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Influence of Integrated Nutrient Management (INM) on yield attributes and economics of kharif onion (*Allium cepa* L.) under loamy sand soils

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A B S T R A C T

A field experiment was conducted at Horticulture farm, S.K.N. College of Agriculture, Jobner (Rajasthan) during kharif, 2013 with sixteen treatment combinations including four levels of organic manures (Control; FYM @ 10 t ha-1; FYM @ 5 t ha-1 + vermicompost @ 2.5 t ha-1; FYM @ 5 t ha-1 + vermicompost @ 2.5 t ha-1+ bio-fertilizers) and four levels of inorganic fertilizers (Control, 100% R D of NPK, NPK + S, NPK + S + Zn) in Randomized Block Design with three replications. The results indicated that combined application of FYM @ 5 t ha-1 + vermicompost @ 2.5 t ha-1 + Bio-fertilizers, among the different treatments of organic manures proved significantly superior over rest of the treatments in respect to yield attributes viz., neck thickness(1.069cm), diameter of bulb (4.22cm), average weight (98.80g), bulb yield(15.81kg plot^{-1}), total bulb yield (219.56 q ha^{-1}) ; net return (Rs. 2,01,705/- ha^{-1}) and B:C ratio (3.26:1). Similarly yield attributes viz., neck thickness(1.056cm), diameter of bulb(4.29cm), average weight(96.14g), bulb yield (15.38 kg plot^{-1}), total bulb yield (213.64 q ha^{-1}); net return (Rs 195489 ha^{-1}), B: C ratio (3.21: 1) in onion bulb were significantly high in treatment of NPK,S & Zn @ 100:50:100:20 & 10 kg ha^{-1}.

Introduction

Onion (*Allium cepa* L.) is a bulbous biennial herb of family Alliaceae. It is commonly called as "Queen of kitchen" for its unique usage throughout the year in the form of salads, condiments or for cooking with other vegetables. The pungency in onion is due to sulphur compound "ally propyl disulphide" in the volatile oil and the outer skin colour is due to the presence of "querctin" (Nadkarni, 1954). Onion bulb is rich in minerals like phosphorus (50mg/100g), iron (0.7mg/100g), calcium (18mg/100g), carbohydrates (11.0g/100g), protein (1.2g/100g), vitamins 'C' (11mg/100g), fibers (0.6g/100g) and nicotinic acid (0.4mg/100g) (Aykroyd,1963).

There is ample necessity to standardise Integrated Nutrient Management (INM) for increasing production and productivity in light textured soil. Production of onion in *kharif* season is necessary to have continuous supply of onion round the year. Organic manures

stimulates the production of polysaccharides and other compounds that favours aggregation of fine soil particles, thereby promoting good structure, improved tilth, aeration, moisture movement and retention (Bose *et al*., 2001). Bio-fertiliser inoculation like *Azosprillium*, PSB helps the plants to attain better vegetative growth and increases yield by 10-30 percent (Mohondas, 1999. The present investigation was taken up to study effect of organic manures, inorganic manures and bio-fertilisers on *kharif* onion in loamy sand soil.

Materials and Methods

The experiment was conducted during 2013 at Horticulture farm, S.K.N. College of Agriculture, Jobner (Jaipur) during *rabi* season. The soil of experimental field was alkaline loamy sand in texture at *p*H 8.1, poor in organic carbon (0.135 %), available N (134.70 kg/ha), P (16.85 kg/ha), K (151.65 kg/ha) and Zn (0.42 mg/kg soil). The experiment was laid with sixteen treatment combinations including four levels of organic manures (Control; FYM @ 10 t ha^{-1}; FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1}; FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1}+ bio-fertilizers) and four levels of inorganic fertilizers (Control, 100% R D of NPK, NPK + S, NPK + S + Zn) in Randomized Block Design with three replications. Randomization of the treatments was done with the help of random number table as advocated by Fisher (1950). The plot size was 2.4 m X 3.0 m with 30 cm × 15 cm spacing between rows and plants. Farm Yard manure (FYM) and Vermicompost were spread in the beds uniformly before transplanting of seedling. *Azosprillium* and Phosphorus Solubulizing Bacteria (PSB) were applied as 100g per acre culture dissolved of water and dipping the bulb of the onion in solution for 10-20 minutes before sowing and dried in shade (Paul *et al.,* 1971). Yield attributes were calculated using standard methods. For calculating economics, the average treatment yield along with prevailing market rates for inputs and output are used. The net return was calculated by subtracting the cost of cultivation for each treatment. The 'F-test' and critical difference (CD) calculated to test significance of difference among the treatments, wherever the results were significant.

