Environment and Ecology 40 (2A) : 613—620, April—June 2022
ISSN 0970-0420

Effect of Integrated Nutrient Management on Growth, Yield and Quality of Onion (*Allium cepa* L.)

Deepa Sharma Madhvi, Aanchal Chauhan, Kumud Jarial

Received 28 December 2021, Accepted 4 May 2022, Published on 4 April 2022

ABSTRACT

The experiment was laid out in Randomized Block Design having nine treatments replicated thrice with a plot size 2 × 2 m^2 and plant spacing 15 × 10 cm at the Experimental Farm of Vegetable Science, College of Horticulture and Forestry, Neri, Hamirpur, Himachal Pradesh. Among the various treatments, treatment T_8 i.e. 50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting was the best treatment for majority of the characters like plant height (59.21 cm), leaf length (49.82 cm), bulb size index (24.53 cm^2), averages bulb weight (87.43 g) and total yield (349.50 q/ha) followed by treatment T_6 (Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting).

Keywords Onion, Inorganic fertilizers, Panchagavya, Ghanjivamrit, Sheep manure.

Dr Deepa Sharma, Madhvi, Dr Kumud Jarial
Dr YSP, UHF, College of Horticulture and Forestry, Neri, Hamirpur, HP, India
Dr Aanchal Chauhan*
College of Horticulture and Forestry, Thunag, Mandi, HP, India
Email : deepabanyal@gmail.com
*Corresponding author

INTRODUCTION

Onion (*Allium cepa* L.) also known as queen of kitchen and is one of the most important commercial vegetable and spice crops grown widely all over the world. It belongs to family Alliaceae and used in almost every household as cooked vegetable, salad and in preparation of sauces, soups, pickles. Raw onion is rich in medicinal properties and contain phenolic compound like Catechol's which possess anti fungal assets. Onion juice is used as insect repellent as well as dyes used in fabric industries. The pungency in onion bulb is due to the presence of volatile oil allyl propyl disulphide ($C_6H_{12}O_2$) organic compound that is rich in sulfur. India is at second place in the production of onion after China and third in export after Netherlands and China. In India, it is grown in area of 1220.0 thousand hectare with an annual production of 22819 thousand metric tonnes (Anonymous 2018-2019). In Himachal Pradesh, it is grown in area of 2.69 thousand hectare with an annual production of 52.19 thousand metric tonnes (Anonymous 2017-2018).

Being a long duration crop it extracts large amounts of nutrients from soil, thereby indicating that nutrition is one of the most vital factors for production of this important spice crop. In order to attain higher yield in vegetable crops excessive amounts of inorganic fertilizers are applied. Heavy, imbalanced and continuous application of inorganic fertilizers without organic supplements generates several lethal effects to the soil, environment and human health leading to unsustainable crop production. Organic fertilizers

Table 1. Effect of INM on various vegetative growth parameters at different stages of crop growth in onion stages.

Sl. No.	Treatments	Plant height (cm)			Leaf length (cm)			Number of leaves		
		30th DAT	60th DAT	90th DAT	30th DAT	60th DAT	90th DAT	30th DAT	60th DAT	90th DAT
T_2	No application of manures and fertilizers (absolute control)	19.50	28.87	39.42	17.00	25.75	35.77	3.10	4.24	6.33
T_2	Recommended dose of FYM (250 q/ ha) and NPK (120 kg N, 80 kg P and 60 kg K/ ha) (Control)	22.75	36.02	49.05	19.43	31.90	45.50	3.20	5.03	6.63
T_3	Recommended FYM (250 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting	24.57	36.25	50.13	19.55	32.37	45.72	3.23	5.13	6.63
T_4	Recommended FYM (250 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting	24.63	36.47	50.20	19.70	32.45	46.50	3.23	5.20	6.70
T_5	Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting	24.70	37.30	51.68	20.17	32.73	47.83	3.43	5.37	7.10
T_6	Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting	24.80	38.02	53.72	20.38	33.07	48.50	3.73	5.57	7.90
T_7	50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting	24.68	36.82	50.99	20.07	32.73	46.03	3.37	5.27	6.80
T_8	50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting	26.63	39.18	59.21	20.53	34.07	49.82	3.43	5.41	7.67
T_9	Ghanjivamrit (250 kg/ ha) + Panchagavya @ 3% (at 10 days interval from transplanting)	20.07	30.08	41.23	18.13	26.10	37.15	3.13	4.77	6.37
Mean		23.59	35.44	49.34	19.44	31.24	44.76	3.32	5.11	6.90
$CD_{0.05}$		3.40	5.02	4.08	1.11	4.13	5.71	0.31	0.04	0.78

