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Effect of integrated nutrient management on yield of onion (*Allium cepa* L.) under North Gujarat condition

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Abstract
The present study was conducted to find out the effect of integrated nutrient management (INM) on yield of onion (*Allium cepa* L.) under North Gujarat Condition in the year 2016-17 during *rabi* season at College of Horticulture, S.D. Agricultural University, Jagudan, Gujarat. The experiment was laid out in randomized block design with three replications and total thirteen treatments were evaluated *viz.*, T_1: 100% RDF (100:50:50 kg NPK/ha + 20 tonne FYM/ha); T_2: 25% RDN through FYM + 75% N through chemical fertilizer; T_3: 50% RDN through FYM + 50% N through chemical fertilizer; T_4: 75% RDN through FYM + 25% N through chemical fertilizer; T_5: 25% RDN through vermicompost + 75% N through chemical fertilizer; T_6: 50% RDN through vermicompost + 50% N through chemical fertilizer; T_7: 75% RDN through vermicompost + 25% N through chemical fertilizer; T_8: 25% RDN through poultry manure + 75% N through chemical fertilizer; T_9: 50% RDN through poultry manure + 50% N through chemical fertilizer; T_{10}: 75% RDN through poultry manure + 25% N through chemical fertilizer; T_{11}: 50% RDN through neem cake + 50% N through chemical fertilizer; T_{12}: 50% RDN through neem cake + 50% N through chemical fertilizer; T_{13}: 75% RDN through neem cake + 25% N through chemical fertilizer. The treatments were evaluated with respect to growth parameters of onion. Among the various treatments, treatment T_7 was recorded significantly superior to other treatments with respect to yield. The yield parameters *viz.,* maximum weight of bulb (147.73 g), total bulb yield (12.53 kg/plot and 596.97 q/ha) and marketable yield (12.28 kg/plot and 585.07 q/ha) were recorded with treatment T_7. Whereas, minimum unmarketable yield of bulb (0.12 kg/plot and 5.55 q/ha) was observed with the treatment T_1.

Keywords: INM, onion bulb weight, marketable yield, unmarketable yield

Introduction

Onion (*Allium cepa* L.) is one of the oldest bulb crops known to mankind and it is consumed worldwide. According to Vavilov (1951) [14] the primary centre of origin of onion lies in Central Asia. The near East and Mediterranean are the secondary centres of origin and it was introduced in India from Palestine (Yadav *et al*., 2013) [16] and it belongs to family *Alliaceae*. The *Allium* genus comprises of 300 to 500 species (Peterson *et al.,* 1988) [8] which are widely distributed in Northern temperate region ranging from Northern hemisphere, North America, North Africa, Europe and Asia. The common onion grown for dry bulb is *Allium cepa* L. It is valued for its distinct pungent flavour and is an essential ingredient in almost every kitchen around globe. Onion is also designated as "queen of the kitchen" (Selvaraj, 1976) [9]. The Onion is preferred because of its green leaves, immature and mature bulbs are either eaten raw or cooked as vegetables and among them mild flavoured are often preferred for salads.

Onion is one of the most important commercial vegetable crops grown throughout the world. India is the second largest producer of onion in the world and occupies 1,320.00 thousand ha area with a production of 20,931.00 thousand MT and productivity 15.9 MT ha^{-1}. Maharashtra is leading state in terms of area and production, whereas productivity was highest in Gujarat during the year 2015-16 (Anonymous, 2017) [1].

