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Effect of Integrated Nutrient Management on Yield Attributing Parameters of *Kharif* Onion (*Allium cepa L.*)

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Authors' contributions

This work was carried out in collaboration among all authors. Author AU data collection, wrote the first draft of the manuscript. Author RBS designed the research program, provided the facilities required during the course of the research. Author PS managed the analysis of the study. Author BL managed the literature searches. Author SS did the proof reading of the manuscript and final formatting. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The objective of the research was to study the effect of Integrated Nutrient Management on the yield attributing parameters of *kharif* onion.
Study Design: The field experiment was carried out in Randomised Block Design (RBD).

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Place and Duration of Study: The experiment was conducted at the Research Farm of the Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur U.P during the *kharif* seasons of 2021-22 and 2022-23.
Methodology: An experiment was carried out during *Kharif* season in the years, of 2021-22 and 2022-23 both the year same time at Vegetable Research Farm, Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture and Technology, Kalyanpur, Kanpur. The experiment was laid out in randomized block design with three replications. The treatments consisted of T1- Control: T2- 100% RDF (NPK @ 120:60:80 kg/ha; T3- 75% RDF+ FYM 6 t/ha: T4- 75%RDF+ Vermicompost@2 t/ ha; T5- 75%RDF+FYM @ 3t/ha+vermicompost@1 t/ha ;T6- 75% RDF + FYM @ 3 t/ha + Vermicompost @ 1t/ha+ Biofertilizer (Azotobacter + PSB @ 5 kg/ha each):T7- 50% RDF + FYM @ 12t/ha; T8-50% RDF + Vermicompost @ 4t/ha: T9- 50%RDF+ FYM @ 6t/ha + Vermicompos @ 2t/ha: T10- 50%RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each).
Results: Results revealed that the treatment T10 (50% RDF +FYM @ 6 t/ha + Vermicompost @ 2t/ha+ Biofertilizer (Azotobacter + PSB @ 5kg/ha each) performed better with respect to yield attributing parameters characters such as Average bulb weight, A, B, C grade bulb percentage, days takes to harvesting, bolting percentage of bulb and double bulb Percentage.
Conclusion: The study underscores the crucial need to shift towards Integrated Nutrient Management (INM), incorporating both organic and inorganic fertilizers. This transition is essential to protect soil fertility, maintain ecosystem health, and ensure sustainable food production for future generations.

Keywords: INM; growth; yield; biofertilizer; vermicompost.

1. INTRODUCTION

Onion is one of the most important vegetable and spice crop grown in temperate, sub-tropical and tropical climates throughout the world. Onion exhibit particular diversity in the Eastern Mediterranean countries, through Turkmenistan, Tajikistan to Pakistan and India, which are the most important sources of genetic diversity and believed to be center of origin. India is one of the leading onion producers with production of 2362.33 thousand MT per year from an area of 1284.99 thousand hectare, with the productivity of 18.10 MT/ha (Horticulture Statistics Department, 2018-19). The more pungent varieties of onion appear to possess the greatest concentration of health promoting phyto-chemicals. Today, onions continue to be an important part of our diet. The National Cancer Institute has reported that onions contain antioxidants that help to block cancer and appear to lower Cholesterol. Onion bulbs and green onion both are rich in vitamin C, potassium, dietary fiber, minerals,folic acid, high protein content. It is mainly used for cuisine, *salad* and culinary purpose. Onions have always held a place in folklore and folk medicine, but recently biochemists have revealed its anti-bacterial properties, particularly against *Helicobacter pylori*, the ulcer-forming microorganism. Besides, the more pungent onions exhibit strong anti-platelet and blood thinning activities in human blood, potentially adding protection against arteriosclerosis, cardio-vascular diseases, stroke, diabetes, osteoporosis and heart attack. The basis for INM, which could involve three nutrient sources: microbial inoculants or biofertilizers including *Azotobacter, Azospirillum*, and phosphate solubilising 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. Onion is a heavy feeder of mineral elements. INM further prescribes that selected nutrient inputs be used judiciously to ensure optimum supply of all essential nutrients for sustainable crop production. Onion is a heavy feeder of mineral elements. A crop of 40 t/ha removes approximately 120 kg of N, 50 kg of P2O5 and 160 kg of K2O per ha [1]. Hence, the greater its ability to utilize nutrients for crop production, the greater is the yield potential Accordingly, the present study was undertaken to assess the effect of Intregrated nutrient management on yield attributing parameters of *kharif* onion

