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Effect of Integrated Nutrient Management on Productivity and Economics of *Rabi* Onion (*Allium cepa* L)

Iqbal Singh Dhillon and Didar Singh

PG Department of Agriculture, Khalsa College, Amritsar 143 005 (Punjab)

ABSTRACT

The present investigation was conducted to know the effect of integrated nutrient management (INM) on productivity and economics of *rabi* onion (*Allium cepa* L.) cultivar PRO 6. The experiment was laid out in randomized block design with twelve treatments with three replications *viz.,* T_1: Control, T_2: 100% Recommended dose of nitrogenous fertilizers (RDNF), T_3: 75% RDNF + 25% N Farm yard manure (FYM), T_4: 75% RDNF + 25% N Vermicompost (VC), T_5: 75% RDNF + 25% N Poultry manure (PM), T_6: 50% RDNF + 50% N (FYM), T_7: 50% RDNF + 50% N (VC), T_8: 50% RDNF + 50% N (PM), T_9: 50% RDNF + 25% N (FYM) + 25% N (VC), T_{10}: 50% RDNF + 25% N (FYM) + 25% N (PM), T_{11}: 50% RDNF + 25% N (VC) + 25% N (PM), T_{12}: 25% RDNF + 25% N (FYM) + 25% N (VC) + 25% N (PM). The results revealed that among different treatments, T_2 (RDNF) recorded maximum plant height (64.60 cm), number of leaves (10.47), bulb diameter (7.26cm), fresh weight of bulb (73.13g), dry weight of bulb (9.29g), dry weight of leaves (1.19g) per plant and bulb yield (421.23q/ha) in terms of growth and yield attributes whereas lowest observation were recorded with treatment T_1 (control). Treatment T_2 also recorded highest net return (Rs 2,44,286/ha) and B:C ratio (1.63).

Key Words: Economics, Farm Yard Manure, Integrated nutrient management, onion, Productivity, *Rabi*.

INTRODUCTION

Onion has been described as the queen of kitchen and one of the most important vegetable crop grown in India. It is a rich source of minerals like phosphorus, calcium, carbohydrates, proteins and vitamin C (Rahman *et al,* 2013). In the year 2017-18, onion was grown over an area of 1285 thousand hectares with annual production of 23262 thousand MT in India and annual production 214.48 thousand MT from an area of 9.36 thousand hectare in Punjab (Anonymous, 2018). Though the total production has been increased but the escalating cost of inorganic fertilizers along with their undesirable effects on soil properties are hitting the small and marginal farmers.

To regulate the nutrients supply and to overcome the rise in price of inorganic fertilizers, use of organic manures should be prompt. Organic manures such as farmyard manure, vermicompost and poultry manure supply all major as well as minor nutrients. Incorporation of organic manures along with inorganic fertilizers help in increasing the yield of onion crop as compared to sole use of inorganic fertilizers (Thangasamy and Lawande, 2015). They also influence the physico-chemical properties and enhance the biological activities in soil (Jat *et al,* 2015). The supply of nutrients from integrated source of organic manures and inorganic fertilizers help not only in improving soil fertility but also help in sustaining crop productivity. Keeping this in view, a field experiment was evaluated to study the integrated effect of different nutrient sources on productivity and economics of onion.

MATERIALS AND METHODS

The field experiment was conducted at Research Farm, Khalsa College, Amritsar during *rabi* 2017-18. The geographical coordinates of the

Corresponding Author's Email: iqbaldhillon14@gmail.com

experimental sites are 31.6376 °N and 74.8370°E and height above sea level is 234m. The soil of the experimental site was sandy loam in texture. The initial physico-chemical properties of the experimental soil were bulk density (1.48 g/cm^3), particle density (2.62 g/cm^3), porosity (43.5%), pH (8.26), EC (0.33 dS/m), organic carbon (0.41%), available N (192.74kg/ha), available P (14.28 kg/ha), available K (262.54 kg/ha) and available S (6.34kg/ha). The experimental field was laid out in randomized block design with twelve treatments with three replications. Experiment comprised of T_1: control, T_2: 100% Recommended dose of nitrogenous fertilizers (RDNF), T_3: 75% RDNF + 25% N through farmyard manure (FYM), T_4: 75% RDNF + 25% N through vermicompost (VC), T_5: 75% RDNF + 25% N through poultry manure (PM), T_6: 50% RDNF + 50% N (FYM), T_7: 50% RDNF + 50% N (VC), T_8: 50% RDNF + 50% N (PM), T_9: 50% RDNF + 25% N (FYM) + 25% N (VC), T_{10}: 50% RDNF + 25% N (FYM) + 25% N (PM), T_{11}: 50% RDNF + 25% N (VC) + 25% N (PM), T_{12}: 25% RDNF + 25% N (FYM) + 25% N (VC) + 25% N (PM).

