

EFFECT OF INORGANIC FERTILIZERS, BIOFERTILIZERS AND ORGANICS ON GROWTH, YIELD AND ECONOMICS OF ONION (*ALLIUM CEPA* L.) CV. N-53

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Abstract: The present investigation entitled Effect of inorganic fertilizers, biofertilizers and organics on growth, yield and economics of onion (*Allium cepa* L.) cv.N-53 was conducted with the aim to understand the better utilization of nutrients for growth, yield and quality improvement of onion. A field experiment was conducted at the Department of Vegetable Science, College of Agriculture, Orissa University of Agriculture & Technology, Bhubaneswar (Odisha), during the *Rabi* season of the year 2012-13 under Randomized Block Design with ten treatments and three replications. The results revealed that the growth characters, like plant height, number of leaves per plant, leaf length, leaf width, dry weight of leaf and neck length; yield-attributing characters such as bulb weight, polar diameter and equatorial diameter of bulb were positively influenced under treatment T₉ i.e., Lime @ 0.2 LR + (*Azotobacter* + *Azospirillum* + P.S.B) @ 4 kg per ha each + Vermicompost @ 5t per ha + RDF (120:60:60 kg per ha), while no fertilizer was applied in control. Maximum bulb yield (27.13 t ha⁻¹) was recorded in the same treatment (T₉), which was due to the sum total effect of different growth and yield-attributing characters. Highest B:C ratio was found in treatment T₇ i.e., (Lime + Biofertilizers +RDF).

Keywords: Recommended dose of fertilizer, Vermicompost, Phosphobacteria, *Azotobacter*, Onion, Bulb yield, Economics

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important vegetable cum condiment crop grown throughout the world including India. India produces onion about 187.77 lakh tonnes from an area of 11.73 lakh hectares (Anon., 2013) and ranks second in the world's production. Fertilizer application proved to be a great success and production of vegetables crops increasing in our country. Intensive cultivation and excess use of chemical fertilizers resulted in ill health of soil and unstable yield of crops. The modern civilization is posing a threat to environment. So in last few years, a greater concern regarding use of biofertilizers and organic sources as an alternative/supplement to chemical fertilization, has been derived to reduce the high costs that inorganic fertilizer represent in agricultural production. The use of nitrogenous and phosphatic fertilizers can be minimized or by the application of biofertilizers like *Azospirillum*, *Azotobacter* for nitrogen and PSB for phosphorus, as these are free from problems of pollution and other hazards. Long term fertilizers trials have clearly shown the positive role of organic fertilizers in conjunction with chemical fertilizers in maintaining the productivity of soil by maintaining the soil fertility and important physical properties (Bharadwaj *et al.*, 1994). Combined use of vermicompost, biofertilizers and inorganic fertilizers is of special significance under intensive cropping system as these are complementary and supplementary to each other in sustaining crop yields and soil productivity. Balanced fertilization has to be made for different crops based on soil testing for attaining maximum yield and profit. Biofertilizers are economically lucrative, ecologically sound and are also self generating sources without any negative

influence either to the crop or to the environment. These are also bio-control agents as they control many pathogens and microorganisms. The beneficial microbes are the biological nitrogen fixers (*Azotobacter*, *Azospirillum*, Blue Green Algae, *Azolla* and *Rhizobium*), Phosphate Solubilising Microbes (PSM) and nutrient mobilizers (*Mycorrhizal* fungi) in the soil which are of great significance to different horticultural crops particularly in vegetables.

