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Effect of organic Nitrogen Management on Yield, Quality, Economics and Nutrient Uptake of onion (*Allium cepa* L.).

R. N. Meena[1]* , V. K. Verma[2], Kalyan Singh[3]

Assistant Professor, Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India[1]

M.Sc. Student, Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India[2]

Ex-Professor, Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India[3]

ABSTRACT: A field experiment was conducted during summer season of 2004 and 2005 to find out the effect of various sources (FYM, VC and PM) and rates of organic manures (100%, 125%, 150% RND) on yield, quality and economics of onion (Pusa Red) on a sandy clay-loam soil low in available N and medium in available phosphorus and potassium. Pooled data analysis revealed that the application of organic manure significantly influenced the yield attributes and bulb yield of onion over 100% RND as urea (control). Progressive increase in dose of all the organic manures significantly increased the bulb yield, haulm yield, pungency (%) and nutrient uptake (NPK). The application of 150% RND as poultry manure gave higher bulb (270.84 q ha^{-1}) and haulm yields (35.13 q ha^{-1}) than other sources and levels of organic manures. Soil physical parameters *viz.* bulk density and water stable aggregates did not showed any profound effect due to addition of organic materials. The maximum organic carbon build up was accured (0.54%) when 150% RND was supplied through PM (T_4). Soil biological properties showed improvement in the soil microbial counts over its initial values at the end of 2-years due to supplementation of organic sources. All the organic treatments recorded higher economic returns over control and the highest net returns (Rs. 74,233 ha^{-1}) was obtained due to 100% as poultry manure followed by 125% RND as poultry manure (Rs. 72,195ha^{-1}) which was 105.05 per cent higher than control (Rs. 36,202 ha^{-1}). The net benefit-cost ratio was also highest with 100% RND applied as poultry manure (2.33).

KEYWORDS: Organic nitrogen, Management, Quality, economics, Uptake, Onion.

I. INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops grown extensively throughout the country. India ranks first in area (0.49 m ha) and second in production (4.9 m tonnes) of onion bulbs in the world. Uttar Pradesh ranks third (12.46%) in onion production after Maharashtra (23%) and Gujarat (16.86%). The annual production of onion in the world is about 35 tonnes and India accounts 16% of the total world production and ranks second after China. Besides, 70% of foreign exchange earnings among fresh vegetables comes from only onion (Fageria, 2003). The continuous chemical fertilizer use deteriorated crop while organic manures improved these properties (Watson *et al*., 2002). The farmers can in turn obtained good remuneration from the organically produced vegetables due to their heavy demands in national and international markets (Singh, 2005). Adoption of organic vegetable production would largely depend upon supplies of organic inputs, thoroughly backed up by well-proven production technologies. Judicious use of organic manures can maintain long term soil fertility and sustain higher productivity of crops. Nitrogen is considered to be the most limiting factor realizing higher yields. An adequate supply of nitrogen to onion is associated with efficient source to sink relationship leading to higher productivity. The present investigation was therefore conducted to study the effect of different organic nitrogen nutrition sources on yield attributes, yield and quality of onion in agro-ecology of eastern Uttar Pradesh.

