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Effect of Integrated Nutrient Management on Yield Attributes of Onion (*Allium cepa* L.) cv. Pusa Shobha

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted at the Horticulture Research Farm, near Gautam Buddha Central Library, Babasaheb Bhimrao Ambedkar University (A Central University),Vidya Vihar Raebareli Road Lucknow, (U.P) experiment was conducted during *Rabi* season in the years, of 2021-2022 and 2022-2023.The experiment was laid out in randomized block design with three replications, the recorded data were statistically analyzed using analysis of variance (ANOVA) as formulated at 5% level of significance was used for data analysis of experiment. The treatments consisted of T_0 -

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Control (without fertilizers); T_1- 100% RDF (NPK@150:50:80 Kg/ha): T_2- 100% RDF + FYM (10 t/ha); T_3 -100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha); T_4 -100% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha); T_5 -100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha); T_6 -75% RDF + FYM (10 t/ha); T_7 -75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha); T_8 -75% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha): T_9 -75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha). T_{10} -50% RDF + FYM (10 t/ha); T_{11}- 50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha); T_{12}- 50% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha);T_{13} -50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha). Results revealed that the treatment T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha) performed better results with respect of yield characters such as average bulb weight (g), polar diameter (cm), equatorial diameter (cm), and total bulb yield (q/ha) onion bulb.

Keywords: Integrated nutrient management; biofertilizer; phosphorus solubilizing bacteria; azotobacter; vermicompost; farmyard manure; recommended dose of fertilizers; yield; onion.

1. INTRODUCTION

"Onion (*Allium cepa* L.) is a most important crop belongs to the Alliaceae family. It is native of the Central Asia and chromosome number 2n=2x=16.It is one of the most important cash vegetable crops among bulb crops and semi-perishable in nature. Onion is an indispensable item in every kitchen as condiment and vegetable-, therefore commands an extensive internal market. Onion is mainly used for its flavor and pungency, the chief component of pungency is 'allyl propyl disulphide'. Onion contains carbohydrate (11.0 g), proteins (1.2 g), fiber (0.6 g), moisture (86.8 g) and several vitamins like vitamin A (0.01 mg), vitamin C (11 mg), thiamine (0.08 mg), riboflavin (0.01 mg) and niacin (0.2 mg). It also contains some minerals like phosphorus (39 mg), calcium (27 mg), sodium (1.0 mg) and potassium (157 mg) per 100 g of bulb" [1]. "Onion is used for flavoring or seasoning the food, both at mature and immature stages; Onion is also used in preparing soups, sauces, curries, pickles and for flavoring or seasoning food. Generally, vegetables require large quantity of major nutrients like nitrogen, phosphorus and potassium, in addition to secondary nutrients such as zinc, boron, cupper, calcium and sulphur for better growth, yield and post-harvest life. Continuous and unbalanced fertilizer use has a negative impact on agricultural production sustainability while also producing environmental damage. Inorganic fertilizers being very expensive are difficult for small and marginal farmers to afford" [2]. "Promotion of the use of inorganic fertilizers for supplying these nutrients in the previous years has now become a bone of contention for its detrimental effect on both soil and environment apart from its enormous price hike every year. Integrated nutrient management (INM) provides excellent opportunities to overcome all the imbalances besides sustaining soil health and enhancing crop production [3,4]. The use of FYM, vermicompost and biofertilizers in such situation is, therefore, a practically paying proposal" [5]. "The farmyard manure supply nitrogen, phosphorus and potassium and other essential nutrients in available form to the plants through biological decomposition. It improves the physical, chemical and biological properties of soil such as organic matter content, microbial activities, aggregation, aeration and water holding capacity and available nutrients" [6]. "Vermicomposting is a mixture of worm casting, organic materials and living earthworms. It is slow releasing organic manure, have most of the macro and micro nutrients that fulfill the nutrient requirement of plants" [7]. "Although the use of manures as nutrient sources for vegetable-s is common, their effectiveness is potentially limited by nutrient release pattern that are often out of synchrony with crop demand, large variability in source quality and various edaphological factors. All of these issues need field experimentation with alternative options. A gradual shift from using purely organic sources to some proportion of inorganic fertilization is gaining acceptance. This shift has formed the basis for INM, which could involve three nutrient sources: microbial inoculants or biofertilizers including *Azotobacter, Azospirillum*, and phosphate solubilizing bacteria (PSB); inorganic fertilizers, and organic manures. However, INM further prescribes that selected nutrient inputs be used judiciously to ensure optimum supply of all essential nutrients for sustainable crop production" [8,9]. Hence, the greater its ability to utilize nutrients for crop production, the greater is the yield potential. "FYM is the commonly used organic manure but its supply is limited. It contains low and widely varying nutrient concentration. Vermicompost is the good source of all plant nutrients but it is using in high quantity. Use of vermicompost as an excellent organic manure for field crops and vegetable- crops has been promoted. Biofertilizers are the inoculation of microorganism which is capable of mobilizing nutrient element from unavailable to available form through biological processes. Biofertilizers are the products that contain living cells of different types of microorganisms; play an important role in atmospheric nitrogen fixation, phosphorus solubilisation and have an ability to convert complex forms of elements to available forms through biological process and improve the crop yield" [10]. "The use of vermicompost and biofertilizers in such situation is, therefore, practically paying proposal Phosphorus solubilizers bacteria like Pseudomonas and Bacillus which solubilize phosphorus in soil and make it available to plants. While, Azospirillum, a nitrogen fixing organism has been reported to be beneficial and economical for several crops" [11]. Therefore, Keeping this the in the view, the present investigation was undertaken to study the effect of integrated nutrient management on yield attributes of onion (*Allium cepa* L.) cv. Pusa Shobha.