can aid as substitute to inorganic fertilizers as they are biological in origin and improve the nutrient status of the soil and microbial population. Sole application of chemical fertilizers is also expensive. Integrated use of different nutrient sources helps to maintain the long-term productivity and also improves soil quality (Lawande *et al.* 2009). The use of organic products like *Panchagavya*, *Ghanjivamrit* is becoming prevalent in various farming systems including vegetable production. Therefore, integrated use of organic and inorganic fertilizers is essential for increasing the bulb yield, maintaining soil health and for improving the quality of produce in an eco-friendly manner.

MATERIALS AND METHODS

The experiment was carried out at Experimental Farm of Department of Vegetable Science at College of Horticulture and Forestry, Neri, Hamirpur during the *rabi* season of 2019-2020. Experiment comprised of nine treatments which were laid out in Randomized Block Design with three replications. Treatment details are given below.

Details of treatments

T_1 No application of manures and fertilizers (absolute control).

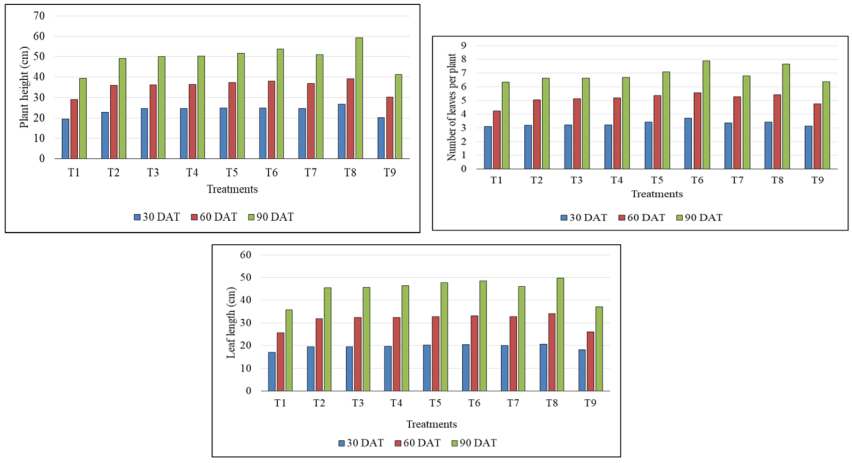

Fig. 1. Effect of INM on various vegetative growth parameters at different stages of crop growth in onion.

T_2 Recommended dose of FYM (250 q/ ha) and NPK (120 Kg N, 80 Kg P and 60 Kg K/ ha) (Control).
T_3 Recommended FYM (250 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting.
T_4 Recommended FYM (250 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting.
T_5 Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting.
T_6 Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting.
T_7 50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting.
T_8 50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting.
T_9 Ghanjivamrit (250 kg/ ha) + Panchagavya @ 3% (at 10 days interval from transplanting).

Seeds of onion cv 'Agrifound Dark Red' were sown in the nursery on 25th October 2019. The plot size was 2 × 2 m^2 and planting was done at spacing of 15 × 10 cm. The observations were recorded on the following characters; growth and yield parameters viz, plant height (cm), number of leaves per plant, leaf length (cm), average bulb weight (g), days to harvest, neck thickness (cm), bulb diameter (cm), bulb size index (cm^2), doubles (%), bolters (%) and total bulb yield (q/ha) Tables 1–3.

RESULTS AND DISCUSSION

Plant height (cm) : Plant height is an important morphological trait that affects the yield of the crop. Plant height has direct correlation with biomass production and photosynthetic activity which leads to more yield and productivity. Plant height was recorded at 30, 60 and 90 days after transplanting. Significant variations were observed for different treatments at 30, 60 and 90 days after transplanting. The maximum plant height (26.63 cm, 39.18 cm and 59.21 cm) at 30th, 60th and 90th days after transplanting was recorded with the treatment T_8 (50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting). Treatment T_1 (absolute control) recorded the minimum plant height (19.50 cm, 28.87 cm and 39.42 cm). The highest plant height was observed with the treatment T_8 at different growth stages, this could be due to the

Table 2. Effect of INM on various yield contributing traits in onion.