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II. MATERIALS AND METHODS

A field experiment was conducted during the winter seasons of 2004 and 2005 at the Research Farm, Institute of Agricultural Sciences, BHU, Varanasi. The soil was sandy clay loam in texture having pH 7.12, organic carbon 0.45% and EC 0.32 dSm^{-1}. The available N, P and K contents of soil were 180.50, 18.46 and 202.42 kg ha^{-1}, respectively. The water holding capacity, bulk density and porosity of the surface soil (0-15cm) were 40.86%, 144 g cc^{-1} and 42.40%, respectively. A set of 10 treatments comprising 3 different rates i.e. 100%, 125% and 150% of recommended nitrogen dose (RND) and 3 sources of organic manures *viz*., farmyard manure (FYM), vermicompost (VM) and poultry manure (PM) were compared with recommended nitrogen dose given through urea (control). The experiment was laid out in a randomized block design with 3 replications in fixed plots in both the years. The nutrient contents of the organic manures were applied on dry weight basis. The organic manures were applied as per treatment 15 days before sowing and mixed thoroughly in 15 cm top soil layer. In control treatment, recommended dose of nitrogen through urea was drilled at sowing, 10 cm deep and 5 cm away from seed. The NPK contents of FYM, VM and PM were 0.50, 2.30 and 2.80% N, 0.20, 0.75 and 2.20% P_2O_5 and 0.50, 1.23 and 1.30% K_2O, respectively. Sixty days old seedlings of 'Pusa Red' were transplanted at 20x10 cm spacing on 26 and 20th February, in 2004 and 2005, respectively. The crop was harvested ninety days after transplanting in both the years on 30 May and 28 May during 2004 and 2005, respectively. Standard agronomical practices were followed to grow successful crop during both the years. The data on days to 50% bulb formation, bulb diameter, bulb and haulm yields were recorded. The samples were analyzed separately for N, P and K contents after drying it in an oven, ground properly in a Wily mill to pass through a 30 mesh sieve. Carbohydrate content (%) was determined using method described by Loomis and Shull (1937). Pungency (%) was computed by Allyl-propyl-disulphide content in onion bulb determined as Pyruvic acid using formula suggested by Hort and Fisher (1970). Economics of the treatments were computed on the basis of prevailing market rates of produce and agro-inputs. As the trend of data was similar in both the years, pooled data are presented.

III. RESULTS AND DISCUSSION

Effects on yield attributes and yield

The application of 150% RND as poultry manure recorded maximum bulb diameter and achieved 50% bulb-formation stage significantly early compared to other treatments (Table 1). It is clear from the data that the bulb and haulm yields were significantly influenced by different treatments of organic nitrogen. The maximum bulb yield (270.84 q ha^{-1}) was recorded with the application of 150% RND as poultry manure which was significantly better than control (236.30 q ha^{-1}). The increase in bulb yield due to 150% RND through PM was 14.62% higher over control. In general, the significant improvement in yield attributes of onion with organic nitrogen fertilization could be ascribed to overall improvement in vigour and crop growth. The increase in yield may be due to better root proliferation, enhanced nutrients uptake and water, higher leaf number, more photosynthesis and accelerated rate of food assimilation (Yadav *et al*. 2005). Increasing levels of organic nitrogen also increase bulb and haulm yields irrespective of sources. This could be attributed to increased vegetative growth possibly a result of effective utilization of nutrients absorbed and a result of improved nourishment through N-fertilization (Bhakher *et al*., 1997). In general better performance of PM on yield was probably due to higher rate of mineralization (Azad and Lehria, 2001; Babu *et al*., 2002 and Chettri *et al*., 2002).

Effect on quality

Significantly higher values of quality parameters *viz*., pungency percentage was recorded with the application of poultry manure followed by vermicompost and FYM compared to control (Table 2). Application of organic N significantly increased the ally-propyl disulphide content in onion bulb and the maximum value was recorded with the application of 150% RND as poultry manure. Application of organic N at higher rates also significantly increased the ally-propyl disulphide content in onion. Carbohydrate (%) did not produce any significant difference due to various organic sources and their application rates. Increasing organic N increased volatile and fatty oil contents resulting in significantly higher production of ally-propyl disulphide in onion bulb. These results are in close agreement with findings of Singh *et al*. (1996).

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The mean total uptake of nitrogen, phosphorus and potassium by onion was significantly highest under all organic treatments compared to control and the highest uptake (42.03N, 41.81 P_2O_5 and 77.23 K_2O kg ha^{-1} respectively) was recorded with PM @150% RND.

