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## Integrated nutrient management: A sustainable approach for onion production

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**Abstract**

Onion is one of the most commercial vegetable which belongs to family Alliaceae. It is also used as spices and medicinal crop. Onion is classified as high value cash crop and have high domestic demand and good export potential. Being a shallow rooted and long duration crop nutrition play important role in its production. It require and often respond well to additional dose of fertilizers (organic, inorganic). Inorganic fertilizers are mainly used to obtain high yield. Long term use of these fertilizers adversely affect the soil fertility and also cause environment pollution. To maintain the sustainable production and soil health integrated nutrient approach should be used. Integrated use of organic and inorganic fertilizers improve the bulb size, quality and also increases the yield in comparison with the exclusive application of any one source of nutrient.

**Keywords:** Onion, Growth, Yield, Economics, Quality, Sustainable production

**Introduction**

Onion (*Allium cepa* L.) is one of the important bulb crop belongs to family Alliaceae. The green leaves, immature and mature bulbs are eaten raw or used in preparation of vegetables. Onion is also used in preparing soups, sauces, pickles and for flavouring food. It is commonly known as “Queen of the Kitchen”, because of its highly valued flavor, aroma and unique taste and the medicinal properties of its flavour compound (Griffiths *et al.* 2002) [13]. Onion is rich in protein, calcium, phosphorus and carbohydrates (Bhattacharjee *et al.* 2013) [6]. The pungency present in onion is due to volatile oil ‘allyl propyl disulphide’ organic compound that is rich in Sulphur. India is second largest producer of onion in world and third in export. In India, it is grown in area of 1270.4 thousand hectare with an annual production of 21563.9 thousand metric tonnes (Anonymous, 2017) [3]. Onion is heavy feeder of mineral elements and require balance application of nutrients for better production. Generally heavy application of inorganic fertilizers are used to obtain a higher yield. Imbalance and long term use of inorganic fertilizers affects the soil fertility and environment along with human health. Inorganic fertilizers are expensive and increases the cost of cultivation. Organic manures can serve as alternative to inorganic fertilizers for improving soil structure and microbial biomass. Application of organic manures alone improves soil health, but the bulb yield reduced by 22-45% (Lawande *et al.* 2009) [19]. Therefore, appropriate combinations of inorganic fertilizers and organic manures are essential for increasing the bulb yield and for maintaining soil health. The adoption of integrated nutrient management approaches holds the key in enhancing the productivity as well as quality of produce in an eco-friendly manner.

- **Effect of organic manures and inorganic fertilizers on growth and yield of onion:**

Vani *et al.* (2019) [36] reported that combined application of 75% RDN through vermicompost + 25% N through chemical fertilizer was recorded significantly superior to other treatments with respect to yield. Ali *et al.* (2018) [4] concluded that application of organic manure (poultry manure) significantly improved the plant height (79.3cm), bulb diameter (10.2cm), average bulb weight (93.4g) and total yield ha<sup>-1</sup> (33.9tonnes), while more number of bulb kg<sup>-1</sup>(13.1) was noticed with control treatment.

Mahala *et al.* (2018) [20] reported that application of 75% RDF of NPKS, poultry manure at 5 t per ha and PSB (Phosphate solubilizing bacteria) + *Azospirillum* considerably increased the yield of onion. Singh and Singh (2018) [32] revealed that maximum value of bulb yield per ha

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was obtained under the treatment 10t per ha vermicompost + 75% RDF. Vachan and Tripathi (2018) [35] revealed that the bulb yield and yield components such as bulb length, bulb diameter and bulb weight, gross returns and net returns were highest with the application of 100% RDF + Azospirillum + PSB.