Sl. No.	Treatments	Days to harvest (DAT)	Neck thick-ness (cm)	Bulb diameter (cm)	Bulb size index (cm^2)	Average bulb weight (g)
T_1	No application of manures and fertilizers (absolute control)	112.33	0.84	4.32	15.37	42.58
T_2	Recommended dose of FYM (250 q/ ha) and NPK (120 kg N, 80 kg P and 60 kg K/ ha) (Control)	127.00	1.05	4.76	19.29	68.73
T_3	Recommended FYM (250 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting	120.67	0.86	5.03	19.28	64.00
T_4	Recommended FYM (250 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Pancha-gavya @ 3% at 20 days interval from transplanting	122.33	0.94	4.90	19.72	74.24
T_5	Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from trans-planting	123.00	0.98	5.08	20.80	81.00
T_6	Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting	126.67	1.08	5.24	21.34	84.55
T_7	50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting	128.00	0.93	5.08	20.53	78.00
T_8	50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting	127.67	0.98	5.20	24.53	87.43
T_9	Ghanjivamrit (250 kg/ha) + Panchagavya @ 3% (at 10 days interval from transplanting)	117.33	0.85	4.75	18.93	51.10
Mean		122.78	0.93	4.93	19.98	70.18
$CD_{0.05}$		2.64	0.16	0.30	3.57	2.91

integrate application of manures (FYM and sheep manure), inorganic fertilizers (Urea, SSP and MOP) and panchagavya. Organic manures supply number of macro and micro nutrients to the plants which are essential for their proper growth and development. Due to their slow decomposition they progressively release the nutrients which also help to increase the growth of the plants. Adequate nitrogen application also affects the plant height. Similar results were reported by Mehere (2018), Gebremichael *et al*. (2017), Shah *et al.* (2016), Vedpathak and Chavan (2016).

Leaf length (cm) : Leaf length regulates the photosynthesis activity which directly affect the bulb and yield characteristics of onion. Leaf length was recorded at 30, 60 and 90 days after transplanting. Significant variations were observed for different treatments at 30, 60 and 90 days after transplanting. The maximum leaf length (19.50 cm, 28.87 cm and 39.42 cm) at 30^{th}, 60^{th} and 90^{th} days after transplanting was recorded with the treatment T_8 (50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting). Treatment T_1 (absolute control) recorded the minimum leaf length (17.00 cm, 25.75 cm and 35.77 cm). More leaf length is mainly depending upon the adequate nutrient supply. Nitrogen, phosphorus and potassium stimulate the production of chlorophyll content and amino acids which enhanced the plant growth in terms of leaf length and plant vigor. Similar findings were reported by Gebremichael *et al*. (2017) and Vedpathak and

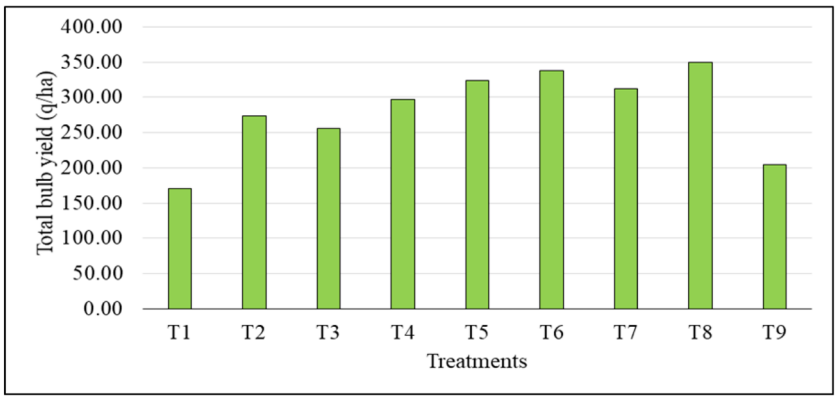

Fig. 2. Effect of INM on total bulb yield (q/ha) in onion.

Chavan (2016).