2. MATERIALS AND METHODS

The experiment conducted during *Rabi* season in the years, of 2021-2022 and 2022-2023 both the year same time at Horticulture Research Farm, near Gautam Buddha Central Library, Babasaheb Bhimrao Ambedkar University (A Central University), Vidya Vihar Raebareli Road Lucknow, (U.P). The experiment was laid out in randomized block design with three replications, the recorded data were statistically analyzed using analysis of variance (ANOVA) as formulated at 5% level of significance was used for data analysis of experiment described by Panse and Sukhatme [12] to find out overall total variability present in the material under study for each character and for all the populations. The soil was sandy clay loam in texture and slightly alkaline in reaction, good in fertility situated at an elevation of 111 meter above mean sea level in the sub-tropical climate of central Utter Pradesh at 26˚56 North Latitude 80˚52 east longitude. The topography of experimental field was fairly uniform during experimental year. According to standard processors, the soil samples were collected randomly from the experiment field at the depth of 0-15cm.The randomly collected sample were thoroughly mixed well and composite soil sample was made up (500 g) of soil, all the cultural practices and treatment application is applicable timely. The sample was analyzed to determine the physical and chemical analysis of soil testing laboratory of university. The pH was determined by electric pH meter as 7.6 and having low in available nitrogen (192 kg/ha) and medium in available P_2O_5 (13.8 kg kg/ha), K_2O (170 kg/ha).Available nitrogen was determined by alkaline permanganate method as reported by Piper [13] and available phosphorus and potash by Olsen's method Olsen et al. [14] and Flame photometer method respectively. The Electrical Conductivity (E.C.) was determined by Conductivity Bridge as described by Jackson [15]. Seeds of onion *cv*. Pusa Shobha were sown in nursery beds prepared two months earlier. The soil of seed bed was prepared with compost and mulching was done with straw to protect the young seedlings from adverse climatic condition. Covering materials were removed from the bed after seed germination (5-6 days after sowing) for optimum growth of the seedlings. Seedlings were ready for transplanting 45 days after sowing. The main field was prepared by ploughing with disc plough and subsequent ploughing was done with cultivator followed by leveling. The soil of the experimental site was irrigated before transplanting for optimum moisture in the field. The healthy seedlings having uniform growth were selected and transplanted on well prepared field in the afternoon hours at a spacing of 15 x 10 cm and all cultural operation done timely like weeding, irrigation, plant protection *etc*. The crop was harvested when 75% tops start falling over but before the foliage is completely dry. The bulbs are harvested by hand pulling and with the help of hand hoe. The tops were removed one day after field curing leaving 2.5 cm top only with the bulb.

