

Original Research Article

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Growth, Yield and Quality of Onion (*Allium cepa* L.) as Influenced by Organic Farming Practices

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ABSTRACT

Keywords

Onion, Farm yard manure, Organic farming, Chemical fertilizers, Growth, Dry matter, Yield and quality.

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A field experiment was conducted during *Rabi* seasons of 2012 and 2013 at fixed organic experimental plot of ICAR-India Institute of Horticultural Research farm, Hesaraghatta, Bengaluru to study the effect of different levels of farm yard manure (FYM) in organic as compared to chemical and conventional practices on growth, yield and quality of onion. The trial included five levels of farm yard manure and two inorganic nutrient supply treatments consisting of only chemical treatment (NPK fertilizers + chemical plant protection) and conventional practice (Recommended dose of FYM + NPK fertilizers + chemical plant protection). Conventional treatment recorded highest plant height (50.1 cm) as well as bulb yield (34.8 t/ha), while onion crop which had received organic manure equivalent to 100 per cent recommended dose of nitrogen (RDN) recorded highest number of leaves (10.5) per plant. This bulb yield was on par with the yields obtained in organic treatments receiving FYM equivalent to 50 to 100 per cent RDN. The lower bulb yields were with organic treatment receiving manures equivalent to 25 per cent RDN and treatment receiving only NPK fertilizers. There were no marked differences among the treatments for the quality parameters such as bulb dry matter and shelf life.

Introduction

Organic cultivation offers one of the most sustainable farming systems with recurring benefits not only in long term soil health but also in providing stability in production by imparting better resistance against various biotic and abiotic stresses. Consumer demand for organically grown vegetables is steadily increasing all over the world for both domestic and export market. This drastic change is due to human concern over health which made him to produce pesticide residue and other harmful chemicals-free crops. The challenges are how to produce these crops in ways that are environmentally friendly and

without lowering the yield levels achieved by conventional production systems (Prabhakar *et al.*, 2012). Organic vegetables fetch a premium price of 10 to 50 per cent over conventional products (Sridhar *et al.*, 2014) making it attractive proposition for the selective farmers interested in this. Onion (*Allium cepa* L.) is one of the important commercial bulbous crops cultivated extensively in India covering an area of 1.203 million hectares with a production of 19.401 million tonnes and productivity of 16.10 tonnes per hectare (NHB, 2014). Onions are classified as dry (bulb) or green (spring

onion). Bulb onion varieties are generally classified by day-length (short, intermediate, long day types), market use (fresh bulb, dehydrator bulb or storage type) and bulb color within the fresh market class (white, yellow, light red, red and dark red). Since onion is consumed as fresh vegetable, used in processing and pickling and also the lead export vegetable from India, developing organic production protocols is highly relevant in the present context.

Materials and Methods

The field trials on organic onion were carried out at ICAR-Indian Institute of Horticultural Research, Bengaluru during *rabi* seasons of 2012 and 2013. The soil of experimental plot was well drained sandy loam with pH 7.29 and EC 0.22 dS/m. The initial soil organic carbon content was in the range of 0.56 to 0.86 %. The available N, P₂O₅ and K₂O were in the range of 186.0-209.0, 21.0- 38.0 and 168.0-207.0 kg/ha, respectively. The experiment was carried out in a Randomized Block Design with three replications. Organic and inorganic plots were situated five meter apart from each other and separated by a *Glyricidia* sp. live hedge to protect from possible spray drift to organic treatments.

The experiment consisted of seven treatments, viz., T₁: 100%, T₂: 75%, T₃: 50 %, T₄: 25 % of recommended dose of nitrogen equivalent to farm yard manure (FYM) application. T₅: only recommended FYM @ 25 t/ha, T₆: chemical treatment receiving only recommended N P K fertilizers and T₇: Conventional practice (recommended FYM @ 25 t/ha + recommended N P K fertilizers). The treatments under organic cultivation received well decomposed FYM as source of nutrients prior to transplanting. Quantity of FYM required for different treatments was calculated based on dry weight and total nitrogen content of manure used. The

recommended dose of fertilizers for onion crop i.e. 125:50:125 kg per hectare of N: P₂O₅: K₂O was adopted. In T₆ and T₇ treatments entire amount of P was applied as basal dose and N and K were applied in two equal splits, one at the time of planting and the other as side dress given after 30 days of planting. Farm yard manure applied in organic treatments was enriched with bio-fertilizers and bio-agents like *Azospirillum*, phosphate solubilizing bacteria (PSB), *Pseudomonas fluorescens* and *Trichoderma harzianum* before field application each at the rate of 2.5 kg per hectare. Supplemental P was given through PSB treated rock phosphate @ 50 kg/ha/year and neem cake was also added @ 625 kg/ha.