Gebremichael *et al.* (2017) [11] showed that combined application of 5 t per ha vermicompost + 50% inorganic N fertilizers recorded the highest plant height (71.67 cm), leaf number (16.15), leaf length (45.19 cm), neck thickness (1.51 cm), bulb length (5.51 cm), bulb diameter (5.90 cm), mean bulb weight (92.64 g), biological yield (131.42 g), harvest index (82.18%), marketable yield. Kumar *et al.* (2017) [18] revealed that the application of 5 t per ha FYM + 2.5 t per ha vermicompost + biofertilizers (*Azospirillum* + *PSB*) recorded the highest bulb yield and net returns.

An experiment was conducted by Adeyeye *et al.* (2017) [2] at the Teaching and Research Farm of Federal University Wukari, Taraba State Nigeria to compare the influence of poultry manure, cow dung, organic manure, NPK (15:15:15) and urea on the growth and yield of onion. The recommended amounts of poultry manure (10 t per ha) cow dung (10 t per ha) organic manure (10 t per ha) NPK (400 kg per ha) and urea (200 kg N per ha) were used as treatments with a control (0 kg per ha). The results showed that all the treatments significantly improved the growth and yield parameters of onion. Poultry manure produced significantly higher number of leaves (50.60), shoot weight (20.96 g) and bulb weight (50.60 g). Bulb height was considerably higher in poultry manure, organic manure and NPK applications.

Chavan *et al.* (2016) [8] showed that maximum values of plant height (57.18 cm) and number of leaves (9.90) at harvest were recorded in treatment 50% N through poultry manure + 50% N through neem cake. Weight of bulb (126.64 g), diameter of bulb (65.47 mm), yield per plot (19.49 kg) and yield per ha (54.13) were found significantly maximum in treatment 50% N through vermicompost + 50% N through poultry manure.

Talwar *et al.* (2016) [33] revealed that *Azotobacter* along with 100% NPK improves vegetative growth, whereas *Azospirillum* along with 100% NPK improves yield and yield attributes of onion. Vedpathak and Chavan (2016) [37] discovered that highest length of leaves (cm per plant), single bulb weight (gm per plant) and bulb yield (Kg per plot) were maximum with application of recommended dose of NPK (100, 50, 50) as compared to other fertilizer treatments.

An experiment was conducted by Shah *et al.* (2016) [30] to find out the collective effect of inorganic fertilizers (NPK) and organic manures [vermicompost, poultry manure and farmyard manure (FYM)] on growth, yield and quality of onion cv. Pusa Madhvi. The results revealed that maximum plant height (73.18 cm), leaf length (56.10 cm), leaf width (4.51 cm), root length (8.02 cm), fresh weight of leaves (55.27 g) and dry weight of leaves (19.61 g) was recorded under the Recommended dose of fertilizers (RDF) 75% + poultry manure 25%. While the neck length (5.08 cm), neck diameter (2.04), and specific gravity (1.47) was recorded maximum under the RDF 100%. The maximum number of leaves (13.60), number of roots per plant (159.40), bulb diameter (6.59 cm), fresh weight of bulb (159.79 g), number of scale per bulb (6.56), yield per hectare (41.88 q) was recorded highest under the RDF 75% + vermicompost 25%. The fresh weight of root (4.24 g) and dry weight of root (2.02 g) was recorded maximum under the RDF 50% + FYM 50%. Moradi (2015) [25] reported that application of sheep manure increased fresh weight, dry weight, plant volume, bulb

diameter, bulb height and plant height by 96.05, 104.48, 95.86, 37.48, 26.93 and 17.41% compared to control. Gopakkali and Sharanappa (2014) [12] showed that application of enriched biodigested liquid manure (EBDLM) at 100 kg N equivalent per ha + 3 sprays of panchagavya (3%) recorded the highest plant height (42.3 cm), leaves per plant (8.1), leaf diameter (1.46 cm), leaf-area index (4.26 cm<sup>2</sup>), fresh weight of bulb (143.7 g), bulb yield (42.8 tonnes per ha), neck diameter (1.42 cm), bulb diameter (6.02 cm), bulb length (5.36 cm), bulb size index (32.26 cm<sup>2</sup> per bulb).