2.1 Treatment Application

1. FYM

Well rotten farm yard manure was incorporated in the soil at the time of field preparation as per treatment. FYM content 0.52 % N, 0.36 % P and 0.60 % K.

2. Vermicompost

Vermicompost procured from the departmental vermicompost unit was applied in the beds as per treatments and was thoroughly incorporated in to the soil at the time of sowing.

List 1. Details of the treatments combination

Treatment No.	Treatment Combination
T0	Control (without fertilizers)
T1	100% RDF (NPK@150:50:80 kg/ha)
T2	100% RDF + FYM (10 t/ha)
T3	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)
T4	100% RDF + FYM (10 t/ha) + Azotobacter (5 kg/ha) + PSB (5 kg/ha)
T5	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 kg /ha) + PSB (5 kg /ha)
T6	75% RDF + FYM (10 t/ha)
T7	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)
T8	75% RDF + FYM (10 t/ha) + Azotobacter (5 kg /ha) + PSB (5 kg /ha)
T9	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 kg /ha) + PSB (5 kg /ha)
T10	50% RDF + FYM (10 t/ha)
T11	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)
T12	50% RDF + FYM (10 t/ha) + Azotobacter (5 kg /ha) + PSB (5 kg /ha)
T13	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 kg /ha) + PSB (5 kg /ha)

Note:
RDF- Recommended Dose of Fertilizers (NPK@150:50:80 Kg/ha)
FYM- Farmyard Manure
PSB- Phosphorus Solubilizing Bacteria

3. Biofertilizers

Azotobacter and PSB @ 5kg ha^{-1} were mixed with FYM. This mixture was applied in soil after the transplanting of seedling.

4. NPK

Recommended doses of nitrogen (150kg ha^{-1}), phosphorus (50kg ha^{-1}) and potassium (80 kg ha^{-1}) were applied in each plot. The source of nutrients was for nitrogen urea and SSP for phosphorus and sulphur, MOP for potash. Half dose of nitrogen and whole doses of phosphorus and potash were applied as basal dose prior to transplanting of onion seedlings. While the rest of nitrogen was given in 2 equal split doses in transplanted onion seedling, first at 30 and second 45 days after transplanting.

2.2 Yield and Yield Attributing Characters was Recorded as-

1. Average bulb weight (g)

Five selected plant from each plot and replication were weighed to determine the average weight for bulb yield of a plant.

2. Equatorial diameter of bulb (cm)

Equatorial diameter of randomly selected bulbs were measured at both equatorial portion of bulb with the help of Vernier's calipers was used to denote bulb diameter (cm) of each accessions.

3. Polar diameter of bulb (cm)

Polar diameter of randomly selected bulbs were measured at both polar portion of bulb with the help of Vernier's calipers was used to denote tuber diameter (cm) of each bulb.

4. Bulb yield (q/ha)

After cutting the leaves (2-2.5 cm above the neck) of cured bulbs, bulbs were weighed on electronic balance and bulb yield per net plot was recorded in kilogram which was converted into quintal per hectare as given below:

Bulb yield per hectare (q) = Bulb yield (kg/plot) x 10,000 / Net area of plot (m^2) x 100

3. RESULTS AND DISCUSSION

Data presented of the both year in Tables 1, 2, 3 and 4 the effect of integrated nutrient management on yield and yield attributes of onion showed the significant difference among the treatments.

