

## RESEARCH PAPER

# Estimation of yield and nutrient uptake by onion under the influence of inorganic, organic and bio-fertilizers

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An investigation was carried out to assess the integrated use of inorganic, organic (FYM, pressmud, poultry manure and vermicompost) and bio-fertilizers (*Azotobacter*, *Azospirillum* and phosphate solubilizing bacteria) on yield, nutrient uptake by onion and nutrient pool of the soil during *Rabi* season of the year 2013-14. There was a significant effect of various treatment found on the yield, nutrient uptake and soil nutrient reserve. Maximum yield per hectare were found in 50 per cent recommended NPK + 50 per cent vermicompost while minimum yield was observed in control. Maximum uptake of nitrogen and potassium was obtained in treatment combination 50 per cent recommended NPK + 50 per cent vermicompost whereas maximum uptake of phosphorus was found in treatment combination 50 per cent recommended NPK + 50 per cent pressmud. Among different treatment combination highest nitrogen and potassium reserve in soil was found in treatment combination 50 per cent recommended NPK + 50 per cent vermicompost while maximum value for organic carbon percentage was in sole vermicompost application.

**Key words** : FYM, Pressmud, Vermicompost, Poultry manure, Biofertilisers, Nutrient uptake

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## INTRODUCTION

Onion (*Allium cepa* L.) belongs to the family Alliaceae, genus *Allium* and species *cepa*. It is a highly nutrient-responsive crop. Conventional methods of fertilization have undoubtedly helped in improving both bulb yield and quality. But lately, routine management practices in India appear to be incapable of maintaining yields over the long-term. Although the use of manures as nutrient sources for vegetables is common, their effectiveness is potentially limited by nutrient release patterns that are often out of synchrony with crop demand, large variability in source quality and field distribution, and food safety. All of these issues have contributed to experimentation with alternative options. A gradual shift from using purely organic sources to

introducing some proportion of inorganic fertilization is gaining acceptance. This shift has formed the basis for INM, which could involve three nutrient sources: microbial inoculants or biofertilizers including *Azotobacter* (Az), *Azospirillum* (Azr), and phosphate solubilizing bacteria (PSB), inorganic fertilizers, and manures. Further, knowing the deleterious effect of using only chemical fertilizers on soil health, use of chemical fertilizers supplemented with organic waste and biofertilizers will be environmentally benign. Keeping the above facts in view, an experiment was conducted to standardize a proper combination of organic, inorganic and bio-fertilizers to feed the onion crop without affecting the yield and uptake of nutrients.

## RESEARCH METHODOLOGY

A field experiment was conducted to study the effect of chemical fertilizers, organic fertilizers and bio-fertiliser on yield and quality of onion cv. NHRDF Red 2 at the Horticulture Research Farm of Babasaheb Bhimrao Ambedkar University, Lucknow, India, during 2013-14. The experiment was laid out in RBD design with three replications having treatments consisted of four levels of NPK (control, 100% of recommended dose of NPK, 75% of recommended NPK and 50% of recommended NPK), four organic fertilizers; farm yard manure (FYM, 15 t/ha), poultry manure (PoM, 4 t/ha), vermicompost (VC, 5.5 t/ha) and pressmud (PM, 11.5 t/ha) each at two levels (100% FYM, 50% FYM, 100% PoM, 50% PoM, 100% VC, 50% VC, 100% PM and 50% PM) and three bio-fertilizers; *Azotobacter* (Azo), *Azospirillum* (Azr) and phosphate solubilising bacteria (PSB). There were fifteen treatment combinations and control (T<sub>0</sub>- Control, T<sub>1</sub>- 100% RDF, T<sub>2</sub>- 100% FYM, T<sub>3</sub>- 100% PoM, T<sub>4</sub>- 100% VC, T<sub>5</sub>-100% PM, T<sub>6</sub>- 50 % RDF +50% FYM, T<sub>7</sub>- 50 % RDF +50% PoM, T<sub>8</sub>- 50 % RDF +50% VC, T<sub>9</sub>- 50 % RDF +50% PM, T<sub>10</sub>- 50 % RDF +Azo, T<sub>11</sub>- 50 % RDF +Azr, T<sub>12</sub>- 50 % RDF +PSB, T<sub>13</sub>- 75 % RDF +Azo, T<sub>14</sub>- 75 % RDF +Azr and T<sub>15</sub>- 75 % RDF +PSB) Seedlings of same age (8-week old) were transplanted after seedling dip treatment with bio-fertilizers at the spacing of 15x10 cm. Recommended dose of fertilizer NPK (150:60:60) in the form of urea, single super phosphate and muriate of potash were applied to grow the crop. Substitution of N through FYM, vermicompost, poultry manure and pressmud was done only on the basis of nitrogen percentage in these manures. Data were recorded after harvesting on yield per plot (kg), yield per hectare (tonnes), nitrogen uptake (kg/ha), phosphorus uptake (kg/ha) and potassium uptake (kg/ha) in bulb and soil was estimated for organic carbon (%), available nitrogen (kg), available phosphorus (kg/ha) and available potassium (kg/ha). Initial soil estimation was done before