2. METHODOLOGY

The experiment was conducted during *Kharif* season in the years, of 2021-22 and 2022-23 both the year same time at Vegetable Research Farm, Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture and Technology, Kalyanpur, Kanpur. The

experiment was laid out in randomized block design with three replications. The treatments consisted of T1- Control: T2- 100% RDF (NPK @ 120:60:80 kg/ha; T3-75% RDF+ FYM 6 t/ha: T4-75%RDF+ Vermicompost@2 t/ ha; T5-75%RDF+FYM @ 3t/ha+vermicompost@1 t/ha; T6- 75%RDF + FYM@ 3t/ha+Vermicompost@ 1t/ha+ Biofertilizer (Azotobacter +PSB @5kg/ha each):T7- 50% RDF + FYM @ 12t/ha; T8- 50%RDF + Vermicompost @ 4t/ha: T9-50%RDF+ FYM @6t/ha + Vermicompos @ 2t/ha: T10- 50%RDF + FYM @ 6t/ha + Vermicompost @2t/ha+ Biofertilizer (Azotobacter + PSB @ 5kg/ha each).having an even topography with adequate irrigation and proper drainage facilities. The soil was sandy loam, good in fertility. Geographically Kanpur is situated in the Gangetic plains of alluvium of Central U.P. It lies in altitude and longitude ranges between 25.28˚ to 28.50˚ 44 north and 79.31˚ to 84.34˚ east at elevation of 125.90 m above mean sea level. Kanpur is characterized by sub-tropical climate with hot dry summer and cold winters. The topography of experimental field was fairly uniform during experimental year. According to standard processes, the soil samples were collected randomly from the experimental field at a depth of 0-15 cm. The randomly collected sample were thoroughly mixed well and composite soil sample was made up (500 g) of soil. Thereafter, the sample was analyzed to determine the physical and chemical analysis of soil testing laboratory of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P). The pH was determined by electric pH meter and available Nitrogen was determined by alkaline permagnate method as reported [1] and available phosphorus and potash by Olsen's method [2] and Flame photometer method respectively. The E.C. was determined by Conductivity Bridge as described by [3]. The observations on different yield attributing parameters (Average bulb weight, A grade bulb percentage, B grade bulb percentage, C grade, days takes to harvesting, bolting percentage of bulb, double bulb Percentage) were recorded on five randomly selected competitive plants of each plot in each replication.

3. RESULTS AND DISCUSSION

3.1 Average Bulb Weight, A, B and C Grade Bulb Percentage

The data presented in Table 1 (Fig. 1) show the effect of integrated nutrient management on yield attributing parameters of *kharif* onion, which exhibited significant differences among the treatments. The data indicated significant effects of different treatments on the average bulb weight (g) during both years.

During the 2021-22 season, the maximum average bulb weight (102.10 g) was recorded in T10 - 50% RDF + FYM @ 6 t/ha + Vermicompost @ 2 t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each), which was at par with T5, T6, and T9. The minimum average bulb weight (74.78 g) was recorded in the control treatment (T1). In the 2022-23 season, the maximum average bulb weight (104.45 g) was observed with the application of T10 - 50% RDF + FYM @ 6 t/ha + Vermicompost @ 2 t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each), again at par with T5, T6, and T9. The minimum average bulb weight (75.89 g) was recorded in the control treatment (T1).