The onion crop is a highly nutrient responsive and the conventional methods of fertilization have undoubtedly helped in improving both bulb yield and quality. But lately, routine management practices appear to be incapable of maintaining yields over the long-term. The steady depletion of native soil fertility and the occurrence of multiple nutrient deficiencies in onion fields have led to the identification of nutrient management as a key factor limiting sustainable onion production. Integrated nutrient management (INM) offers an effective strategy (Dimri and Singh, 2005) [4] by the combined application of organic manures and inorganic fertilizers to increase yield of onion crop. Although the use of manures as nutrient sources for vegetables is common, their effectiveness is potentially limited by nutrient release patterns that are often out of synchrony with crop demand, large variability in source quality and field distribution and food safety. Use of Inorganic fertilizers now a day is costly issue and increases cost of cultivation. Secondly the sole application of inorganic fertilizers deteriorates soil fertility level day by day, that affect the production, economics of production and human health, whereas organic manures seems to act directly for increasing crop yield by accelerating the soil microbial activities, which supplies most of the essential nutrients to the plants in a slow release pattern. Indirectly, it improves the physical properties of soil such as aggregation, aeration, permeability and water holding capacity (Chandramohan, 2002) [3]. Although many attempts have been made to study the role of inorganic fertilizers on onion crop, however, systematic fertilization of different organic manures for onion cultivation is needed particularly as the research work and technology on this aspect is very scanty under North Gujarat Condition.

Materials and Methods

The experiment was carried out in open field condition during *Rabi* season, 2016 at College of Horticulture, S.D. Agricultural University, Jagudan, Dist. - Mehsana (Gujarat), India. Under the study, Agrifound Light Red variety of onion was taken as this variety is promising one and most suitable for *Rabi* onion cultivation. The seeds of this variety were procured from National Horticultural Research and Development Foundation (NHRDF), Rajkot.

The experiment was laid out in randomized block design with three replications. Total thirteen treatments were evaluated under the study *viz*., T_1: 100% RDF (100:50:50 kg NPK/ha + 20 tonne FYM/ha); T_2: 25% RDN through FYM + 75% N through chemical fertilizer; T_3: 50% RDN through FYM + 50% N through chemical fertilizer; T_4: 75% RDN through FYM + 25% N through chemical fertilizer; T_5: 25% RDN through vermicompost + 75% N through chemical fertilizer; T_6: 50% RDN through vermicompost + 50% N through chemical fertilizer; T_7: 75% RDN through vermicompost + 25% N through chemical fertilizer; T_8: 25% RDN through poultry manure + 75% N through chemical fertilizer; T_9: 50% RDN through poultry manure + 50% N through chemical fertilizer; T_{10}: 75% RDN through poultry manure + 25% N through chemical fertilizer; T_{11}: 50% RDN through neem cake + 50% N through chemical fertilizer; T_{12}: 50% RDN through neem cake + 50% N through chemical fertilizer; T_{13}: 75% RDN through neem cake + 25% N through chemical fertilizer.

The NPK content applied through organic manures (FYM, Vermicompost, Poultry manure, Neem cake) as per treatments as basal dose and the remaining content of phosphorus and potassium was also applied as basal dose through chemical fertilizers (DAP and MOP). However, the doses of nitrogen except the source of organic manures and DAP were applied as per treatments through chemical fertilizer (Urea) in four splits at 30, 50, 70 and 90 days after transplanting.

Weight of bulb (g): The weight of bulb of ten tagged plant from each treatment was recorded in gram and average weight of bulb was worked out.

Marketable yield of bulb (kg/plot): The total unmarketable yield from each net plot area is deducted from the total bulb yield from each net plot area and the remaining was calculated as total marketable yield in kg.

Unmarketable yield of bulb (kg/plot): From the each net plot area, the double bulbs (splits), less than 2.5 cm size bulb and bolters were separated and weighted. The total weight of these both types of bulbs were counted as unmarketable yield in kg.

Total bulb yield (kg/plot): Onion bulbs were dug out from each net plot at proper physiological maturity stage. The bulbs after digging were kept under shade for one week then all the dried leaves and bottom roots were removed and onion bulbs were weighted for each net plot area in kg. The weight of ten bulbs under observations was also added to the net plot yield.

Marketable yield of bulb (q/ha): Only good quality bulbs of more than 2.5 cm size (consumer acceptable) of each net plot were weighted. The bulbs damages by cracking, rotting and smaller than 2.5 cm sized bulb were discarded.

Unmarketable yield of bulb (q/ha): From the each net plot area, the double bulbs (splits), less than 2.5 cm size bulb and bolters were separated and weighted. The total weight of these both types of bulb were counted as unmarketable yield in quintal.