Soil properties

Soil physical parameters viz. bulk density and water stable aggregates did not showed any profound effect due to addition of organic materials (Table-3). The values of chemical properties of soil like organic carbon, available N, P and K increased significantly from initial stage and over control treatment on the completion of 2 years cycle of rice-tablepea-onion sequence. The maximum organic carbon build up was accured (0.54%) when 150% RND was supplied through PM (T_4) while the least value (0.40%) was noticed with the 100% RND through urea (T_{10}). The organic carbon of the soil increased over its initial status (0.38%) under nitrogen supply through organic sources. The nutrient status of the experimental site was also affected significantly by the application of different organic manures alongwith their varying rates. Results clearly indicated improved fertility status of soil due to increased values of available N, P and K in all organic treatments over its initial value as well as control. Application of organic manures with increased rate enhanced soil fertility over their lower doses. At the end of 2-year sequence, 150% RND applied as PM maintained higher values of organic carbon and available N, P and K. Next best treatments in this respect were also found when PM applied with reduced rates of 125% and 100% RND, respectively. Continuous application of organic manures in sufficient quantities have been reported to improve the soil organic carbon and available N, P and K in soil thereby sustaining the soil health (Tiwari *et al.*, 2002). Soil biological properties showed improvement in the soil microbial counts over its initial values at the end of 2-years cropping sequence due to supplementation of organic sources. Poultry manure applied @ 150% RND was best which lead into higher counts of bacteria (82.45×10^3), fungi (37.82×10^3) and actinomycetes (58.23×10^3) closely followed by the treatments where PM was applied with reduced rates (T_8 & T_7), respectively. The control treatment (T_{10}) had relatively lower values of soil microbial count than the organic treatments. The favourable effect of organics on soil biological properties is a proven fact which helped in providing ideal conditions and presumably increased the microbial activity because of the available high organic matter. Hati *et al.* (2001) and Shanmei *et al.* (2002) also reported favourable effect of organic manures on soil physical and biological properties.

Economics

A perusal of data (Table 1) revealed that net return in onion was influenced to a great extent by organic manure. Data indicated that application of 100% RND as PM recorded highest net return (Rs. 74,233 ha^{-1}) and benefit-cost ratio (2.33) over control (Rs. 36,202 ha^{-1} and 1.58). The monetary gain by application of 100% RND as PM was 105.05 per cent higher over inorganic treatment (control). Data further revealed that progressive increase in N levels decreased the net return of onion consequently application of 100% RND recorded higher net returns with application of all three sources of organic manure. Similar trend was observed in respect to benefit cost ratio.

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Table-1: Effect of organic nitrogen management on yield and economics of onion (pooled data over 2 years)

	Days to 50% bulb formation	Bulb diameter to 50% bulb formation (cm)	Bulb diameter at 15 days after 50% bulb formation (cm)	Onion yield (q ha^{-1})	Haulm yield (q ha^{-1})	Total cost (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	Benefit cost ratio
T_1 – 100% RND as FYM	60.08	1.58	3.79	239.31	13.76	31788	95724	63936	2.01
T_2 – 125% RND as FYM	60.76	1.65	3.88	245.35	18.27	34288	98140	63852	1.86
T_3 – 150% RND as FYM	61.26	1.72	3.93	250.64	19.60	36788	100256	63468	1.72
T_4 – 100% RND as VM	62.42	1.75	4.08	254.63	20.36	31787	101852	70065	2.20
T_5 – 125% RND as VM	62.71	1.92	4.32	259.24	24.65	34289	103696	69407	2.02
T_6 – 150% RND as VM	63.15	2.06	4.60	262.22	26.83	36788	104888	68100	1.85
T_7 – 100% RND as PM	63.46	2.18	4.71	265.05	28.83	31787	106020	74233	2.33
T_8 – 125% RND as PM	64.60	2.26	4.79	266.21	30.83	34289	106484	72195	2.10
T_9 – 150% RND as PM	65.27	2.38	4.93	270.84	35.13	36788	108336	71548	1.94
T_{10} – 100% RND through urea	59.17	1.53	3.45	236.30	11.27	22873	59075	36202	1.58

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SEm ±	0.33	0.16	0.26	5.77	2.87				
C.D. (0.05)	0.99	0.48	0.77	11.70	5.81				

Market price of onion bulb (organic) Rs. 400 q^{-1}, Onion bulb (inorganic) Rs. 300 q^{-1}, Cost (Rs. $quintal^{-1}$): FYM – 50, VM – 300, PM – 300 and Urea – 500.