3.1 Effect of Integrated Nutrient Management on Average Bulb Weight (g) of Onion (*Allium cepa* L.)

Average bulb weight: Data presented in Table- 1 and Fig. 1, during 2021-22, the maximum average bulb weight (98.86g) was recorded in T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha) followed by the T_{13}. The minimum average bulb weight (39.07g) was recorded in case of control T_0. During 2022-23, the maximum average bulb weight (99.87g) was recorded with application of T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha) followed by the T_{13}. The minimum average bulb weight (38.61g) was recorded in case of control T_0. These similar results are in conformity by Dhakad et al. [16], Badal et al. [17] and Upadhyay et al. [18] in onion.

Table 1. Effect of integrated nutrient management on average bulb weight (g) of onion (*Allium cepa* L.)

	Average bulb weight (g)		
	Treatment Combination	**2021-22**	**2022-23**
T_0	Control (without fertilizers)	39.07	38.61
T_1	100% RDF (NPK@150:50:80 Kg/ha)	72.78	73.84
T_2	100% RDF + FYM (10 t/ha)	73.46	74.92
T_3	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	75.25	76.28
T_4	100% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	77.97	75.81
T_5	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	79.20	80.20
T_6	75% RDF + FYM (10 t/ha)	76.89	77.89
T_7	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	81.56	82.56
T_8	75% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	89.78	90.72
T_9	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	98.86	99.87
T_{10}	50% RDF + FYM (10 t/ha)	83.44	84.52
T_{11}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	80.20	80.08
T_{12}	50% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	87.87	88.88
T_{13}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	94.56	95.57
SE (m) ±		0.972	0.697
CD (P=0.05)		2.828	2.028

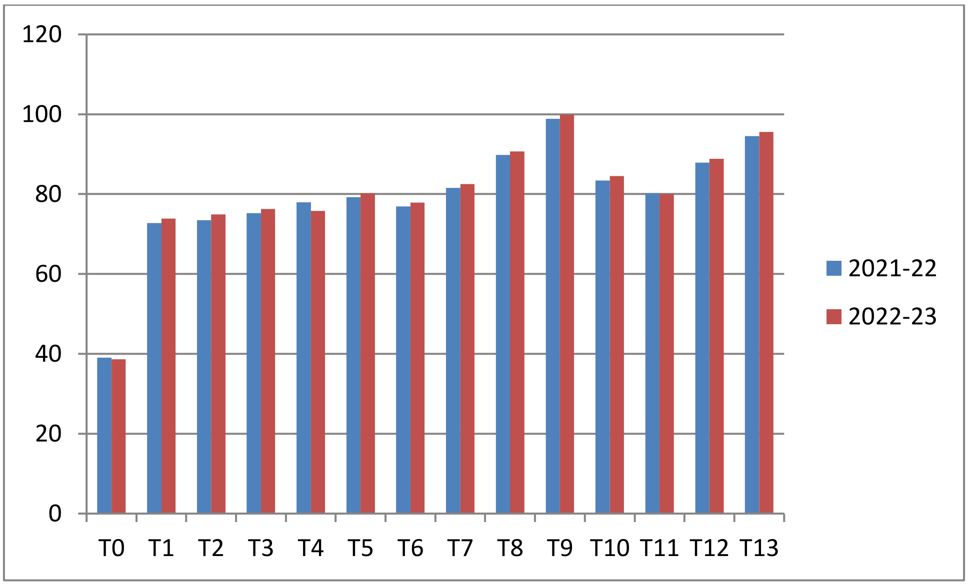

Fig. 1. Effect of integrated nutrient management on average bulb weight (g) of onion (*Allium cepa* L.)

3.2 Effect of Integrated Nutrient Management on Polar Diameter (cm) of Onion (*Allium cepa* L.)

Polar diameter of bulb: Perusal of data in Table- 2 and Fig. 2 indicated significant effects of different treatments on polar diameter of bulb in both the years. During 2021-22, the maximum polar diameter (6.61cm) was recorded with application of T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha) followed by the T_{13}. The minimum polar diameter (3.95cm) was recorded in case of control T_0. During 2022-23, the polar diameter was the maximum (6.77 cm) in case of application T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha) followed by the T_{13}. The minimum polar diameter (3.85cm) was recorded in case of control T_0. However the use of organic and biofertilizers increase the polar diameter similar results found by Singh et al. [19], Dhakad et al. [16] and Kalirawna et al. [20] in onion.