The onion cultivar Punjab Round Onion (PRO 6) was sown in nursery during November and transplanted in last week of December (27th Dec, 2017) with a spacing of 15 x 7.5 cm between rows and plants, respectively. Recommended dose of fertilizers for *rabi* onion was 100:50:50 kg NPK/ha. Nitrogen was supplied through urea, phosphorus through single super phosphate and potassium through muriate of potash. Nitrogen was applied in two splits *i.e.* one half of N before transplanting and remaining dose of N after six weeks as top dressing. Entire quantity of phosphorus and potassium was applied as basal dose. All the manures in required quantities were applied as per the treatments duly taking into account their nitrogen content based on dry weight basis and incorporated in soil 15 d before transplanting the onion seedlings. The nitrogen of farmyard manure, vermicompost and poultry manure were 0.88 percent, 1.74 percent and 2.31percent, respectively. The crop was harvested manually when most of the leaves dried and neck fall down indicating maturity. The benefit:cost ratio was calculated with the help of gross and net income. The analysis of the statistical data was done with the help of OPSTAT software.

RESULTS AND DISCUSSION

Growth parameters

The perusal of data related to plant height and number of leaves per plant (Table 1) signifies a progressive increase with the advancement in crop age as influenced by various treatments. The result showed that the increase in plant height and number of leaves per plant was rapid from 30 to 60 days after transplanting (DAT), thereafter height increased up to 90 DAT but at a slower rate. Among different treatments, T_2 (100% RDNF) recorded highest plant height and number of leaves per plant at 60 and 90 DAT which was at par with T_5 (75% RDNF + 25% PM) and T_4 (75% RDNF + 25% VC) but significantly superior than all other treatments. This might be due to quick release of nutrients and more availability of nitrogen from inorganic fertilizers. These results were in close conformity with the findings of Assefa *et al* (2015) and Mahala *et al* (2018) in onion. Moreover, nitrogen is associated with increase in protoplasm, cell division and cell enlargement resulting in taller plants (Tisdale *et al,* 2016). Among organic manures, better plant growth in terms of plant height and number of leaves per plant in poultry manure might be due to higher N content that become readily available to crop (Farooq *et al,* 2015) and involvement of certain growth promoting substances such as NAA, cytokinines, gibberellins which might have accelerated the higher production of carbohydrates which ultimately results in maximum number of leaves per plant (Ramesh *et al,* 2017). Better performance of vermicompost over FYM treated plots might be due to its presence of macronutrients and micronutrients (Reddy and Reddy, 2005).

Table 1. Growth attributes of onion as influenced by different integrated nutrient sources.

Treatment	Periodic plant height (cm)			Periodic no. of leaves/plant		
	30 DAT	60DAT	90DAT	30DAT	60DAT	90DAT
T_1	16.87	22.51	28.57	1.85	3.30	5.51
T_2	25.33	54.93	64.60	4.60	8.43	10.47
T_3	22.76	44.90	55.51	3.59	6.53	8.97
T_4	23.03	49.93	60.20	3.68	7.69	9.90
T_5	24.97	50.87	62.83	4.14	7.90	10.33
T_6	20.03	32.57	39.62	2.68	4.49	7.06
T_7	21.23	35.45	48.13	3.04	5.17	8.02
T_8	21.61	42.47	54.33	3.13	5.98	8.85
T_9	20.13	34.67	42.33	2.77	4.69	7.14
T_{10}	20.57	35.85	43.42	2.83	4.72	7.22
T_{11}	21.50	37.43	49.61	3.07	5.23	8.05
T_{12}	19.67	27.54	34.91	2.00	3.98	6.21
LSD (p=0.05)	N.S	5.02	4.68	N.S	0.74	0.79

