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SHORT COMMUNICATION

Effect of integrated nutrient management (INM) on growth and quality attributes of *kharif* onion (*Allium cepa* L.)

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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). The productivity of onion in India is very low (16.81 t ha^{-1}) in comparison to other countries. Thus there is ample necessity to standardise integrated nutrient management (INM) for increasing production in light textured soil. Production of onion in *kharif* season is more important 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 per cent (Mohondas, 1999 and Tilak and Annapurna, 1993). The present investigation was taken up to study effect of organic manures, inorganic manures and bio-fertilisers on *kharif* onion loamy sand soil.

The experiments were conducted during 2012-13 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 first experiment was laid with four treatment combinations comprising four levels of organic manures (Control; Farm Yard Manure @ 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). Similarly, second experiment was conducted with and four levels of inorganic fertilizers (Control, 100% Recommended Dose 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 Phosphate Solubilizing Bacteria 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). Growth attributes were calculated using standard methods and chlorophyll content was estimated by method advocated by Arnon (1949). Sulphur was estimated by Turbidimetric method (Tabatabi and Bremner, 1970), Zinc by digesting the sample with di acid mixture using Atomic Absorption Spectrophotometer (AAS), while phosphorus by digesting plant sample with Tri-acid mixture of HNO_3: H_2SO_4: $HClO_4$ and was estimated by "Vandomolybdo" phosphate yellow colour method (Jackson, 1973). Estimation of nitrogen was done from digested samples by colorimetric method after development of colour with Nesseler's reagent (Snell and Snell, 1939) and total soluble solids (TSS) per cent were determined using zeiss hand refractometer. The 'F-test' and critical difference (CD) calculated to test significance of difference among the treatments.

Effect of organic manures

Growth attributes

The increasing levels of organic manures significantly increased the plant height, number of leaves per plant, fresh weight of leaves and total chlorophyll content in leaves

(Table 1). The application of FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1} + bio-fertilisers (Azospirillium+PSB) gave significantly highest increase in the growth attributes. The interactive influence of mineral nutrients and organic manures + mineral nutrients on growth attributes might be due to improved physic-chemical and biological properties of the soil like water holding capacity, hydraulic conductivity, high rate of microbial transformation of complex form of nutrients in the form of organic carbon, soil aggregation, aeration and addition of certain growth regulators might have act as not only growth stimulant but also worked as sustained supply of crop nutrients in balanced form throughout the growth period of the crop (Muthuramalingam *et al*., 2001).

Quality parameters

A significant increase in TSS, nitrogen, phosphorus, sulphur and zinc content of onion bulb was observed by the application of FYM @ 5 t ha^{-1} + vermicompost @ 2.5t ha^{-1} + biofertilizers (Azosprillium+PSB) (Table 1), over control. This might be due to enhanced translocation of nutrient, vitamins and proteins in to the bulb, due to improved nutritional environment in the rhizosphere as well as its utilization in the plant system. This in turn helped in improved physiological functions of plants. The increased activity of nitrate reductase, which helped in synthesis of certain amino acids and protein can also be other reason (Ramesh *et al*., 2006, Yeptho *et al*., 2012, Choudhary *et al*., 2003 and Sharma *et al*., 2009).

Effect of inorganic fertilisers

Growth parameters

The significant increase in plant height, number of leaves, fresh weight of bulb and total chlorophyll content of leaves were observed due to increased levels of inorganic fertilisers over control (Table 1). The application of NPK (100:50:100 kg ha^{-1}) + S + Zn registered highest significant increase in the growth attributes. This might be due to increase in available nitrogen and phosphorus in rhizosphere due to atmospheral nitrogen fixing by *Azosprillium* and by activity of phosphate solubilizers (Mengistu and Singh, 1999 and Barakart and Gabr, 1998).

Quality parameters

The significant increase in the nitrogen, phosphorus, sulphur and TSS content of onion bulb was observed with application of NPK @ 100:50:100 kg ha^{-1} + S + Zn over control (Table 1). The increase in TSS, nitrogen, phosphorus, sulphur and zinc content might be due to improved nutrition environment in the rhizosphere as well as its readily utilization in the plant system, leading to enhanced translocation of nutrient in developing cell of the plant. It may also be due to the increased activity of nitrate reductage enzyme and enhanced synthesis of certain amino acids and protein (Ramesh *et al*., 2006)

Table 1. Effect of integrated nutrient management (INM) on growth and quality attributes of *kharif* onion (*Allium cepa* L.) under loamy sand soils

Treatments	Plant height (cm)	Number of Leaves	Total chlorophyll content of leaves (mg^{-1})	TSS content of bulb (%)	Nitrogen content of bulb (%)	Phosphorus content of bulb (%)	Sulphur content of bulb (%)	Zinc content of bulb (ppm)
Organic manures								
Control	48.17	9.90	0.061	9.95	0.681	0.244	0.558	13.49
FYM 10 t ha^{-1}	52.75	11.07	0.066	10.54	0.728	0.264	0.611	13.58
FYM 5 t ha^{-1} +V.C. 2.5 t ha^{-1}	57.67	12.30	0.070	11.38	0.738	0.267	0.637	13.75
FYM 5 t ha^{-1} +V.C. 2.5 t ha^{-1}+ Bio-fertilizers (Azospirillum+PSB)	59.08	13.44	0.071	12.41	0.751	0.285	0.653	15.64
SEm±	0.35	0.08	0.001	0.07	0.003	0.001	0.003	0.07
CD (p=0.05)	1.01	0.23	0.002	0.19	0.009	0.003	0.008	0.20
Inorganic fertilsers								
Control	49.67	9.91	0.061	10.34	0.696	0.250	0.591	12.72
NPK	54.58	11.90	0.067	10.64	0.715	0.259	0.607	13.35
NPK + S	56.00	12.16	0.069	11.44	0.740	0.268	0.625	15.06
NPK + S + Zn	57.42	12.73	0.070	11.87	0.757	0.282	0.637	15.34
SEm±	0.35	0.08	0.001	0.07	0.003	0.001	0.003	0.07
CD (p=0.05)	1.01	0.23	0.002	0.19	0.009	0.003	0.008	0.20

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

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