MATERIAL AND METHOD

The experiment was laid out during the *rabi* season of 2012-13 at Department of Vegetable Science, College of Agriculture, Orissa University of Agriculture & Technology, Bhubaneswar (Odisha) which is subjected to the extreme of weather conditions. The climate of region is subtropical with maximum temperature ranging from 22°C to 45°C in summer, minimum temperature ranging from 7°C to 15°C in winter and relative humidity ranging from 60 - 80% in different season of the year. Before start of the experiment, the representative soil samples were taken randomly a depth of 15 cm from experimental field and brought to laboratory for physical and chemical analysis. The results of soil analysis have been presented in the soil of field may texturally be classified as silty clay loam and slightly acidic in reaction. Onion seeds of N-53 were sown on nursery beds at Department of Vegetable Science, College of Agriculture, during the *Rabi* season in line sowing. Raised bed about 3 meter long, one meter width and 15 cm above ground level was prepared for that purpose. The seed beds were covered with compost, mulches and thatches with polythene paper above the bed to protect the young seedling from adverse climatic condition. 60 Days after sowing, bulb lets

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were ready for transplanting. These healthy bulblet uniform shape and size were selected and transplanted in well prepared field. The experiment was laid out in Randomized Block Design with ten treatment combinations and three replications. The treatments comprised of combinations T₁- No application of fertilizers (control); T₂- RDF; T₃ - Lime + Biofertilizers (*Azotobacter* + PSB + *Azospirillum*); T₄ -Lime + Vermicompost; T₅-Lime + RDF (100 %), T₆ - Lime + Biofertilizers (*Azotobacter* + PSB + *Azospirillum*)+ Vermicompost, T₇ -Lime + Biofertilizers (*Azotobacter* + PSB + *Azospirillum*)+ RDF (100 %), T₈ - Lime + Vermicompost + RDF (100 %), T₉ - Lime + Biofertilizers (*Azotobacter* + PSB + *Azospirillum*)+ Vermicompost + RDF (100 %), T₁₀ -Biofertilizers (*Azotobacter* + PSB + *Azospirillum*)+ Vermicompost + RDF (100 %). Seeds were germinated after 5-6 days. The land of the experimental site was irrigated prior to showing for optimum moisture level. The required area was then marked and plots were prepared according to the layout plan. The land of the experimental site was irrigated prior to transplanting for optimum moisture level. The first ploughing was done with disc plough

and sub-sequent ploughing was done with cultivator followed by planking. About 50% of NPK and Vermicompost @ 5 tones/ha is applied at the last ploughing. Seedling were treated with combination of biofertilizers *Azotobacter* @4 Kg/ha and PSB @ 4kg/ha and *Azospirillum* @ 4kg/ha. Sixty days old bulblets of uniform size (1.5 cm long and 0.25 cm diameter) were selected. After dipping, they were transplanted in field at a spacing of 15 cm × 10 cm. From every plot 5 plants of onion were taken randomly for recording periodical data. The observations were recorded on the plant height (cm), leaf length (cm), leaf width (cm), number of leaves (cm), neck length (cm), polar diameter (cm), equatorial diameter (cm), bulb yield (t/ha), fresh bulb weight (g), dry bulb weight, volume of bulb (ml) and dry weight of leaves (g). The statistical analysis was carried out as per the methods suggested by Steel and Torrie (1981).

RESULT AND DISCUSSION

The data with respect to plant growth and yield-attributing are presented in Table 1 and 2, respectively.

Growth Attributing Characters

Table 1. Effect of organic and inorganic nutrient treatments on plant height and leaf characters of onion cv. N-53

Treatments	Plant height (cm)	Number of leaves	Leaf length (cm)	Leaf width (cm)	Dry weight of leaf (g)	Neck length (cm)
T ₁ : L ₀ + BF ₀ + VC ₀ + RDF ₀	29.70	6.90	25.09	1.11	2.00	0.57
T ₂ : RDF	38.41	10.98	34.60	1.51	3.20	1.04
T ₃ : L + BF	32.89	8.04	27.34	1.25	2.50	0.97
T ₄ : L + VC	31.47	8.34	27.09	1.39	2.47	1.11
T ₅ : L + RDF	43.39	11.34	37.15	1.55	3.10	1.01
T ₆ : L + BF + VC	35.48	10.11	33.61	1.35	2.20	0.73
T ₇ : L + BF + RDF	46.78	11.01	39.47	1.87	2.77	1.05
T ₈ : L + VC + RDF	47.35	12.09	40.15	1.77	3.00	1.13
T ₉ : L + BF + VC + RDF	51.44	14.11	43.25	1.97	2.90	2.17
T ₁₀ : L ₀ + BF + VC + RDF	41.32	11.88	38.33	1.44	2.70	0.84
S.E.m ±	0.83	0.42	0.90	0.14	0.03	0.14
C.D. (P=0.05)	2.58	1.25	2.66	0.42	0.08	0.41