Total bulb yield (q/ha): The bulb yield of onion of net plot was converted into bulb yield per hectare in quintal.

Results and discussion

Effect of INM on weight of bulb: Data presented in Table 1 showed that the effect of integrated nutrient management on weight of bulb was significantly affected by various treatments. Maximum weight of bulb (147.73 g) was recorded with treatment T_7 which was statistically at par with the treatments T_3, T_4, T_6, T_9, T_{10} and T_{13}. Whereas, the minimum weight of bulb (108.11 g) was recorded with treatment T_1.

An increase in weight of bulb might be due to increased bulb diameter. This might be due to efficient translocation of photosynthats to bulbs thereby increase in dry matter accumulation of bulbs hence, increase bulb weight (Singh *et al*., 1997) [12]. These results are in conformity with the findings of Warade *et al.* (1996) [15], Gupta *et al.* (1999) [5], Tiwari *et al.* (2002) [13] and Sharma *et al.* (2018) [11] in onion and Nasreen *et al.* (2009) [7] in garlic.

Table 1: Effect of integrated nutrient management on weight of bulb

Treatment No.	Treatments detail	Weight of bulb (g)
T_1	100% RDF (100:50:50 kg NPK/ha + 20 tonne FYM/ha)	108.11
T_2	25% RDN through FYM + 75% N through chemical fertilizer	110.23
T_3	50% RDN through FYM + 50% N through chemical fertilizer	134.35
T_4	75% RDN through FYM + 25% N through chemical fertilizer	134.94
T_5	25% RDN through vermicompost + 75% N through chemical fertilizer	118.85
T_6	50% RDN through vermicompost + 50% N through chemical fertilizer	146.36

T_7	75% RDN through vermicompost + 25% N through chemical fertilizer	147.73
T_8	25% RDN through poultry manure + 75% N through chemical fertilizer	113.05
T_9	50% RDN through poultry manure + 50% N through chemical fertilizer	135.21
T_{10}	75% RDN through poultry manure + 25% N through chemical fertilizer	135.37
T_{11}	25% RDN through neem cake + 75% N through chemical fertilizer	108.80
T_{12}	50% RDN through neem cake + 50% N through chemical fertilizer	123.16
T_{13}	75% RDN through neem cake + 25% N through chemical fertilizer	133.39
	S.Em. ±	8.20
	C.D. (P = 0.05)	23.94
	C.V. %	11.19

Effect of INM on total bulb yield: It is apparent from the data presented in Table 2 showed that the effect of integrated nutrient management on total bulb yield was found significant. Maximum total bulb yield (12.53 kg/plot and 596.97 q/ha) was recorded under the treatment T_7 (75% RDN through vermicompost + 25% N through chemical fertilizer). While, the minimum yield of bulb (8.35 kg/plot and 397.87 q/ha) was recorded with T_1 [100% RDF (100:50:50 kg NPK/ha + 20 tonne FYM/ha)].

An increase total bulb yield might be due to increase by better uptake of nutrients, resulting in faster synthesis and translocation of photosynthats from source (leaves) to sink (bulb) influenced the increase in yield (Singh *et al*., 1997) [12]. The increase in yield could be due to better uptake of nutrients from soil which might have contributed to increased plant height, number of leaves, bulb diameter and weight of bulb which ultimately enhanced the yield. These results are conformity with the findings of Warade *et al.* (1996) [15], Gupta *et al.* (1999) [5] and Jilani *et al*. (2004) [6] in onion and Nasreen *et al.* (2009) [7] in garlic.

Table 2: Effect of integrated nutrient management on total bulb yield

Treatment No.	Total bulb yield (kg/plot)	Total bulb yield (q/ha)
T_1	8.35	397.87
T_2	9.51	453.00
T_3	10.24	487.76
T_4	10.29	490.17
T_5	9.58	456.10
T_6	11.99	570.85
T_7	12.53	596.97
T_8	9.57	455.60
T_9	11.35	490.17
T_{10}	11.40	540.74
T_{11}	8.56	542.79
T_{12}	9.87	470.34
T_{13}	9.95	473.84
S.Em. ±	0.66	32.43
C.D. (P = 0.05)	1.94	94.65
C.V. %	11.22	11.36

Effect of INM on marketable and unmarketable yield of bulb: Data presented in the Table 3 showed that influences of integrated nutrient management on marketable and unmarketable yield of bulb per hectare were found significant variation.