During 2021-22, the maximum (Fig. 2) A grade Bulb percentage (29.86%) was recorded with application of T10- 50% RDF + FYM @ 6 t/ha + Vermicompost @ 2 t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each) which was at par with T5 and T6. The minimum A grade Bulb percentage (21.10%) was recorded in control (T1). During 2022-23, the A grade bulb percentage was maximum (32.32%) in case of application ofT10- 50% RDF + FYM @ 6 t/ha+ Vermicompost @ 2 t/ha + Bio fertilizer (Azotobacter + PSB @ 5 kg/ha each).The minimum A grade Bulb percentage (20.24%) was recorded in control (T1).

The maximum (Fig. 2) B grade Bulb percentage during 2021-2022 (42.65%) was recorded with application of T10- 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each) which was at par with T5, T8 and T9. The minimum (31.68%) B grade Bulb percentage was recorded in case of control (T1). During 2022-23 the maximum B grade Bulb percentage (41.66%) was recorded with application of T10- 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each) which was at par with T5, T6, T7 and T9. The minimum B grade Bulb percentage (30.48 cm) was recorded in case of control (T1).

The minimum (Fig. 2) C grade Bulb percentage during 2021-2022 (19.75%) was recorded with application of T10- 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer

(Azotobacter + PSB @ 5 kg/ha each) which was at par with T5. The maximum (25.86%) C grade bulb percentage was recorded in case of control (T1). During 2022-23 the minimum C grade bulb percentage (18.64%) was recorded with application of T10- 50 % RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each). The maximum C grade Bulb percentage (26.86cm) was recorded in case of control (T1).

Results showed that Average bulb weight (g), A, B and C grade Bulb percentage increased with application T10- 50 % RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each).The application of inorganic fertilizer in conjunction with organics and bio-fertilizers will minimize use of costly fertilizers inputs and results into more fertilizer use efficiency. Further, use of nutrient supply system that include organic, inorganic and bio-fertilizers increases the yield apart from soil health. PSB caused significant improvement in bulb yield over the application with Azospirillum. Increase in yield due to PSB inoculation could be attributed to increase in growth and yield attributing characters resulting from dissolution of insoluble phosphorus in soil to soluble forms and production of plant growth hormones and vitamins by microorganisms [4,5].

Table 1. Effect of integrated nutrient management of average bulb weight (g), A grade Bulb percentage, B grade bulb percentage, C grade bulb percentage of onion

Treatment no.	Average bulb weight (g)		A grade Bulb percentage		B grade Bulb percentage		C grade Bulb percentage	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
T1	74.78	75.89	21.10	20.24	31.68	30.48	25.86	26.86
T2	81.20	80.57	24.75	23.56	34.55	31.65	23.10	24.15
T3	78.65	79.73	22.55	23.20	37.75	34.54	24.33	23.23
T4	77.56	78.68	23.53	25.65	35.88	33.87	20.86	21.86
T5	93.63	95.64	27.64	28.75	39.64	38.85	20.11	22.12
T6	98.76	101.20	28.73	29.10	38.24	39.47	21.53	21.64
T7	89.85	93.22	25.46	26.75	38.00	38.64	22.75	20.88
T8	92.75	94.11	26.75	27.12	38.88	36.75	22.86	21.45
T9	96.41	98.86	25.86	27.86	40.20	39.20	20.56	21.11
T10	102.10	104.45	29.86	32.32	42.65	41.66	19.75	18.64
SE (m) ±	**2.961**	**3.016**	**0.844**	**0.851**	**1.263**	**1.223**	**0.89**	**0.905**
CD (P=0.05)	**8.864**	**9.032**	**2.526**	**2.549**	**3.782**	**3.661**	**2.664**	**2.711**