transplanting to assess the NPK content in soil. Available nitrogen (0.32% alkaline KMnO<sub>4</sub> oxidizable), phosphorus (0.5 M Na HCO<sub>3</sub> extractable) and potassium (1N neutral ammonium acetate extractable) was estimated in soil as method described by Walkley and Black (1934), Subbiah and Asija (1956) and Olsen *et al.* (1954), respectively. Eight weeks old seedlings were transplanted at spacing 10 x 15 cm. After harvesting bulbs and leaves were collected for estimation of nutrient uptake. Total uptake of N, P and K in plant was computed by multiplying the yield with the respective nutrient content.

## RESEARCH FINDINGS AND ANALYSIS

Various treatments significantly affected the yield (Table 2), uptake of nitrogen, phosphorus and potassium in onion (Table 3). The highest growth and yield response were achieved with 50 per cent RDF+50 per cent VC. This positive performance of the reduced rate of inorganic fertilization with vermicompost might be due to vermicompost worked as supplements to inorganic fertilizers. Kumar *et al.* (2014) also reported that vermicompost gives better performance in quality of okra as compared to solely inorganic fertilizer application. Maximum uptake of nitrogen (119 kg/ha) by the onion was found in treatment combination 50 per cent RDF + 50 per cent VC while maximum uptake of phosphorus (57.25 kg/ha) was estimated in 50 per cent RDF + 50 per cent PM. Similarly, highest uptake of potassium (77.17 kg/ha) was investigated in 50 per cent RDF + 50 per cent VC followed by 50 per cent RDF + 50 per cent PoM. However, Yanthan *et al.* (2010) reported in his investigation that maximum uptake of nitrogen, phosphorus and potassium found in 50 per cent application of NPK along with 50 per cent vermicompost and it supports the present finding that half dose of inorganic and organic fertilizer results in maximum uptake of nitrogen. This might be due to combined application of organic and inorganic fertilizers prevent the leaching loss of nitrogen due to

**Table 1 : Initial properties of the soil and organic manures (2013-14)**

Properties	Soil	FYM	Poultry manure	Vermicompost	Pressmud
pH	8.82	-	-	-	-
Organic carbon (%)	0.35	6.60	9.30	13.05	8.80
Available nitrogen (kg/ha)	372.96	0.92	3.08	2.29	1.03
Available phosphorus (kg/ha)	20.12	0.12	2.09	1.41	2.76
Available potassium(kg/ha)	110.18	1.55	2.53	2.36	0.90
Sulphur (kg/ha)	11.78	0.88	4.60	1.76	0.22

**Table 2 : Effect of inorganic, organic and bio-fertilizers on yield of onion (2013-14)**

Treatments	Parameters	Yield per plot (kg)	Yield per hectare (tones)
Control		4.59	31.11
RDF		5.86	39.92
FYM		5.17	34.82
PoM		4.97	33.88
VC		5.27	35.06
PM		5.11	34.42
50 % RDF +50% FYM		5.82	38.89
50 % RDF +50% PoM		5.65	37.96
50 % RDF +50% VC		5.89	39.61
50 % RDF +50% PM		5.75	38.51
50 % RDF +Azo		5.47	36.87
50 % RDF +Azr		5.41	36.15
50 % RDF +PSB		5.32	35.52
75 % RDF +Azo		5.72	38.06
75 % RDF +Azr		5.57	37.80
75 % RDF +PSB		5.51	37.48
C.D. (P=0.05)		0.12	0.90
S.E. (d)		0.06	0.43

binding of nutrient in an organic base (Shahi, 2013). Less uptake of nutrient was found on application of bio-

fertilizers along with inorganic fertilizers might be due to bio-fertilizer could not be able to increase their population in absence of organic matter in soil as well as at high pH (8.82). In the same way sole application of organic manures was not effective in nutrient uptake because of slow rate of mineralization (Ngullie *et al.*, 2011).