Results and Discussion

Effect of organic manures on yield and yield attributes

The significant increase in yield and yield attributes was observed with application of of FYM @ 5 t ha^{-1} + Vermicompost @ 2.5 t ha^{-1} + Bio-fertilizers (*Azosprillium* + PSB) over the control. The increase in yield and yield attributes with application of FYM + Vermicompost + Bio-fertilizers may be ascribed due to sustained availability of balanced nutrient throughout the growing period and which resulted increased vegetative growth (Warade *et al*., 1996).

Effect of inorganic fertilisers on yield and yield attributes

The significantly enhanced neck thickness, diameter of bulb, average weight of bulb and bulb yield per plot and total bulb yield ha^{-1} were observed with the increasing level of inorganic fertilizers. The application of NPK (100:50:100kg ha^{-1}) + S + Zn gave significantly maximum increase in yield and yield attributes of onion crop over control. The application of inorganic fertilizers alone might supply one or two nutrients only but combined application of macro and micro nutrient fertilizers the responses of the micronutrients viz. Mo, Fe and Zinc have also been found in promising to increase the productivity of the soil (Masood Ali and Mishra 2000), Gupta *et al.* 2012 and Chavan *et al*. 2012. The direct addition of multi nutrients might have also increased the availability of these nutrients, which in turned increased enter of nutrients.

Table.1 Effect of Integrated Nutrient Management (INM) on yield attributes and economics of *kharif* onion (*Allium cepa* L.) under loamy sand soils

Treatments	Neck thickness of bulb (cm)	Diameter of bulb (cm)	Average Weight of bulb (g)	Bulb yield (kg/plot)	Total bulb yield (q/ha)	Net Returns (Rs.)	B:C Ratio
Organic manures							
Control **(M_0)**	0.974	3.00	76.45	12.23	169.89	148334	2.66
FYM 10 t ha^{-1}**(M_1)**	1.028	3.99	87.40	13.98	194.23	175549	3.04
FYM 5 t ha^{-1} +V.C. 2.5 t ha^{-1} **(M_2)**	1.061	4.05	93.98	15.04	208.84	189078	3.07
FYM 5 t ha^{-1} +V.C. 2.5 t ha^{-1}+ Bio-fertilizers (*Azosprillium*+PSB) **(M_3)**	1.069	4.22	98.80	15.81	219.56	201705	3.26
SEm±	**0.003**	**0.05**	**0.40**	**0.06**	**0.90**	**1076**	**0.02**
CD (p=0.05)	**0.010**	**0.14**	**1.16**	**0.19**	**2.58**	**3098**	**0.05**
Inorganic fertilisers							
Control **(F_0)**	0.994	3.20	77.20	12.35	171.55	150048	2.67
NPK **(F_1)**	1.032	3.76	89.11	14.26	198.02	177835	2.96
NPK + S **(F_2)**	1.051	4.02	94.19	15.07	209.31	191293	3.19
NPK + S + Zn **(F_3)**	1.056	4.29	96.14	15.38	213.64	195489	3.21
SEm±	**0.003**	**0.05**	**0.40**	**0.06**	**0.90**	**1076**	**0.02**
CD (p=0.05)	**0.010**	**0.13**	**1.16**	**0.19**	**2.58**	**3098**	**0.05**