The data showed that the effect of integrated nutrient management on marketable yield of bulb per hectare was significant. Maximum marketable yield of bulb (12.28 kg/plot and 585.07 q/ha) was recorded with treatment T_7 (75% RDN through vermicompost + 25% N through chemical fertilizer) which was statistically at par with treatment T_6, T_9 and T_{10}. Whereas, the minimum marketable yield of bulb (8.19 kg/plot and 390.09 q/ha) was recorded with treatment T_1 [100% RDF (100:50:50 kg NPK/ha + 20 tonne FYM/ha)].

The influences of integrated nutrient management on unmarketable yield of bulb were found significant. Minimum unmarketable yield of bulb (0.12 kg/plot and 5.55 q/ha) was noted under treatment T_1 [100% RDF (100:50:50 kg NPK/ha + 20 tonne FYM/ha)] which was statistically at par with treatment T_2, T_5, T_8, T_{11}, T_{12} and T_{13}. Whereas, the maximum unmarketable yield of bulb (0.25 kg/plot and 11.90 q/ha) was recorded with treatment T_7 (75 % RDN through vermicompost + 25% N through chemical fertilizer).

Only the good quality bulbs of more than 2.5 cm size considered as a marketable bulb that might be increased due to vigorous growth resulted by photosynthats present in onion sets and reserve food material and also favourable weather conditions might have helped to increase the marketable yield of bulb, that might be due to its positive correlation with bulb diameter and weight of bulb. These results are in accordance with results of Sharma *et al.* (2003) [10], Jilani *et al.* (2004) [6] and Bagali *et al.* (2012) [2] in onion.

The increase in unmarketable yield might be due to more number of bolters, splited bulbs and twins were observed during the study. These results are in accordance with Sharma *et al.* (2003) [10] in onion and Nasreen *et al.* (2009) [7] in garlic.

Table 3: Effect of integrated nutrient management on marketable and unmarketable yield of bulb

Treatment No.	Marketable yield of bulb (kg/plot)	Unmarketable yield of bulb (kg/plot)	Marketable yield of bulb (q/ha)	Unmarketable yield of bulb (q/ha)
T_1	8.19	0.12	390.09	5.55
T_2	9.38	0.13	446.81	6.19
T_3	10.08	0.16	480.14	7.62
T_4	10.12	0.16	482.07	7.78
T_5	9.44	0.14	449.75	6.51
T_6	11.87	0.18	565.30	8.57
T_7	12.28	0.25	585.07	11.90
T_8	9.43	0.13	449.09	6.35
T_9	11.18	0.17	532.49	8.10
T_{10}	11.22	0.17	534.22	8.25
T_{11}	8.43	0.13	401.55	6.03
T_{12}	9.73	0.14	463.84	6.51
T_{13}	9.81	0.14	467.17	6.66
S.Em. ±	0.66	0.01	31.40	0.55
C.D. (P = 0.05)	1.92	0.03	91.64	1.59
C.V. %	11.32	12.78	11.32	12.79

Conclusion

In the study of all the yield parameters *viz.,* weight of bulb, total bulb yield per plot, total bulb yield per hectare, marketable and unmarketable yield of bulb per plot and hectare were recorded under the various yield and yield parameters. Among all the treatments, significantly maximum weight of bulb (g), total bulb yield (kg/plot and q/ha), marketable yield of bulb (kg/plot and q/ha) and minimum unmarketable yield of bulb (kg/plot and q/ha) were recorded under treatment T_7. From the foregoing discussion, it was concluded that for efficient nutrient management in *rabi* onion, application of 75% RDN through vermicompost along with 25% N through chemical fertilizer is beneficial for onion cultivation under North Gujarat Agro-climatic condition.

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