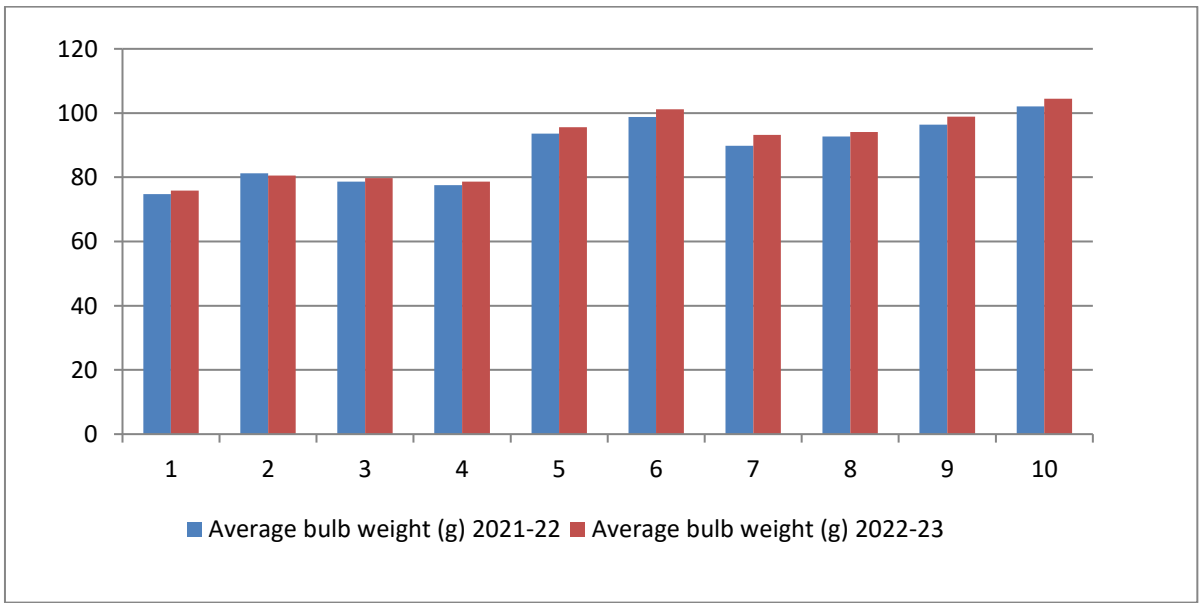

Fig. 1. Effect of integrated nutrient management on average bulb weight (g) of onion

