

## Onion (*Allium cepa*) yield under different integrated nutrient management interventions

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### Abstract

Various nutrient interventions affect onion yield and storage quality. Integrated nutrient management interventions need be evaluated for their effect on yield of *rabi* onion. Three farmyard manure (FYM) rates (0, 25 and 50 t ha<sup>-1</sup>), three nitrogen (N) rates (75, 100 and 125 kg N ha<sup>-1</sup>), three P rates (30, 50 and 70 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) and three K rates (30, 50 and 70 kg K<sub>2</sub>O ha<sup>-1</sup>) were tested on Punjab Naroya cultivar by using Latin Square Design. A control plot was kept with each rate of FYM application. The treatments were replicated over three artificially created fertility strips. Fertilizer N was the most limiting element. Higher FYM rates though can be used to reduce N, P, and K fertilizer rates, but doubling FYM rate from 25 to 50 t ha<sup>-1</sup> did not benefit in general. Bulb yield data indicated that 25 t ha<sup>-1</sup> FYM, 100 kg N ha<sup>-1</sup>, 50 kg of P and K ha<sup>-1</sup> gave the best results. The results hold significance in view of higher FYM rate recommendation (50 t ha<sup>-1</sup>) in certain states.

**Key words:** *Rabi* onion, fertilizer, farmyard manure, integrated nutrient management, nitrogen, phosphorus, potassium.

### Introduction

India with about 20% share in the world onion (*Allium cepa* L.) production is the second largest producer, next to China (Govt. of India, 2013). Owing to its large demand resulting from export potential and wide use as condiment in Indian cuisine, over the past 30 years, both the area and production of onion have undergone a sea change. The 250 thousand hectares area under this crop in 1980-81 has risen four-fold to 1087 thousand hectare, whereas the corresponding increase in production has been from 9961 thousand tonnes to 17511 thousand tonnes (Govt. of India, 2013). This trend in productivity has been the result of high yielding varieties, expansion of irrigation facilities and high inorganic fertilizer use.

Onion roots seldom branch and lack adequate root hair. As a result, it is highly responsive to irrigation and fertilizer use (Melo, 2003), especially nitrogen (N) (Kumar *et al.*, 2001). High use of N fertilizers has, however, been implicated in impaired storage quality of onion (Shukla *et al.*, 1993). Therefore, integrated nutrient management interventions are recommended as an alternative in order to ensure less reliance on inorganic N (Tumbare and Pawar, 2003) and to enhance shelf life of onion (Sankar *et al.*, 2009). Anecdotal evidence from Punjab state suggests that in addition to nitrogen (N) fertilizer, farmers also use lavish doses of phosphorus (P) and potassium (K) fertilizers in quest of higher returns. Highly subsidized fertilizer supply stokes the situation and leads to environmental problems.

Onion in India is grown in three seasons: *Rabi*, *Kharif* and late *Kharif*. *Rabi* crop is harvested in May-June and it shares 60-65% of the total onion production in the country (Govt. of India, 2014). In the quest of higher yields, onion growers use high amounts of FYM along with high fertilizer rates. General reports from Punjab state however reveal that excessive FYM or N fertilizer use impairs storage quality. Keeping in view the scenario stated above, the study was conducted with the objective of evaluating

*rabi* onion bulb yield response to FYM, N, P, and K fertilizer based nutrient management regimes so as to select optimum fertilizer rates.

### Materials and methods

A field experiment was conducted at Punjab Agricultural University, Soil Science Research Farm, Ludhiana during the year 2011-12 by subjecting onion (var. Punjab Naroya) seedlings to N, P, and K fertilizer combinations that were further integrated with variable rates of FYM application. The experimental design was Latin Square with three rates of FYM (0, 25 and 50 t ha<sup>-1</sup>), three nitrogen (N) rates (75, 100 and 125 kg N ha<sup>-1</sup>), three P rates (30, 50 and 70 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) and three K rates (30, 50 and 70 kg K<sub>2</sub>O ha<sup>-1</sup>). A control plot was kept with each rate of FYM application. The treatments were replicated over three artificially created fertility strips. Healthy Punjab Naroya onion seedlings were raised and planted by following recommended package of practices (PAU, 2013). The cured bulb yield was recorded at maturity. The data were analyzed by using SAS Enterprise Guide 4.3 (SAS Inc. Cary, NC, USA)

### Results and discussion

Data in Table 1 and Fig. 1 suggest that use of FYM improved onion bulb yield. However, the effect became negative in most cases when the application rate exceeded 25 t ha<sup>-1</sup>. The results were particularly negative when fertilizer N dose was on higher side. Therefore, for good results inorganic N fertilizer use should be balanced with FYM dose. Keeping in view, the scarcity of FYM owing to lack of matching livestock population, the medium FYM dose of 25 t ha<sup>-1</sup> is adequate. The negative impact of high FYM dose on yield at high fertilizer levels and positive at lower fertilizer levels rendered the overall correlation of FYM with bulb yield quite low and insignificant (Table 2).