The various treatments have also significant impact on the residual soil fertility (Table 1). The data revealed that there was significant increase in the organic carbon, available nitrogen, phosphorus, potassium and organic carbon content of the soil. There was a marked reduction in available NPK of the soil found in control. Highest content of organic carbon (0.69%) in the soil was estimated in sole use of vermicompost because it has maximum organic carbon percentage as compared to other organic manure. Maximum amount of available nitrogen (243.60 kg/ha) available potassium (163.83 kg/ha) was estimated in treatment combination 50 per cent RDF + 50 per cent VC followed by treatment combination 50 per cent RDF + 50 per cent PoM whereas maximum value for available phosphorus was obtained in treatment combination 50 per cent RDF + 50 per cent PM. This response of maximum nitrogen and potassium reserve in organic and inorganic fertilizers might be due

**Table 3 : Nutrient (N, P and K) uptake (kg/ha) by onion crop and available N, P and K of soil after harvesting as influenced by inorganic, organic and bio-fertilizers (2013-14)**

Treatments	Nitrogen uptake (kg/ha)	Phosphorus uptake (kg/ha)	Potassium uptake (kg/ha)	Available nitrogen (kg/ha)	Available phosphorus (kg/ha)	Available potassium (kg/ha)	Organic carbon (%)
Control	41.38	18.52	34.90	102.65	23.52	97.97	0.16
RDF	96.17	53.85	71.71	198.17	75.85	156.74	0.32
FYM	65.03	33.79	44.79	157.70	53.79	132.45	0.51
PoM	82.84	38.44	51.42	164.17	61.78	139.42	0.60
VC	97.69	35.82	56.34	188.69	57.49	146.34	0.69
PM	74.65	42.51	49.65	160.32	65.17	135.98	0.59
50 % RDF +50% FYM	90.80	41.13	59.09	207.82	67.80	154.76	0.48
50 % RDF +50% PoM	109.32	54.25	70.67	238.00	79.25	158.34	0.56
50 % RDF +50% VC	119.93	47.33	77.17	243.60	74.66	163.83	0.61
50 % RDF +50% PM	109.20	57.25	69.32	221.87	86.58	150.32	0.54
50 % RDF +Azo	66.45	30.69	45.64	154.46	40.36	128.64	0.35
50 % RDF +Azr	64.60	30.78	41.75	149.94	43.78	126.75	0.39
50 % RDF +PSB	59.47	32.71	42.87	145.80	52.71	129.97	0.38
75 % RDF +Azo	83.82	37.14	59.72	170.82	64.14	145.38	0.42
75 % RDF +Azr	89.80	33.76	57.70	189.13	58.10	143.70	0.44
75 % RDF +PSB	80.67	38.07	57.13	175.67	64.40	141.13	0.41
C.D. (P=0.05)	2.19	2.38	2.50	3.47	2.06	2.25	0.02
S.E. (d)	1.06	1.16	1.22	1.69	1.00	1.09	0.01

FYM= Farm Yard Manure, PoM= Poultry manure, VC= Vermicompost, PM= Pressmud, Azo= *Azotobacter*, Azr= *Azospirillum*, PSB=Phosphate Solubilising Bacteria

to organic matter improve the nitrogen pool not only due to mineralization of the organic manure but also due to better nutrient holding capacity of the organic matter. Sharma *et al.* (2009) also reported that addition of organic manure increases the available nitrogen reserve in the soil. Although, sole use of organic fertilizers also increases the nutrient reserve but in less as compared to fertilization with inorganics because of direct addition of nitrogen in the soil and slow rate of mineralization of organic matter. Application of half dose of recommended NPK along with bio-fertilizers were less effective in increasing the nutrient pool. This reduced performance of bio-fertilizers was due to absence of organic matter which in turn affects their multiplication or population in the soil. These results are also in confirmation with the finding of Desai *et al.* (2009). Use of bio-fertilizers along with organic

manure helps in conversion of organically bound nutrient to inorganic form reported by Yanthan *et al.* (2010).

### Conclusion:

From this investigation, it is concluded that application of 50 per cent recommended NPK + 50 per cent vermicompost was effective in maximum uptake of nitrogen and potassium while application 50 per cent recommended NPK + 50 per cent pressmud enhanced the uptake of phosphorus and in turn increased the yield. Soil nutrient pool increased significantly on application of 50 per cent recommended NPK + 50 per cent vermicompost. This study indicated that inclusion of half quantity of organic manure can successfully replace the half quantity of recommended NPK without affecting the yield.

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