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Table -2: Effect of organic nitrogen management on quality and nutrienuptake of onion (pooled data over 2 years)

atments	Pungency (%)	Carbohydrate (%)	Nutrient uptake (kg ha^{-1})		
			N	P_2O_5	K_2O
T_1 – 100% RND as FYM	0.0030	10.33	37.13	37.30	68.25
T_2 – 125% RND as FYM	0.0039	10.45	38.07	37.88	69.97
T_3 – 150% RND as FYM	0.0043	10.66	38.89	38.70	71.48
T_4 – 100% RND as VM	0.0047	10.85	39.51	39.31	72.61
T_5 – 125% RND as VM	0.0058	10.92	40.23	40.02	73.93
T_6 – 150% RND as VM	0.0063	11.98	40.69	40.48	74.79
T_7 – 100% RND as PM	0.0067	11.05	41.13	40.92	75.56
T_8 – 125% RND as PM	0.0073	11.40	41.31	41.09	75.91
T_9 – 150% RND as PM	0.0077	11.88	42.03	41.81	77.23
T_{10} – 100% RND through urea	0.0015	10.15	36.67	36.48	67.39

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SEm ±	0.001	0.70	0.17	0.16	0.8
C.D. (0.05)	0.004	NS	0.49	0.64	0.53

Table -3: Parameters as influenced by organic nitrogen nutrition at the end of 2 years cycle of onion.

Treatment	Soil physical parameters			Soil chemical parameters				Soil biological parameters		
	Bulk density (g/cc)	Porosity (%)	Water stable aggregates (%)	Organic Carbon (%)	Available nutrient (kg/ha)			Bacteria ($x10^3$)	Fungi ($x10^3$)	Actinomycetes ($x10^3$)
					N	P	K			
T_1 – 100% RND as FYM	1.36	40.32	18.01	0.44	184.34	24.43	154.41	62.82	22.5	33.73
T_2 – 125% RND as FYM	1.37	40.38	18.18	0.45	185.46	24.61	154.87	63.63	23.03	34.74
T_3 – 150% RND as FYM	1.39	41.34	18.2	0.46	186.72	25.44	155.44	66.92	24.00	35.43
T_4 – 100% RND as VM	1.38	40.3	18.01	0.47	187.73	26.52	157.42	72.34	25.31	36.25
T_5 – 125% RND as VM	1.4	40.36	18.2	0.48	189.44	27.82	158.84	77.94	27.94	37.44
T_6 – 150% RND as VM	1.41	41.18	18.5	0.49	189.95	28	160.42	78.65	28.63	43.18
T_7 – 100% RND as PM	1.39	40.2	18.04	0.5	190.44	28.42	161.72	79.54	29.45	46.94
T_8 – 125% RND as PM	1.41	40.22	18.32	0.52	191.43	28.84	162.43	80.44	32.11	54.46
T_9 – 150% RND as PM	1.42	40.95	18.65	0.54	192.98	29.43	164.12	82.45	37.82	58.23
T_{10} – 100% RND through urea	1.35	40.02	18.00	0.4	178.95	22.44	152.44	41.85	11.49	33.44

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Initial	**1.35**	**40.00**	**18.00**	**0.38**	**178.43**	**22.41**	**151.24**	**41.45**	**11.25**	**32.41**
C.D. (P=0.05)	NS	0.86	NS	0.12	9.78	0.56	8.94	-	-	-

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