Mandal *et al.* (2013) [21] described that the application of 50% vermicompost + 50% NPK recorded maximum plant height, neck diameter, bulb polar and equatorial diameter, whole plant weight, average bulb weight and bulb yield of onion over other treatments. Zedan (2011) [39] reported that application of sheep manure at the rate 15 q ha<sup>-1</sup> increased plant height, vegetative growth weight and bulb length significantly. Jawadagi *et al.* (2012) [16] recorded maximum leaf length and number of leaves in onion with the application of RDF (125:50:125: N:P:K kg per ha) + FYM at the rate 30 t per ha. Chattoo *et al.* (2010) [7] concluded that higher bulb yield (33.67 t per ha) was registered in the application of poultry manure with 75: 30: 30 NPK kg per ha.

Chuda *et al.* (2009) [9] showed that the treatment of 50% NPK + 50% FYM recorded significantly higher plant height (45.45 cm), number of leaves per plant (12.67), neck thickness (2.95 cm), bulb size (5.84 cm), doubling (1.78%), bulb yield (141.47 q per ha) and dry matter (12.85%). Sankar *et al.* (2009) [28] reported that panchagavya + 100% recommended dose of NPK fertilizers facilitated in maintaining higher number of leaves in onion throughout the crop growth period.

#### • Effect of organic manures and inorganic fertilizers on quality and economics of onion:

Hafez and Geris (2019) [14] reported that combined application of nitrogen (100 Kg per hac) and foliar application of humic acid (1Kg fed<sup>-1</sup>) was found to be the best combined rates, for giving the highest bulb yield with the highest net returns 12580 EGP (Dolar = 17.80 EGP) with B: C ratio of 2.35.

Abou-El-Hassan *et al.* (2018) [1] conducted a field experiment at Giza Agriculture Research Station, Giza Governorate, Egypt to compare the influence of compost, vermicompost and plant growth promoting rhizobacteria (PGPR) on growth, yield, quality and storage of certain onion cultivars. Compost, vermicompost and PGPR as individual or combined treatments and recommended mineral fertilizers (RMF) were applied on three onion cultivars (Giza 20, Giza Red and Giza 6 Mohassan). The results revealed that "Giza 20" and "Giza red" recorded the highest values of bulb quality (TSS, dry matter and firmness) compared to "Giza 6 mohassan". This study suggested that application of vermicompost + PGPR with "Giza 20" give higher bulb quality at harvesting and during storage but application of RMF decreased bulb quality at harvesting and at the end of storage period. Prasad *et al.* (2017) [26] revealed that combined application of manure + *Azotobacter* + woodash + phosphorus solubilizing bacteria + oil cake improved significantly total sugars (7.95%), total soluble solids (9.01°B), acidity (0.857) and TSS: acidity ratio (11.12) in onion

Dhaker *et al.* (2017) [10] showed that application of 100% RDF through vermicompost + *PSB* + *Azotobacter* significantly influenced the TSS (°B) and allyl propyl content (ppm). Sharma *et al.* (2017) [31] described that maximum total sugar (6.60) was recorded under the (RDF100%).

Considerably higher TSS (13.7°B) was recorded under the 20 t per ha FYM + (state recommended) NPK (125-100-100 kg per ha). Maximum pyruvic acid (8.1 μmol per g) was recorded under the 10 t per ha FYM + mustard oil cake (1 t per ha) + (state recommended) NPK (125-100-100 kg per ha) and 10 t per ha FYM + mustard oil cake (1 t per ha) + (soil test based) NPK (156-100-75 kg per ha).