Trends in Fig. 2 along with the results in Table 1 show that in general, fertilizer N rate of 100 kg ha<sup>-1</sup> was optimum. However, at

Table 1. Average bulb yield of rabi onion at different FYM, fertilizer N, P, and K level

N (kg ha <sup>-1</sup> )	Yield (q ha <sup>-1</sup> )	P <sub>2</sub> O <sub>5</sub> (kg ha <sup>-1</sup> )	Yield (q ha <sup>-1</sup> )	K <sub>2</sub> O (kg ha <sup>-1</sup> )	Yield (q ha <sup>-1</sup> )
FYM=0 t ha <sup>-1</sup>					
0	93.1±18.8	0	102.0±18.5	0	115.3±24.9
75	116.1±21.3	30	99.3±11.8	30	111.8±10.0
100	140.0±8.7	50	143.7±11.5	50	133.9±12.3
125	128.4±12.4	70	130.9±3.7	70	136.6±14.8
FYM=25 t ha <sup>-1</sup>					
0	108.1±11.8	0	115.6±13.1	0	122.3±17.3
75	125.0±5.5	30	132.1±5.4	30	131.0±10.0
100	149.7±6.0	50	139.4±9.5	50	136.6±6.8
125	133.8±9.1	70	140.0±6.1	70	145.0±9.6
FYM=50 t ha <sup>-1</sup>					
0	106.4±3.0	0	109.4±5.3	0	117.2±12.6
75	143.8±10.7	30	139.8±11.5	30	136.4±7.1
100	128.9±7.0	50	136.3±6.5	50	138.1±8.0
125	139.2±11.4	70	126.9±15.3	70	117.1±16.4

higher FYM level of 50 t ha<sup>-1</sup> the N fertilizer dose can be reduced by 25%. Data also show that N fertilizer doses higher than 100 kg ha<sup>-1</sup> prove counterproductive. Notwithstanding the mix of negative and positive trends, the bulb yield was most significantly related positively to N fertilizer application (Table 2).

Phosphorus fertilizer effects on rabi onion bulb yield, presented in Table 1 and Fig. 3 exhibit that optimum P fertilizer dose was 50 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>. However, when FYM was used, the response to P added beyond this level was not appreciable in general. This is also corroborated by the correlation coefficient of fertilizer P to yield. It was significant only when no FYM was used. Therefore, there exists possibility of reducing P fertilizer dose when FYM is used.

Potassium fertilizer and yield relationships seem to show anomalous behavior as is evident from Table 1 and Fig. 4. Lack of