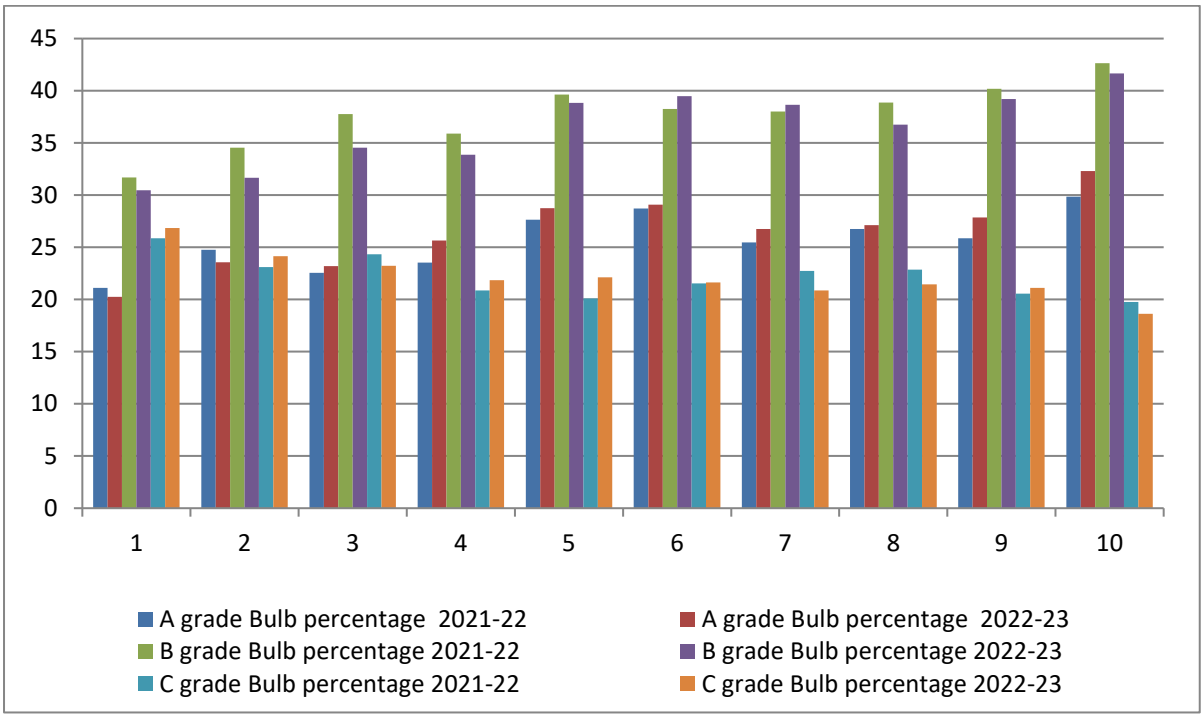

Fig. 2. Effect of integrated nutrient management on A,B,C grade Bulb percentage of onion

3.2 Days takes to harvesting, Bolting and Double Bulb Percentage

The data on days takes to harvesting, Bolting percentage of bulb, Double bulb Percentage as influenced by various treatments are presented in Table 2. Perusal of data indicates significant effects of different treatments on days taken to harvesting during both the years, during 2021-22, the minimum days taken to harvesting (120.23 days) was recorded in T10- 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each). The maximum days taken to harvesting (132.88 days) was recorded in case of control (T1). During 2022-23, the minimum days taken to harvesting (115.07 days) was recorded in case of T10- 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each) which at pat with T6 and T9. The maximum days taken to harvesting (127.37 days) was recorded in case of control (T1).

The minimum (Fig. 3) bolting percentage (0.64%) was recorded in T10- 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each) which at par with T5 and T6. The maximum bolting percentage (1.14%) was recorded in case of control (T1). During 2022-23, the minimum bolting percentage (0.86%) was recorded in case of T10- 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each). The maximum bolting percentage (2.20%) was recorded in case of control (T1).

The minimum (Fig. 3) percentage of double bulb (0.44 %) was recorded in T10- 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha + Biofertilizer (Azotobacter + PSB @ 5 kg/ha each). The maximum percentage of double bulb (0.98%) was recorded in case of control (T1). During 2022-23, the minimum percentage of double bulb (0.64%) was recorded in case of T10- 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha +Biofertilizer (Azotobacter + PSB @ 5 kg/ha each) which at par with T5,T6 and T9. The maximum percentage of double bulb (1.06%) was recorded in case of control (T1).

This may be attributable to the fact that the combined use of organic manures and inorganic fertilisers boosted leaf and chlorophyll content, which may have accelerated photosynthetic activity and, as a result, increased the supply of carbohydrates to the plants. The application of 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha +Biofertilizer (Azotobacter +PSB @ 5 kg/ha each) favored the metabolic and auxin activities in plant. vermicompost and biofertilizers improved physical, chemical and biological

Table 2. Effect of integrated nutrient management on days taken to harvesting, bolting percentage of bulb, double bulb percentage of onion

Treatment no.	Days taken to harvesting		Bolting percentage of bulb		Double bulb Percentage	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
T1	132.88	127.37	1.14	2.20	0.98	1.06
T2	127.81	124.10	1.09	1.54	0.80	0.95
T3	128.82	126.69	1.01	1.44	0.84	0.83
T4	132.10	125.29	0.88	2.10	0.90	0.86
T5	124.76	123.61	0.72	1.14	0.60	0.70
T6	122.65	118.16	0.75	0.97	0.71	0.67
T7	128.93	120.70	0.96	1.87	0.66	0.85
T8	126.55	121.99	0.91	1.23	0.74	0.77
T9	125.64	118.89	0.83	1.06	0.51	0.72
T10	120.23	115.07	0.64	0.86	0.44	0.64
SE (m) ±	**2.088**	**2.081**	**0.038**	**0.072**	**0.032**	**0.035**
CD (P=0.05)	**6.252**	**6.232**	**0.113**	**0.214**	**0.096**	**0.105**