Number of leaves : Leaves has direct association with the synthesis of food reserve and chlorophyll content. More number of leaves per plant resulted in more food reserve and ultimately more bulb yield. Number of leaves per plant was recorded at 30, 60 and 90 days after transplanting. At 30th, 60th and 90th days after transplanting, the highest number of leaves per plant (3.73, 5.57 and 7.90) were recorded with the treatment T_6 (Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting) which was statistically at par with the treatments T_8 and the lowest number of leaves per plant (3.10, 4.24 and 6.33) were recorded with the treatment T_1 (absolute control). Panchagavya improves the biological efficiency of the plants which results in more production of metabolites. The increase in number of leaves per plant may be due to better absorption of essential nutrients, production of growth promoting components and metabolites. Similar studies were reported by Mehere (2018) and Gopakkali and Sharanappa (2014).

Days to harvest (DAT) : Harvesting at proper time is important because extra early and late harvesting can cause severe loss in the yield and also affects the storage capacity of the crop. Early maturity (112.33 days) was recorded with T_1 (absolute control) and late maturity (128.00 days) was observed with the treatment T_7 (50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting). The maximum number of days to maturity was recorded with treatment T_7 because of the use of different type of nutrient sources as they provided the higher amount of nutrients and other essential components which accelerated the physiological activity and extended the translocation of photosynthates, resulting in late maturity. These results agree with the work of Gebremichael *et al.* (2017).

Neck thickness (cm) : Neck thickness is an important qualitative character as it indicates the vigour of the plant and it also influence the shelf life of onion bulb. Those bulbs which have less neck thickness can be stored for longer period and also retain better quality. Minimum neck thickness (0.84 cm) was observed with the treatment T_1 (absolute control). Maximum neck thickness (1.08 cm) was noted with the treatment T_6 (Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting). Neck thickness found to be increase with the combined application of organic and inorganic fertilizers. This might be due to presence of high level of nutrients and growth promoting substances which accelerated the vegetative growth and hence increased the neck diameter. Similar results were reported by Bhagwat *et al.* (2017) and Gopakkali and Sharanappa (2014).

Bulb diameter (cm) : Bulb diameter is considered as an important character as it determines the size of the

Table 3. Effect of INM on bolting (%), doubles production (%) and total bulb yield (q/ha) in onion. Figures in parentheses are square root transformed values.

Sl. No.	Treatments	Bolting (%)	Doubles (%)	Total bulb yield (q/ha)
T_1	No application of manures and fertilizers (absolute control)	1.87 (1.69)	1.25 (1.46)	170.25
T_2	Recommended dose of FYM (250 q/ ha) and NPK (120 kg N, 80 kg P and 60 kg K/ ha) (Control)	2.63 (1.90)	1.37 (1.52)	274.00
T_3	Recommended FYM (250 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting	1.50 (1.57)	0.37 (1.15)	256.00
T_4	Recommended FYM (250 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting	1.62 (1.61)	0.87 (1.34)	296.75
T_5	Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting	1.37 (1.53)	1.12 (1.42)	324.00
T_6	Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting	1.12 (1.42)	0.50 (1.22)	338.00
T_7	50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting	1.37 (1.53)	0.87 (1.34)	312.00
T_8	50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting	1.12 (1.42)	0.75 (1.32)	349.50
T_9	Ghanjivamrit (250 kg/ ha) + Panchagavya @ 3% (at 10 days interval from transplanting)	1.75 (1.60)	0.62 (1.26)	204.25
	Mean	1.60	0.86	280.53
	$CD_{0.05}$	0.71	N/S	5.82

bulb which is directly responsible for total bulb yield. The data showed that the highest bulb diameter (5.24 cm) was recorded for treatment T_6 (Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation+ 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting) and treatment T_1 (absolute control) has shown the lowest bulb diameter (4.32 cm). Bulb diameter was increased with the application of sheep manure, reduced dose of inorganic fertilizers and panchagavya. This may be due the supply of proper nutrition and enhanced biological activity. Similar results were found by Dhillon and Singh (2019), Mehere (2018), Shah *et al.* (2016), Vedpathak and Chavan (2016) and Moradi (2015).