Forty days old seedlings of onion variety Arka Niketan were transplanted during second week of November in both the years at a spacing of 20 cm x 10 cm. The crop was irrigated with inline drip system having the discharge rate of 4 liter per hour to supply irrigation @ 0.8 Epan losses. Organic plant protection was taken up using *Trichoderma harzianum*, *Beauveria basiana*, *Verticillium lecani*, neem seed powder extract (4%), neem, pongamia soap (0.7%) and bordeaux mixture (1 %) for management of alternaria, basal rot and thrips mainly. For T₆ and T₇, recommended plant protection chemicals were used. The harvesting of the crop was done at 120 days after transplanting. The observations on crop growth, yield parameters and bulb quality were recorded and data was statistically analyzed as adopted by Gomez and Gomez (1983).

Results and Discussion

Effect on growth parameters

The results obtained from the response of onion to application of organic nutrients with respect to growth parameters are presented in

table 1 as pooled analysis data of two years. Effect of organic treatments on growth parameters with reference to number of leaves in onion exhibited significant differences, while it remained non-significant for plant height. It can be seen that the conventional treatment T₇ recorded numerically highest plant height (50.1 cm) than remaining treatments. Within the organic nutrient supply treatments, higher plant height (46.1 cm) was observed with T₁, where highest amount of FYM equivalent to 100% of recommended N was applied.

Similarly the treatment T₁ has resulted in significantly highest number of leaves per plant (10.5) than all other treatments, while the chemical treatment T₆ (recommended NPK fertilizers only) recorded lowest number of leaves (8.9). The plant height and number of leaves were found to decrease with decrease in amount of FYM given in organic treatments.

The increase in plant growth parameters with higher application of organic sources can be attributed to supply of higher amounts of N, P and K besides making unavailable sources of elemental nitrogen, bound phosphates and micronutrients from decomposed plant residues into available form, thereby facilitating the plants to absorb these nutrients.

This may be also due to better plant root development by virtue of improved aeration in soil. These are in agreement with the findings of Mamatha (2006), Sofia *et al.*, (2006) and Yadav *et al.*, (2013) in onion crop.

Effect on yield and quality attributes

The pooled data on onion bulb yield parameters and yield are presented in table 1. Though organic and inorganic treatments tested did not result in significant differences

with respect to mean fresh bulb weight, higher values were recorded in conventional treatment T₇ (103.5 g) followed by organic treatments T₁ (100.9 g). The lowest bulb weight of 94.4 g was observed with chemical treatments receiving only chemical fertilizers. The conventional treatment T₇ recorded significantly highest bulb yield (34.81 t/ha) followed by the treatment T₁ which received organic manure equivalent to 100 per cent of RDN (32.88 t/ha). The lower bulb yield of 29.94 t/ha and 29.13 t/ha were recorded in treatments T₄ (organic treatment receiving FYM equivalent to 25 per cent of RDN) and T₆ (chemical treatment receiving only chemical fertilizers). Higher yields per hectare in T₁ and T₇ treatments were mainly due to higher bulb weight. This is in agreement with the findings of Lal *et al.*, (2002) who reported that increase rates of organic manure application resulted in higher bulb size and bulb yield of onion.

Quality attributes such as bulb dry matter content (%) and total soluble solids (TSS °B) recorded are also presented in table 1. Though there were no significant differences among organic and inorganic treatments tested with respect to these parameters the values were marginally superior in conventional treatment and the organic treatments receiving higher quantities of organic manures. These results are in line with the findings of Yassen and Khalid (2009) and Pradeep and Sharanappa, (2014) in organically grown onion crop.