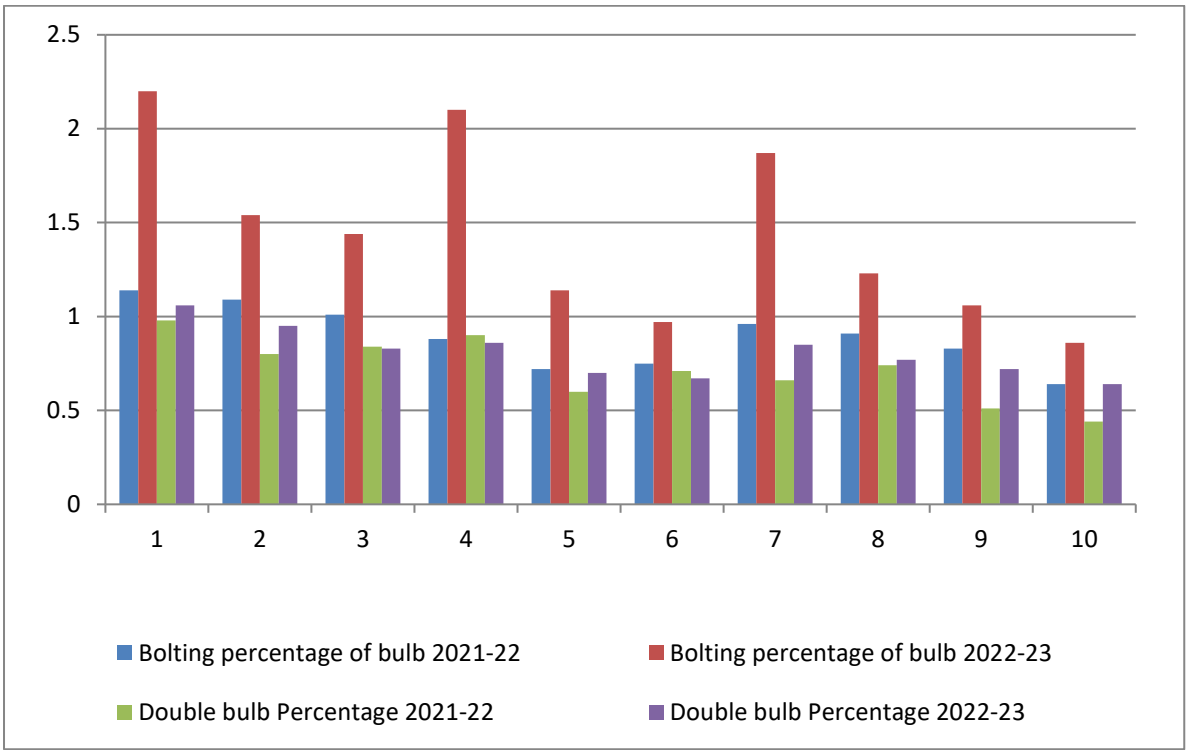

Fig. 3. Effect of integrated nutrient management on bolting percentage of bulb, double bulb percentage of onion

properties of soil which consequently increased the value of yields attributing parameters of onion and finally yield. These finding are in conformity with [4-15].

4. CONCLUSION

The experiment was particularly planned to get information about integrated use of chemical fertilizers and organic manures, farm yard manures, vermicompost and bio-fertilizer in *kharif* onion and the efforts have been made to isolate the probable reasons of different treatment effects, causes and their effective relationships. Based on the results obtained, it can be concluded that the utilization of T10- 50% RDF + FYM @ 6t/ha + Vermicompost @ 2t/ha +Biofertilizer (Azotobacter +PSB @ 5 kg/ha each) emerged as the most effective treatment combination in terms of the following parameters:

Average bulb weight,A grade bulb percentage, B grade bulb percentage, C grade, days taken to harvesting, bolting percentage of bulb, double bulb Percentage.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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