Bulb size index (cm^2) : The data showed significant difference for different treatments. Significantly maximum bulb size index (24.53 cm^2) was observed with the treatment T_8 (50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting) which was statistically at par with the treatment T_6 while, the minimum bulb size index (15.37 cm^2) was recorded with the treatment T_1 (absolute control). Organic manures and panchagavya also contain beneficial microorganisms which helps to improve the soil physical conditions. This also results in better nutrient absorption, more dry matter production and translocation of photosynthesis which ultimately increased the bulb size. Balanced application of inorganic fertilizers improves the rate of metabolism and synthesis of carbohydrates resulting in better bulb development. Similar results were obtained by Adeyeye *et al*. (2017).

Average bulb weight (g) : Average bulb weight

has positive significant association with the photosynthetic activity. Hence, more production of photosynthates more will be the food reserve which results in more bulb weight. The data showed that significantly higher average bulb weight (87.43 g) was recorded with treatment T_8 (50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting). Whereas, the lowest bulb weight (42.58 g) was recorded with the treatment T_1 (absolute control). Organic manures and panchagavya improved microbial population in the soil which helped in mobilization of unavailable nutrients. Optimum availability of nutrients and hormones improves the metabolism activity and synthesis of carbohydrate which resulted in more food accumulation which ultimately increased the bulb weight. Similar results have been reported by Mehere (2018), Adeyeye *et al.* (2017), Gebremichael *et al.* (2017) and Kumar and Neeraj (2015).

Bolting (%) : Bolting is defined as the emergence of flower stalk before the bulb formation and development. It is an undesired character because it affects the economic bulb yield. Minimum (1.12) bolters were found in treatments T_6 (Recommended Sheep manure (190 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting) and T_8 (50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK+ Panchagavya @ 3% at 20 days interval from transplanting) whereas, highly significant value for bolting (2.63%) was recorded with the treatment T_2 (control). The maximum bolting percentage was recorded with the treatment T_2 (control) this could be due the change in weather conditions and more fluctuation in day and night temperature. This treatment received the heavy dose of inorganic fertilizers as compare to other treatments. This might be attributed to more bolting percentage. These finding were also in line with Bhasirbhai (2017).

Doubles (%) : Doubles is considered as undesired character in onion because it affects the marketable bulb yield. Data revealed that treatments had shown non-significant effect on the number of double bulbs. However, maximum number of double bulbs (1.37 %) were recorded in treatment T_2 (control) and minimum number of double bulbs (0.37 %) was recorded with the treatment T_3 (Recommended FYM (250 q/ ha) as basal dose at the time of field preparation + 50% RDF of NPK + Ghanjivamrit (250 kg/ ha) at 20 days interval from transplanting). The results agree with the work of Jadia *et al.* (2018).

Total bulb yield (q/ha) : Yield is one of the most important quantitative trait. The main aim of the production is to have maximum yield with good quality bulbs for better returns. Data recorded for total bulb yield showed significant variation among the different treatments. Significantly highest bulb yield (349.50 q/ha) was found with the treatment T_8 (50% Recommended FYM (125 q/ ha) + Sheep manure (95 q/ ha) as basal doss at the time of field preparation + 50% RDF of NPK + Panchagavya @ 3% at 20 days interval from transplanting) as compare to treatment T_2 (control) and the lowest value (170.25 q/ha) was observed with the treatment T_1 (absolute control). Significantly higher bulb yield was observed in T_8 this might be due the increase in vegetative growth and yield contributing characters (Figs. 1-2). Nutrients provided by inorganic fertilizers are absorbed too quickly as compare to the nutrients provided by organic fertilizers because of their slow decomposition they provide nutrients as well as phytohormone to the plants throughout their growing period which ultimately results in vigorous vegetative and root growth and finally increases the total yield. Nitrogenous fertilizers should be provided in split doses to reduce their adverse effect on crop and soil. Adequate use of inorganic fertilizers helps to increase the metabolic activities and auxin synthesis in plants which finally increase the total yield. Similar results in onion were obtained by Dhillon and Singh (2019), Sharma *et al*. (2018), Talwar *et al*. (2016), Kumar *et al.* (2014) and Latha and Sharanappa (2014).

Hence, it can be concluded from the present study that, integrated application of inorganic fertilizers with organic products like sheep manure, panchagavya, ghanjivamrit in onion cultivation enhances the growth, yield and quality of the produce, ultimately gives higher returns.