Table 2. Effect of integrated nutrient management on polar diameter (cm) of onion (*Allium cepa* L.)

	Polar diameter (cm)		
	Treatment Combination	**2021-22**	**2022-23**
T_0	Control (without fertilizers)	3.95	3.85
T_1	100% RDF (NPK@150:50:80 Kg/ha)	4.13	4.23
T_2	100% RDF + FYM (10 t/ha)	4.43	4.53
T_3	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	4.60	4.80
T_4	100% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	4.88	4.98
T_5	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	5.29	5.39
T_6	75% RDF + FYM (10 t/ha)	5.53	5.63
T_7	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	5.65	5.75
T_8	75% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	5.75	5.85
T_9	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	6.61	6.77
T_{10}	50% RDF + FYM (10 t/ha)	5.28	5.38
T_{11}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	5.56	5.66
T_{12}	50% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	5.67	5.77
T_{13}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	5.85	5.95
SE (m) ±		0.053	0.056
CD (P=0.05)		0.155	0.163

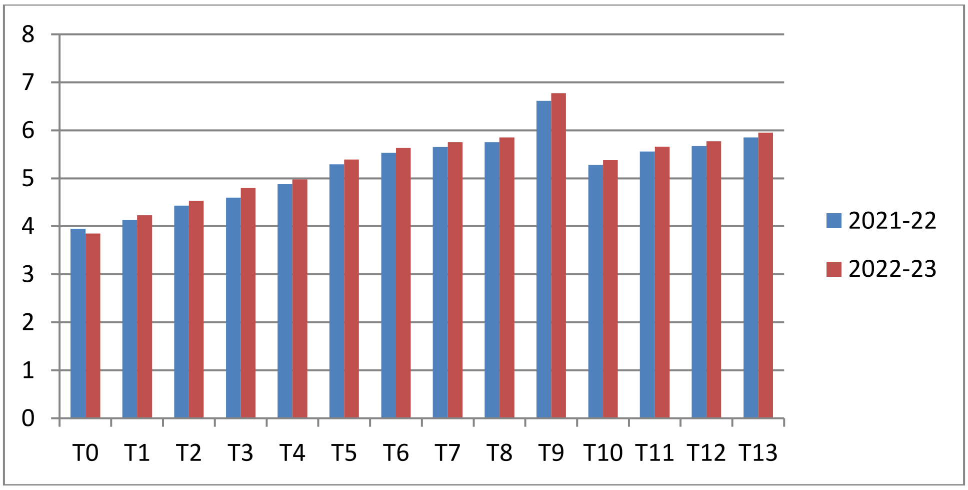

Fig. 2. Effect of integrated nutrient management on polar diameter (cm) of onion (*Allium cepa* L.)

3.3 Effect of Integrated Nutrient Management on Equatorial Diameter (cm) of Onion (*Allium cepa* L.)

Equatorial diameter of bulb: Data in Table- 3 and Fig. 3 indicated significant effects of different treatments on Equatorial diameter of bulb during both the years. The maximum Equatorial diameter during 2021-22 (6.21cm) was recorded with application of T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha) followed by the T_{13}. The minimum Equatorial diameter (3.80cm) was recorded in case of control T_0. During 2022-23, the maximum equatorial diameter (6.24cm) was recorded with application of T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha) followed by the T_{13}. The minimum equatorial diameter (3.82cm) was recorded in case of control T_0. These similar results are in conformity by Meena et al. [21], Dhakad et al. [16], and Singh et al. [19] and Upadhyay et al. [18] in onion.

Table 3. Effect of integrated nutrient management on equatorial diameter (cm) of onion (*Allium cepa* L.)