Rabari *et al.* (2016)<sup>[27]</sup> showed that higher TSS (13.38 %) was recorded under the 75% RDF + Vermicompost at 1.25 per ha and application of 75% RDF + Vermicompost @ 1.25 ha<sup>-1</sup> (T7) registered the highest net realization of Rs. 1,18,637 ha<sup>-1</sup> with the highest ICBR of 1:3.44 followed by 75% RDF + NADEP compost @ 1.75 ha<sup>-1</sup> (T5) with net realization of Rs. 1,03,677 ha<sup>-1</sup> and ICBR of 1:2.50. Whereas, the treatment T3 (NADEP compost at the rate 7 ha<sup>-1</sup>) recorded the lowest net realization of Rs. 71,952 ha<sup>-1</sup> with the lowest ICBR of 1:0.18. Meena *et al.* (2016)<sup>[24]</sup> described that maximum cost : benefit ratio (1 : 3.97) was achieved by combined application of 60 per cent recommended dose of fertilizer of NPKS + neem cake 6 q ha<sup>-1</sup> + vermicompost 20 q ha<sup>-1</sup> + *Azotobacter* 2 kg ha<sup>-1</sup> + PSB 2 kg ha<sup>-1</sup>. Baraik *et al.* (2016)<sup>[5]</sup> reported that organic management practices emerged best in terms of benefit-cost ratio (3.63).

Meena *et al.* (2015)<sup>[22]</sup> described that growth attributes, total soluble solids and nitrogen content in onion bulb increased considerably with the combined application of FYM at 5 t per ha + vermicompost at 2.5 t per ha. However, phosphorus and sulphur content of bulb were considerably increased with the application of FYM 5 t per ha + poultry manure at 2.5 t per ha.

Thangasamy and Lawande (2015)<sup>[34]</sup> reported that maximum pyruvic acid content was recorded with application of 100% RDF (3.0 μmoles per g fresh onion) followed by 100% RDF + 20 t FYM per ha (2.9 μmoles per g fresh onion) and 75% RDF + 7.5 t poultry manure per ha (2.8 μmoles per g fresh onion). The highest total soluble solids were observed with application of 75% RDF along with 5.0 t FYM, 2.5 t PM and 2.5 t vermicompost per ha.

Meena *et al.* (2014)<sup>[23]</sup> reported that the highest net returns (Rs 74,233 ha<sup>-1</sup>) was obtained due to 100% as poultry manure followed by 125% RND as poultry 16 manure (Rs 72,195 ha<sup>-1</sup>) which was 105.05% higher than control (Rs. 36,202 ha<sup>-1</sup>). The benefit: cost ratio was also highest with 100% RND applied as poultry manure (2.33).

Kandil *et al.* (2013)<sup>[17]</sup> showed that foliar application of humic acid 4.76 liter per ha twice after 60 and 80 days from transplanting in onion significantly influenced TSS and total weight loss (%) of bulb at 2, 3, 4 and 5 months after harvesting.

Jamir *et al.* (2013)<sup>[15]</sup> reported that the combination of 50% NPK + 50% FYM was found to be the most profitable treatment in onion exhibiting highest net return of Rs 1, 29,260 ha<sup>-1</sup> with cost: benefit ratio of 1:3.5 followed by Rs 1, 15,500 ha<sup>-1</sup> in the treatment 50% NPK + 50% Pig manure + *Azospirillum*.

Yoldas *et al.* (2011)<sup>[38]</sup> showed that highest Na content was determined at the 40 t per ha doses of cattle manure as 0.13% and K content was maximum at 60 t per ha dose (4.09%).

Seran *et al.* (2010)<sup>[29]</sup> stated that half fold of the inorganic fertilizer and compost at the rate of 4 t ha<sup>-1</sup> give profitable yield (4.75 t ha<sup>-1</sup>) and this combination could possibly reduce the cost of production in the cultivation of onion.

## Conclusion

The literature reveals that, the practise of integrated nutrient management (INM) help in better crop growth, yield and

quality of onion and ultimately help the growers in earning better net returns if applied in proper manner and in suitable doses. Combined application of organic and inorganic fertilizers also help to maintain the soil fertility and reduces environment pollution.

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