V.C. = Vermi-compost, FYM. = Farm Yard Manure

Table.2 Interaction effect of Organic and Inorganic fertilisers on yield attributes of *kharif* onion (*Allium cepa* L.) under loamy sand soils

Organic / Inorganic	Avg. weight of onion bulb (g)				Bulb yield (kg/plot)				Total bulb yield (q/ha)			
	M_0	M_1	M_2	M_3	M_0	M_1	M_2	M_3	M_0	M_1	M_2	M_3
F_0	60.78	75.42	84.46	88.13	9.72	12.07	13.51	14.10	135.06	167.60	187.68	195.85
F_1	72.34	85.70	97.09	101.32	11.57	13.71	15.53	16.21	160.76	190.44	215.75	225.15
F_2	80.07	94.89	99.61	102.17	12.81	15.18	15.94	16.35	177.94	210.87	221.36	227.05
F_3	92.60	93.61	94.75	103.59	14.82	14.98	15.16	16.57	205.78	208.01	210.56	230.19
SEM±	**1.61**				**0.26**				**3.59**			
CD (p=0.05)	**4.62**				**0.74**				**10.33**			

Table.3 Interaction effect of Organic and Inorganic fertilisers on economics of *kharif* onion (*Allium cepa* L.) under loamy sand soils

Organic / Inorganic	Net Returns (Rs.)				Benefit : Cost Ratio			
	M_0	M_1	M_2	M_3	M_0	M_1	M_2	M_3
F_0	109821	146870	166968	176532	2.10	2.71	2.87	3.02
F_1	136682	170290	196664	207704	2.43	2.92	3.16	3.32
F_2	157214	194732	203321	209907	2.79	3.34	3.26	3.36
F_3	189618	190303	189361	212667	3.31	3.21	2.99	3.35
SEM±	**4304**				**0.07**			
CD (p=0.05)	**12393**				**0.21**			

F_0	-	Control	M_0	-	Control
F_1	-	NPK	M_1	-	FYM 10 t ha^{-1}
F_2	-	NPK + S	M_2	-	FYM 5 t ha^{-1} +V.C. 2.5 t ha^{-1}
F_3	-	NPK + S + Zn	M_3	-	FYM 5 t ha^{-1} +V.C. 2.5 t ha^{-1}+ Bio-fertilizers (*Azosprillium* +PSB)

Interactive effect of organic and inorganic fertilisers

The interactive effect of treatments showed that increase in organic manures at the same level of inorganic fertilizers resulted in maximum average weight of bulb, bulb yield per plot and total bulb yield ha^{-1}, net return, B: C ratio under treatment combination FYM @ 5 t ha^{-1} + Vermicompost @ 2.5 t ha-^{1} + Bio-fertilizers (*Azosprillium* + PSB) and NPK (100:50:100 kg ha^{-1}) + S + Zn (Table 2 and 3).

Application of organic manures in the form of FYM and vermicompost increased the average weight of bulb and bulb yield per plot, total bulb yield ha^{-1}, net return, B: C ratio.

The beneficial response of FYM and vermicompost to yield might also be attributed to the availability of sufficient amount of plant nutrients in balanced way in inorganic form throughout the growth period and especially at critical growth period of crop resulting in better uptake, plant vigour and superior yield attributes (Rao and Sitaramayya, 2000).

Economics

The highest net return (Rs 201705Rs ha-^{1}) and B: C ratio (3.26) from the onion crop were obtained at M_3 (5 t ha-^{1} FYM + 2.5 t ha-^{1} Vermicompost + biofertilizers (Azosprillium + PSB) with NPK+S+Zn and followed by 5 t ha^{-1} FYM + 2.5 t ha^{-1} Vermi-compost) with NPK+S, net return (Rs 195489 ha^{-1}) and B:C ratio (3.21) showed in the table 1.

This clearly brings out the people to use bio-fertilizers for getting better returns.

The interaction effect of organic manures and inorganic fertilizers were found significant.

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