	Equatorial diameter (cm)		
	Treatment Combination	**2021-22**	**2022-23**
T_0	Control (without fertilizers)	3.80	3.82
T_1	100% RDF (NPK@150:50:80 Kg/ha)	4.29	4.30
T_2	100% RDF + FYM (10 t/ha)	4.38	4.41
T_3	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	4.70	4.81
T_4	100% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	4.98	4.99
T_5	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	5.18	5.19
T_6	75% RDF + FYM (10 t/ha)	5.40	5.42
T_7	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	5.52	5.53
T_8	75% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	5.69	5.70
T_9	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	6.21	6.24
T_{10}	50% RDF + FYM (10 t/ha)	5.02	5.02
T_{11}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	5.11	5.24
T_{12}	50% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	5.26	5.29
T_{13}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	5.97	5.98
SE (m) ±		0.064	0.07
CD (P=0.05)		0.188	0.204

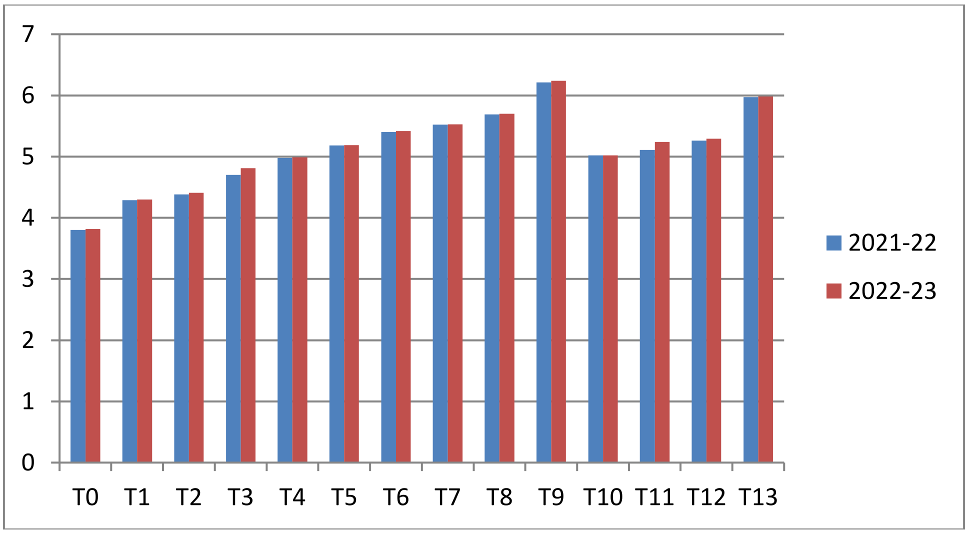

Fig. 3. Effect of integrated nutrient management on equatorial diameter (cm) of onion (*Allium cepa* L.)

3.4 Effect of Integrated Nutrient Management on Total Bulb Yield (q/ha) of Onion (*Allium cepa* L.)

Total bulb yield (q/ha): As evident from the data present in Table- 4 and Fig. 4 treatment effect on total bulb yield (q/ha) was significant during both the years. During 2021-22, the maximum total bulb yield (246.22 q/ha) was recorded with T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5Kg/ha) followed by the T_{13}. On the other hand, the minimum (102.60 q/ha) for total bulb yield was recorded in case of control T_0. During 2022-23, total bulb yield was found to be maximum (247.61 q/ha) in case T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5Kg/ha followed by the T_{13}. The minimum total bulb yield (103.70 q/ha) was found in control T_0. Similar results was found by Badal et al. [17], Kaur and Singh (2019) and Kalirawna et al. [20] in onion.

Table 4. Effect of integrated nutrient management on total bulb yield (q/ha) of onion (*Allium cepa* L.)