REFERENCES

Adeyeye AS, Ishaku MA, Gadu HO, Olalekan KK, Lamid WA (2017) Comparative effect of organic and inorganic fertilizers treatments on the growth and yield of onion (*Allium cepa* L.). *J Bot Sci* 6 (2) : 8—11.

Anonymous (2017-2018) National Horticulture Board. Gurgaon, Haryana, India.

Anonymous (2018-2019) National Horticulture Board. Gurgaon, Haryana, India.

Bhagwat KP, Shinde KG, Bhalekar MN, Durgude AG (2017) Effect of nutrient management on soil nutrient status, its uptake and yield of *rabi* onion. *Bioinfolet* 14 (4): 416—420.

Bhasirbhai VF (2017) Effect of integrated nutrient management on growth, yield and quality of onion (*Allium cepa* L.) under North Gujarat conditions. MSc thesis. Department of Vegetable Science, Sardarkrushinagar Dantiwada Agricultural University, Gujarat, 112 pp.

Dhillon IS, Singh D (2019) Effect of integrated nutrient management on productivity and economics of *rabi* onion (Allion (*Allium cepa* L). *J Krishi Vigyan* 8 (1) : 87—91.

Gebremichael Y, Woldetsadik K, Chavahan A, Gedamu F (2017) Effect of integrated nutrient management on growth and bulb yield of onion (*Allium cepa* L.) under irrigation at Selekleka, Northern Ethiopia. *Internat J Life Sci* 5 (2) : 151—160.

Gopakkali P, Sharanappa S (2014) Effect of organic farming practices on growth, yield, quality and economics of onion (*Allium cepa* L.) in dry zone of Karnataka. *Ind J Agron* 59 (2): 103—107.

Jadia M, Singh SK, Basedeya SS, Parihar MS (2018) Study the effect of organic and inorganic fertilizers on growth and yield attributes of *kharif* onion (*Allium cepa* L.). *Int J Pure Appl Biosci* 6 (1) : 141—148.

Kumar P, Thontadarya RN, Udachappa UP, Allolli TB (2014) Onion growth, yield and quality parameters as influenced by panchagavya and biofertilizers. *Green Farm* 5 (6) : 998—1000.

Kumar V, Neeraj (2015) Evaluation of the performance of onion varieties in response to organic cultivation. *Int J Adv Res* 3 (9) : 1558—1562.

Latha HS, Sharanppa (2014) Effect of organic amendments on the productivity and quality of produce and soil groundnut-onion cropping system. *Ind J Agric Sci* 84 (8) : 999—1003.

Lawande KE, Khar A, Mahajan V, Srinivas PS, Sankar V, Singh RP (2009) Onion and garlic research in India. *J Hortic Sci* 4 : 91—119.

Mehere SS (2018) Evaluation of different organic growth promoters on growth and yield of onion (*Allium cepa* L.). MSc Thesis. Department of Vegetable Science, Vanstro Naik Marathwada Krishi Vidyapeeth, Maharashtra, pp 105.

Moradi S (2015) Impact of sheep manure, urea and triple superphosphate on onions morphological properties. *Int-J Farm Allied Sci* 4 (2) : 167—170.

Shah KN, Singh V, Rana DK (2016) Effect of inorganic and organic manures on growth, yield and quality of onion cv. Pusa Madhvi under valley condition of Garhwal Himalaya. *Hortic Flora Res Spectrum* 5 (3) : 233—237.

Sharma SK, Garhwal OP, Mahala P, Yadav TV (2018) Influence of integrated nutrient management on yield attributes and economics of *kharif* onion (*Allium cepa* L.) under loamy sand soils. *Int J Curr Microbiol Appl Sci Applied Sci* 7 (6) : 2806—2811.

Talwar D, Singh K, Sardana V, Singh J (2016) Growth yield and quality of onion as influenced by integrated nutrient management. *Int J Agric Sci* 8 (51) : 2295—2298.

Vedpathak MM, Chavan BL (2016) Effects of organic and inorganic chemical fertilizers on growth and yield of onion (*Allium cepa* L). *Int J Environm Agricult Biotechnol* 1 (4) : 1033—1037.