The data pertaining to storage studies in Arka Niketan onion bulbs presented in table 2. Irrespective of nutrition levels, fresh weight of bulbs stored up to ninety days showed a very marginal loss in weight in the range of 9.2- 15.5 per cent. However, the loss in weight was comparatively low in organic treatments indicating improvement in storage life of bulbs with organic cultivation.

Table.1 Growth, yield and bulb quality in onion as influenced by source and quantity of manures and fertilizers (pooled data)

Treatment	Plant height (cm)	No. of leaves/plant	Bulb dry matter content (%)	TSS (°B)	Bulb weight (g)	Bulb yield (t/ha)
T ₁	46.1	10.5	13.8	13.2	100.9	32.88
T ₂	45.9	10.0	12.6	12.2	98.8	32.40
T ₃	45.3	9.9	13.5	12.8	96.2	31.60
T ₄	43.9	9.7	13.6	12.9	94.9	29.94
T ₅	45.2	9.9	13.1	12.7	96.1	31.46
T ₆	44.9	8.9	14.6	13.7	94.4	29.13
T ₇	50.1	10.2	14.3	13.5	103.5	34.81
C.D @ 5%	NS	0.53	NS	NS	NS	3.23

Treatment details

T₁: FYM equivalent to 100 % RDN
 T₂: FYM equivalent to 75 % RDN
 T₃: FYM equivalent to 50 % RDN
 T₄: FYM equivalent to 25 % RDN

T₅: Only recommended FYM @ 25 t/ha
 T₆: Recommended NPK fertilizers only
 T₇: Conventional practice (recommended FYM+NPK fertilizers)

Table.2 Storage studies in onion (10 bulbs) as influenced by organic manures and fertilizers (pooled data)

Treatment	Fresh wt. of bulbs at harvest (g)	Air dry wt. after 30 days (g)	Air dry wt. after 60 days (g)	Air dry wt. after 90 days (g)
T ₁	1009	945 (6.3)	916 (9.2)	902 (10.6)
T ₂	988	919 (7.0)	906 (8.3)	900 (9.6)
T ₃	962	928 (3.7)	902 (6.2)	873 (9.2)
T ₄	989	923 (6.6)	902 (8.8)	878 (11.2)
T ₅	1012	949 (6.2)	915 (9.5)	855 (15.5)
T ₆	931	870 (6.5)	833 (10.5)	813 (12.6)
T ₇	1035	974 (5.9)	939 (9.3)	901 (12.0)
C.D@ 5%	NS	NS	NS	NS

* - Figures in the parenthesis indicates percentage reduction

Table.3 Chemical and microbial properties of experiment plot soils

Treatment	pH	EC (dS/m)	OC (%)	Soil respiration (C mg/kg/ha)	Dehydrogenase activity (µg of TPF released g ⁻¹ of soil/ha)
T ₁	7.67	0.19	1.33	9.43	122.50
T ₂	7.57	0.18	1.35	9.47	125.57
T ₃	7.56	0.21	0.93	9.07	115.57
T ₄	7.26	0.16	1.30	7.83	99.60
T ₅	7.63	0.17	0.97	7.23	98.80
T ₆	7.48	0.33	0.70	6.77	85.20
T ₇	7.54	0.28	0.86	7.05	78.75

Chemical and microbial properties of soil

Data with respect to chemical and microbial properties of soil in organic and inorganic treatments after harvest of the crop are presented in table 3. From the data it can be seen that in general the association of organic manure has resulted in marginal increase in soil pH and reduction in electrical conductivity. There was substantial improvement in organic carbon content and the values were markedly higher in all organic treatments as compared to inorganic treatments, which are in accordance with the findings of Saha *et al.*, (2010). The data on soil respiration and dehydrogenase activity, the indicators of microbial population and their activity clearly suggests that substantial increase in microbial population in all organic treatments as compared to inorganic treatments and also among organic treatments the activity was marginally more with increased amount of farm yard manure application. These are in agreement with findings of Krishnakumar *et al.*, (2005) and Chang *et al.*, (2007).

Thus, from this study it can be concluded that onion crop can be successfully produced organically by adopting appropriate organic farming protocols with more emphasis on good organic nutrient supply system adopting enrichment of manures using bio-fertilizers and bio-pesticides. The results also have shown positive aspects of organic farming practices through improvement in storage life of onion bulbs and enhanced soil microbial population and their activities.

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