	Total bulb yield (q/ha)		
	Treatment Combination	**2021-22**	**2022-23**
T_0	Control (without fertilizers)	102.60	103.70
T_1	100% RDF (NPK@150:50:80 Kg/ha)	212.70	212.74
T_2	100% RDF + FYM (10 t/ha)	216.20	215.71
T_3	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	218.51	219.90
T_4	100% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	220.83	219.44
T_5	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	221.90	221.37
T_6	75% RDF + FYM (10 t/ha)	203.70	202.77
T_7	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	212.96	211.57
T_8	75% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	216.66	217.59
T_9	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	246.22	247.61
T_{10}	50% RDF + FYM (10 t/ha)	191.20	193.51
T_{11}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	205.55	204.62
T_{12}	50% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	211.57	212.50
T_{13}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	230.31	230.24
SE (m) ±		6.334	6.352
CD (P=0.05)		18.413	18.467

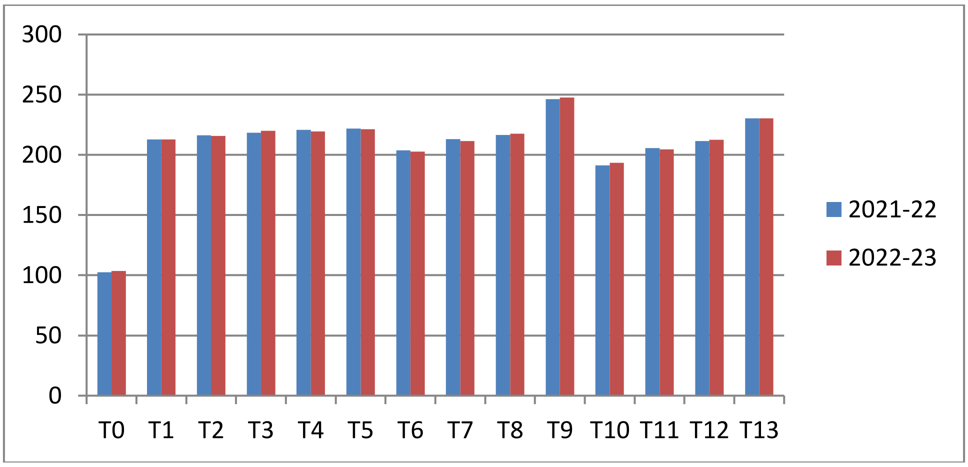

Fig. 4. Effect of integrated nutrient management on total bulb yield (q/ha) of onion (*Allium cepa* L.)

Results showed that weight of bulb, equatorial diameter, polar diameter and total bulb yield increased with T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha). This might be due the facts that combined application of inorganic fertilizers and organic manures helped in the expansion of leaf and chlorophyll content which together might be have accelerated the photosynthetic rate and in turn increased the supply of carbohydrates to the plants. The application of 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha) favored the metabolic and auxin activities in plant and ultimately resulted in increased weight of bulb, equatorial diameter, polar diameter and total bulb yield. Similarly, vermicompost and biofertilizers improved physical, chemical and biological properties of soil which consequently increased the value of yields attributes and finally yield. “Further, it is relevant to note that, organic manure and biofertlizers seems to be directly responsible in increasing crop yields either by accelerating the respiratory process by increasing cell permeability due to hormone growth action or combination of all these processes. It supplies nitrogen, phosphorus, potassium of which phosphorus involved in cell division, photosynthesis and metabolism of carbohydrates where potash regulated proper translocation of photosynthesis and stimulated enzyme activity which in turn might have increased the rate of growth and positive development in yield characters which was resulted in high bulb yield of onion”. These finding are in conformity with Brar et al. [22], Meena et al. [21], Chavan et al. (2016), Sharma et al. [23], Prusty et al. [24], Kaur and Singh (2019), Dhakad et al. [16], Sahoo et al. [25], Kalirawna et al. [20] and Upadhyay et al. [18] in onion.

4. CONCLUSION

On the basis of experimental results, it could be concluded that the application of T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha) was found to be the best treatment combination in terms of yield and yield attributing parameters of onion. Integrated approach of vermicompost, FYM and biofertilizer performed better with respect to yield parameters average bulb weight (g), polar diameter (cm), equatorial diameter (cm) and total bulb yield (q/ha) onion bulb. In the future integrated nutrient management play a vital role to sustain soil fertility and maintain crop productivity for long time. And provide natural and healthy food material for the human being without damaging the environment components.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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