub> (13.28%) and lowest content was registered in T<sub>3</sub> with the concentration of 10.23%.

**Table 1. Treatment details**

Treatment details	
T <sub>1</sub>	NPK (60:60:30 kg/ha.) Control
T <sub>2</sub>	Farm yard manure (FYM) (25t/ha.)
T <sub>3</sub>	FYM (25t/ha.) + NPK (60:60:30 kg/ha.)
T <sub>4</sub>	FYM (25t/ha.) +Azospirillum (2kg/ha.)+ NPK (30:30:15 kg/ha.)
T <sub>5</sub>	FYM (25t/ha.) + Phosphobacteria (2kg/ha.) +NPK (60:30:30 kg/ha.)
T <sub>6</sub>	FYM (25t/ha.) + Azospirillum (2kg/ha.) + Phosphobacteria (2kg/ha.) +NPK (30:30:15 kg/ha.)
T <sub>7</sub>	FYM (25t/ha.)+NPK (60:60:30 kg/ha.) + gypsum (50kg/ha.)
T <sub>8</sub>	FYM (25t/ha.) + Azospirillum (2kg/ha.) + Phosphobacteria (2kg/ha.) +NPK (30:30:15 kg/ha.) +gypsum (50 kg/ha.)
T <sub>9</sub>	FYM (25 kg/ha) + gypsum (50 kg/ha).

**Table 2. Effect of organic, inorganic and bio-fertilizers on total soluble solids in small onion**

Treatments	Total soluble solids (Brix)		
	Rabi season	Summer season	Pooled data*
T <sub>1</sub>	12.66	10.64	11.65
T <sub>2</sub>	11.68	10.44	11.06
T <sub>3</sub>	12.94	11.86	12.40
T <sub>4</sub>	14.33	13.22	13.77
T <sub>5</sub>	13.56	12.08	12.82
T <sub>6</sub>	14.82	13.64	14.23
T <sub>7</sub>	12.76	11.28	12.02
T <sub>8</sub>	15.30	14.24	14.77
T <sub>9</sub>	12.32	11.12	11.72
Mean	13.37	12.06	12.72
SEd	0.51	0.38	0.28
CD (0.05)	1.05	0.78	0.57

\*pooled data of the experiment carried out in rabi and summer season

**Table 3. Effect of organic, inorganic and bio-fertilizers on ascorbic acid content in small onion**

Treatments	Ascorbic acid (mg/100g)		
	Rabi season	Summer season	Pooled data*
T <sub>1</sub>	11.89	10.14	11.02
T <sub>2</sub>	10.63	9.34	9.99
T <sub>3</sub>	12.97	10.68	11.83
T <sub>4</sub>	14.06	11.90	12.98
T <sub>5</sub>	13.74	12.62	13.18
T <sub>6</sub>	14.37	12.22	13.36
T <sub>7</sub>	12.84	10.36	11.60
T <sub>8</sub>	14.76	12.86	13.81
T <sub>9</sub>	10.96	9.73	10.35
Mean	12.91	11.09	12.00
SEd	0.42	0.36	0.27
CD (0.05)	0.85	0.78	0.54

\*pooled data of the experiment carried out in rabi and summer season

**Table 4. Effect of organic, inorganic and bio-fertilizers on total sugars in small onion**

Treatments	Total sugars (%)		
	Rabi season	Summer season	Pooled data*
T <sub>1</sub>	12.32	10.46	11.39
T <sub>2</sub>	11.04	9.43	10.23
T <sub>3</sub>	12.42	11.72	12.07
T <sub>4</sub>	13.62	12.04	12.83
T <sub>5</sub>	13.40	11.82	12.61
T <sub>6</sub>	14.28	12.28	13.28
T <sub>7</sub>	12.64	10.08	11.36
T <sub>8</sub>	14.72	12.64	13.68
T <sub>9</sub>	11.12	10.86	10.99
Mean	12.84	11.26	12.05
SEd	0.42	0.36	0.24
CD (0.05)	0.85	0.72	0.49

\*pooled data of the experiment carried out in rabi and summer season

In any vegetables, the quality of the produce determines the market value. Vegetables are agricultural produces with high moisture content,

ascorbic acid, total soluble solids and total sugars would be ideal character for onion. Ethel *et al* [5] recorded highest TSS value after

harvesting fresh onion bulbs applied with FYM and bio-fertilizers compared to control. In the present study, the ascorbic acid, TSS and total sugar increased by the combined application of FYM (25 t/ha.)+ Azospirillum (2kg/ha.)+ phosphobacteria (2 kg/ha.) + NPK (30:30:15kg/ha.) and gypsum (50kg/ha.) in both rabi and summer seasons. The application of gypsum and inorganic nutrients play a vital role in the induction of chlorophyll by the production of starch, sugars, oils, fats, vitamins and other vital compounds [6],[7]. Similar findings were reported by [8-10] in onion.

Increase in TSS and total sugars might be due to the increased IAA activity by Azospirillum and phosphobacteria which would have enhanced the sucrose synthetase activity and thereby promoted the carbohydrate content. The higher amount of total sugars might also be attributed to increase in the rate of net photosynthesis. It may be due to the application of N, P, K along with organic and inorganic fertilizers. Similar findings were reported by [11] in cluster beans, and onion [12].

#### 4. CONCLUSION

The study concluded that the total soluble solid (0B), ascorbic acid and total sugar significantly increased with FYM (25t/ha.) + Azospirillum (2kg/ha.) + Phosphobacteria (2kg/ha.) +NPK (30:30:15 kg/ha.) +gypsum (50 kg/ha.).The findings of this study, create awareness the farmers to use organic, inorganic and bio-fertilizers to produce good quality of onion.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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