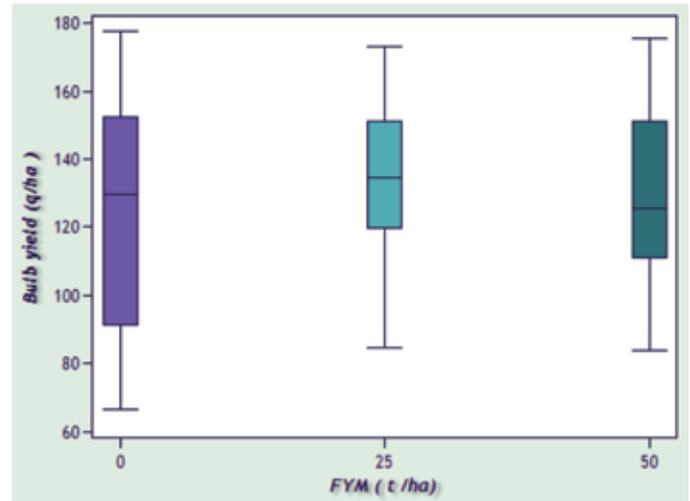


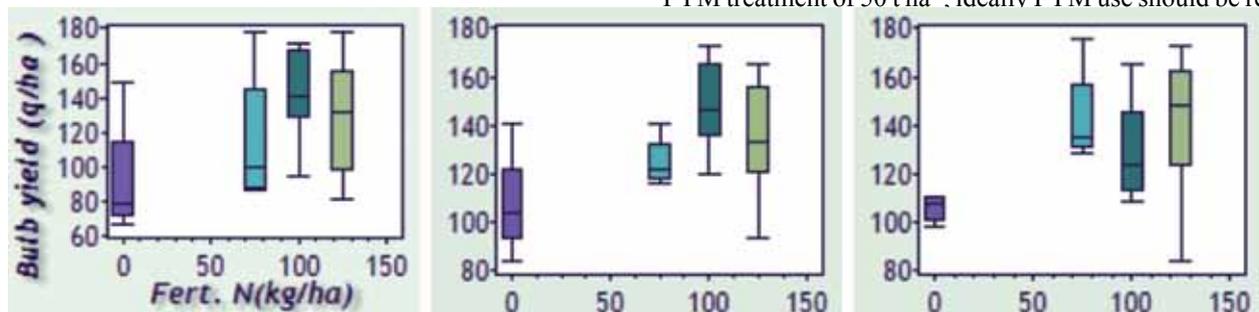
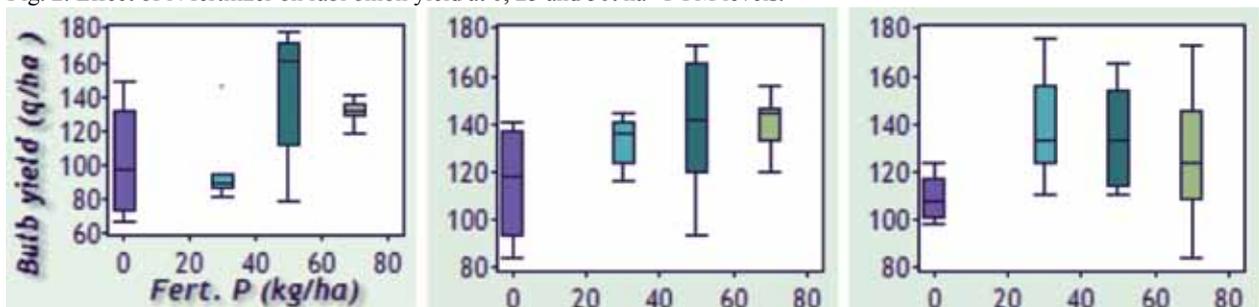
Fig. 1. Rabi onion bulb yield as influenced by FYM application

Table 2. Correlation of rabi onion bulb yield with fertilizer N, P, and K at different FYM levels (t ha<sup>-1</sup>)

0		25		50	
Fertilizer	Correlation	Fertilizer	Correlation	Fertilizer	Correlation
N	0.411*	N	0.472**	N	0.405*
P	0.414*	P	0.351	P	0.224
K	0.260	K	0.293	K	0.063

strong correlation between yield and K application also supports this observation. However, when trends are watched at different FYM levels, it appears that 50 kg K<sub>2</sub>O ha<sup>-1</sup> seems to be adequate in most cases. However, again FYM application seems to contribute towards K nutrition of the rabi onion crop.

Overall, onion crop in rabi season on alluvial soils of northwest region can be grown profitably by using FYM @ 25 t ha<sup>-1</sup>, fertilizer N @ 100 kg ha<sup>-1</sup>, fertilizer P at the rate of 50 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>, and fertilizer K at the rate of 50 kg K<sub>2</sub>O ha<sup>-1</sup>. At higher inorganic N levels, higher FYM application rates *viz.* 50 t ha<sup>-1</sup> impact yields negatively in general. Since, FYM treatment of 25 t ha<sup>-1</sup> without any N, P or K fertilizer use did not differ much from the similar FYM treatment of 50 t ha<sup>-1</sup>, ideally FYM use should be restricted

Fig. 2. Effect of N fertilizer on rabi onion yield at 0, 25 and 50t ha<sup>-1</sup> FYM levels.Fig. 3. Effect of P fertilizer on rabi onion yield at 0, 25 and 50t ha<sup>-1</sup> FYM levels.

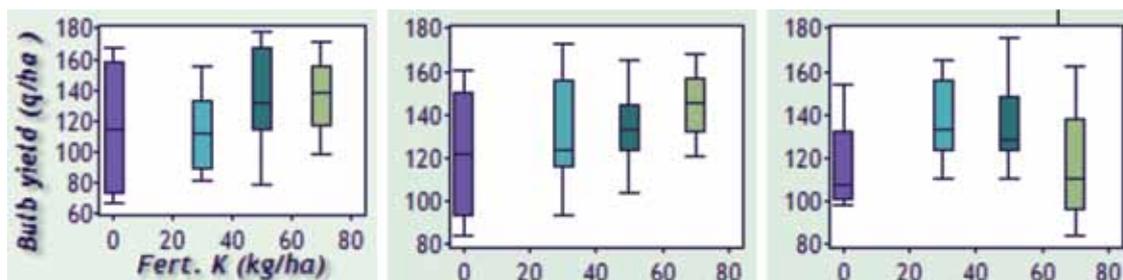


Fig. 4. Effect of K fertilizer levels on rabi onion bulb yield at 0, 25 and 50 t ha<sup>-1</sup> FYM levels.

to 25 t ha<sup>-1</sup> or other suitable dose less than 50 t ha<sup>-1</sup> worked out from the statistical models or further refined experiments.

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