The data showed in Table 1 revealed that maximum plant height (51.44 cm) was recorded in T₉, which was significantly superior to all other treatments including control (T₁). The major nutrient phosphorus being essential constituent of cellular protein and nucleic acid might have encouraged the meristematic activities of the plant resulting in increased plant height. This finding corroborates with the findings of Singh *et al.* (1993) and Varu *et al.* (1997) in onion. Maximum number of leaves, leaf length and leaf width was recorded with T₉ (14.11), (43.25 cm) and

(1.97 cm), respectively and was significantly different from rest of the treatments. This might be due to the adequate availability and supply of nutrients in proportion, which ultimately triggers the plant growth hormones for proper growth. Maximum dry weight of leaf was recorded in treatment T₂ (3.20 g) and minimum was found in treatment T₁ (2.00 g). Jilani (2004) reported that application of higher amount of nitrogen significantly enhanced the length of onion leaves. Maximum neck length was recorded in T₉ (2.17 cm) which was significantly superior than other

treatments including control followed by T₈ (1.13 cm) and T₄ (1.11 cm). This might be due to increased number of leaves per plant resulting in better photosynthesis and accumulation of photosynthates leading to more vigour. Similar results were also reported by Setty (1988) in Garlic and Thimmiah in Onion (1989).

Yield-attributing characters

Maximum fresh bulb weight was recorded in T₉ (128.53 g) which was significantly higher than the rest of the treatments. The organic treatment of vermicompost had increased the soil organic matter, soil structure and biological activity of the soil and would have reduced the loss of nitrogen by increased cation and anion exchange capacity in soil. Kebede (2003) observed yield increases of about 10 - 15% in onion with nitrogen fertilization in the range of 120 kg N ha⁻¹. Maximum dry weight of the bulb was recorded with T₉ (21.37 g), which was significantly superior to other treatments followed by T₈ (18.70 g) and T₇ (18.49 g). Improved dry weight of bulb was also related to altered root permeability of the plant for nutrients due to effect of biofertilizers. Hansen and Henriksen (2001) reported, dry matter content increased during the period of bulb development while harvesting later than 80 - 90% top fall reduced

dry matter content and storage ability of the bulbs. Maximum volume of bulb was recorded in T₉ (131.41 ml), which was significantly higher than rest of the treatments. Maximum polar diameter and equatorial diameter was recorded in T₉ (5.73 cm) and (6.09 cm), respectively which was significantly higher than other treatments. The increase in bulb equatorial and polar diameter with incorporation of organics with inorganics is a reflection of better performance of the plant with respect to different growth parameters by enhancing the nutrient uptake ability. Maximum yield (27.13 t ha⁻¹) was recorded with the application of 100% recommended dose of chemical fertilizers with biofertilizers, vermicompost and lime which was significantly higher than other treatments including control. The minimum marketable yield was recorded in T₁ (11.50 t ha⁻¹) which happens to be control. The increase in crop growth rate such as plant height and number of leaves might have positive and significant correlation with the yield. It increased the net assimilation rate leading to production of more amount of metabolites and phytohormones followed by their mobilization from the source to sink which ultimately resulted in higher yield as also reported by number of workers (Neerja *et al.*, 2001; Thilkawati and Ramaswami, 1998; Jayathilake *et al.*, 2003) in onion.