N.S= Not Significant

Yield attributes

The result on yield attributes like bulb diameter, fresh weight of bulb, dry weight of bulb, dry weight of leaves and bulb yield were significantly influenced by different integrated nutrient treatments (Table 2). The maximum bulb diameter (7.26 cm), fresh weight of bulb (73.13 g), dry weight of bulb (9.29 g), dry weight of leaves (1.19 g) and bulb yield (421.23 q/ha) was recorded with the application of 100% RDNF (T_2) which was at par with 75% RDNF + 25% N through PM (T_5) and 75% RDNF + 25% N through VC (T_4) and significantly superior than all other treatments. The minimum bulb diameter (3.78 cm), fresh weight of bulb (33.83 g), dry weight of bulb (3.96 g), dry weight of leaves (0.44 g) and bulb yield (163.20 q/ha) was noticed in absence of organic and inorganic fertilizers (T_1). The magnitude of increase in bulb diameter, fresh weight of bulb, dry weight of bulb, dry weight of leaves and bulb yield in T_2 over T_1 was 92.06, 116.17, 134.60, 170.45 and 158.11 percent, respectively. Numerically the trend in various treatments for all yield parameters was $T_2>T_5>T_4>T_3>T_8>T_{11}>T_7>T_{10}>T_9>T_6>T_{12}>T_1$. The increase in yield parameters under 100% RDNF (T_2), 75% RDF + 25% N through poultry manure (T_5) and 75% RDNF + 25% N through vermicompost might be due to the higher N content which result in increased growth performance with respect to plant height and number of leaves per plant resulting in better photosynthesis and better translocation of photosynthates in storage organ of bulb resulting in increased weight of bulb, bulb diameter and ultimately bulb yield. Similar results have been reported by Kaswan *et al* (2017) and Mahala *et al* (2018). Moreover, the nitrogen application might have influenced the availability of other nutrients also especially phosphorus and sulphur and thus better nutrition, ultimately leading to increased bulb yield (Assefa *et al,* 2015).

The increased yield and yield parameters with poultry manure might be because of rapid availability and utilization of nitrogen for various internal plant processes for carbohydrates production. Later on these carbohydrates may undergo hydrolysis and get converted into reducing sugars which ultimately helped in increasing yield. The higher carbohydrates content due to application of poultry manure may be attributed to balanced

Table 2. Yield attributes of onion as influenced by different integrated nutrient sources.

Treatment	Bulb diameter (cm)	Fresh weight of bulb (g/plant)	Dry weight of bulb (g/plant)	Dry weight of leaves (g/plant)	Bulb yield (q/ha)
T_1	3.78	33.83	3.96	0.44	163.20
T_2	7.26	73.13	9.29	1.19	421.23
T_3	6.48	63.79	7.88	0.99	361.20
T_4	7.05	68.98	8.68	1.10	394.23
T_5	7.19	70.80	8.92	1.14	407.00
T_6	5.12	45.29	5.57	0.68	250.20
T_7	5.74	54.47	6.80	0.84	305.73
T_8	6.34	60.95	7.49	0.95	346.90
T_9	5.16	48.03	5.98	0.73	268.00
T_{10}	5.21	49.58	6.04	0.74	276.83
T_{11}	5.81	56.07	6.84	0.85	315.90
T_{12}	4.59	40.41	4.87	0.55	206.30
LSD (p=0.05)	0.52	4.86	0.64	0.09	27.03

Table 3. Effect of integrated nutrient management on economic analysis.

Treatment	Total cost (Rs)	Gross return(Rs)	Net return(Rs)	B:C ratio
T_1	87536	130560	43024	0.49
T_2	92698	336984	244286	2.63
T_3	94724	288960	194236	2.05
T_4	97911	315384	217473	2.22
T_5	95462	325600	230138	2.41
T_6	94880	200160	105280	1.10
T_7	103598	244584	140986	1.36
T_8	98637	277520	178883	1.81
T_9	99256	214400	115144	1.16
T_{10}	96800	221464	124664	1.29
T_{11}	99682	252720	153038	1.53
T_{12}	102087	165040	62953	0.61

Note: Selling price (Rs/kg) : Onion bulb: 8.00

Input Price (Rs/kg) : FYM : 0.5, Vermicompost : 2.50, Poultry manure : 1.00, Urea : 6.57, SSP : 7.24, MOP : 19.4

C : N ratio and increased activity of plant metabolisms. These results were in close conformity with the findings of Chattoo *et al* (2010) and Farooq *et al* (2015).

Economics

Among various treatments, the highest benefit: cost ratio of 2.63 was recorded in treatment T_2 (RDNF) while minimum benefit : cost ratio of 0.49 was observed in T_1 (control) as presented in Table

3. The Treatment, T_2 recorded highest B:C ratio due to maximum yield obtained with less cost of production as compared to all other treatments.

CONCLUSION

It can be concluded that among different treatments, application of 100% RDNF found the most effective treatment in respect of growth, yield attributes, bulb yield along with highest net return and B:C ratio. It was at par with 75% RDNF + 25% N (PM) and 75% RDNF + 25% N (VC).

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