Table 2. Effect of organic and inorganic nutrient treatments on yield and yield-attributing characters of onion cv. N-53

Treatments	Fresh weight of Bulb (g)	Dry weight of Bulb (g)	Volume of Bulb (ml)	Polar Bulb diameter (cm)	Equatorial Bulb diameter (cm)
T ₁ : L ₀ + BF ₀ + VC ₀ + RDF ₀	58.76	9.67	61.18	3.57	4.10
T ₂ : RDF	88.33	14.92	93.14	4.13	4.54
T ₃ : L + BF	71.07	13.20	86.25	3.99	4.20
T ₄ : L + VC	84.41	13.35	83.79	3.80	4.34
T ₅ : L + RDF	98.68	15.84	117.42	4.40	5.12
T ₆ : L + BF + VC	79.88	12.34	95.30	4.12	4.08
T ₇ : L + BF + RDF	111.89	18.49	123.30	4.74	5.43
T ₈ : L + VC + RDF	111.84	18.70	123.48	5.10	5.49
T ₉ : L + BF + VC + RDF	128.53	21.37	131.41	5.73	6.19
T ₁₀ : L ₀ + BF + VC + RDF	91.44	14.27	110.85	4.38	4.83
S.E.m ±	5.63	0.75	1.92	0.14	0.97
C.D. (P=0.05)	16.72	2.23	5.72	0.40	2.89

Economics

Details on economics and benefit: cost ratio in onion variety N-53 in relation to various combinations of different treatments tested is presented in Table 3. Highest gross return (Rs.1,89,910) was obtained in the treatment T₉ (L+BF+VC+RDF) followed by T₈ (L+VC+RDF) with Rs.1,68,700 per ha. Though treatment T₉ resulted in highest gross return, it failed to earn highest net income owing to higher cost of the vermicompost. As for net income, the best performance was that of the treatment T₇ where

(L+BF+RDF) was applied to the crop. This treatment also resulted in highest B: C ratio (3.18) by virtue of fetching higher net return, and incurring comparatively low cost investment.

CONCLUSION

From this study, it is evident that application of 100% recommended dose of fertilizers, lime, biofertilizers and vermicompost resulted in higher yield in onion. However, from the point of view of economics,

application of 100% recommended dose of fertilizers with biofertilizers and lime is more profitable. Hence, it is concluded that for better performance and

profitability from onion variety N-53, application of 100% RDF along with biofertilizers and lime, is appropriate.

Table 3: Economics of onion as influenced by different organic and inorganic fertilizer treatments

Treatments	Bulb yield (t ha ⁻¹)	Cost of cultivation (Rs/ha)	Gross Return (Rs/ha)	Net Return (Rs/ha)	B:C Ratio
T ₁	11.50	44,137	80,500	36,363	1.82
T ₂	16.67	51,193	1,16,690	65,497	2.27
T ₃	12.77	45,061	89,390	44,329	1.98
T ₄	13.80	59,641	96,600	36,959	1.61
T ₅	20.75	51,193	1,45,250	94,057	2.83
T ₆	13.60	57,541	95,200	37,659	1.65
T ₇	23.52	51,613	1,64,640	1,13,027	3.18
T ₈	24.10	66,193	1,68,700	1,02,507	2.54
T ₉	27.13	66,613	1,89,910	1,23,297	2.85
T ₁₀	17.44	66,613	1,22,080	55,467	1.96

T₁- No application of fertilizers (control); T₂- RDF; T₃ - Lime + Biofertilizers (*Azotobacter* + PSB + *Azospirillum*); T₄- Lime + Vermicompost; T₅-Lime + RDF (100 %), T₆- Lime + Biofertilizers (*Azotobacter* + PSB + *Azospirillum*) + Vermicompost, T₇-Lime + Biofertilizers (*Azotobacter* + PSB + *Azospirillum*) + RDF (100 %), T₈ - Lime + Vermicompost + RDF (100 %), T₉ - Lime + Biofertilizers (*Azotobacter* + PSB + *Azospirillum*) + Vermicompost + RDF (100 %), T₁₀ -Biofertilizers (*Azotobacter* + PSB + *Azospirillum*) + Vermicompost + RDF (100 %)

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