Effect of integrated nutrient management on yield attributes of onion (*Allium cepa* L.) cv. Pusa Shobha

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 treatments consisted of T_0 -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). Resultsrevealed 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 with respect of yield characters such as average bulb weight (99.36g), polar diameter (6.22cm), equatorial diameter (6.2cm), neck thickness (0.94cm), number of scales/bulb (9.44) and total bulb yield (259.25q/ha) onion bulb.

Keywords:INM, Biofertilizer, PSB,Azotobacter,Vermicompost, Farmyard manure, Yield.

INTRODUCTION

Onion (*Allium cepa* L.) is a most important crop belongs to the Alliaceae family. 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 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. It is native of the Central Asia and Mediterranean region and commercially grown in China, India, U.S.A., erstwhile U.S.S.R., Japan, Spain, Turkey, Brazil, Egypt *etc*.In the world production of onion, India has second place after China. In the foreign exchange point of view, onion ranks first in vegetables. Continuous and unbalanced fertilizer use has a negative impact on agricultural production sustainability while also producing environmental damage.**Greenland (1975**) suggested that for a sustainable crop production system, chemical nutrients removed by the crop must be replenished and physical conditions of the soil maintained. Integrated nutrient management (INM) provides excellent opportunities to overcome all the imbalances besides sustaining soil health and enhancing crop production. 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. 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. The use of FYM, vermicompost and biofertilizers in such situation is, therefore, a practically paying proposal. Although the use of manures as nutrient sources for vegetables 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 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. A crop of 40 t/ha removes approximately 120 kg of N, 50 kg of P2O5 and 160 kg of K2O per ha (**Tandon and Tiwari, 2008).** 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. Use of bio fertilizers not only supplement the nutrient but also improve the efficiency of applied nutrients. The use of vermicompost and biofertilizers in such situation is, therefore, a 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. They are known to improve growth, yield as well as productivity of crops (**Gaur, 2010**). 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**

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 treatments consisted of T_0- 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).having an even topography with adequate irrigation and proper drainage facilities. The soil was sandy clay loam 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 $26^{\circ}56$ North Latitude $80^{\circ}52$ east longitude. The topography of experimental field was fairly uniform during experimental year. Experimentwas studies in RBD keeping three replications in each treatment plants were transplanted in a plot size 1.8mx1.2m and at the spacing of 15x10cm.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 and available Nitrogen was determined by alkaline permagnate method as reported by Piper (1966) and available phosphorus and potash by Olsen's method Olsen *et al.* (1954) and Flame photometer method respectively. The E.C. was determined by Conductivity Bridge as described by Jackson (1967).

Yieldandyield attributingcharacters are recorded as-

1. Averagebulbweight(g)

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

2. Equatorialdiameterofbulb(cm)

Equatorial diameter of randomly selected bulbs were measured at both equatorial portionofbulb withthe help ofVernier’s calipers was used to denote bulbdiameter (cm) of each accessions.

3. Polardiameterofbulb (cm)

Polar diameter ofrandomlyselected bulbs were measured at bothpolar portionof bulb with the help of Vernier’s calipers was used to denote tuber diameter (cm) of each bulb.

4. Neckthickness(cm)

The neck thickness of five bulbs randomly selected in each plot was measured with the help of Vernier’s calipers at harvesting and average was worked for each treatment.

5. Numberofscalesper bulb

Number of scales per bulb was counted after cutting of the bulb horizontally in two halves.

6. Bulbyield (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 kilogramwhich was converted into quintal per hectare as given below:

Bulbyieldper hectar(q)= Bulbyield(kg/plot) x10,000 / Net area of plot (m^2) x 100

RESULTS AND DISCUSSION

Data presented in Table-1 and Table-2 the effect of integrated nutrient management on yield and yield attributes of onion showed the significant difference among the treatments.

Average bulb weight-Data presented in table-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 (43.34g) 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 (44.35g) was recorded in case of control (T_0). These similar results are in conformity by Upadhyay *et al.*(2023).

Polar diameterof bulb-Perusal of data in table-1 indicated significant effects of different treatments on polar diameter of bulb in both the years. During 2021-22, the maximum polar diameter (6.12cm) was recorded with application of T9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha).The minimum polar diameter (3.95cm) was recorded in case of control (T_0). During 2022-23, the polar diameter was the maximum (6.32 cm) in case of application T9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha). 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 Dhakad*et al.* (2019).

Equatorial diameter of bulb-Data in table-1 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 T9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha). 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 T9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha). The minimum equatorial diameter (3.82cm) was recorded in case of control (T_0). These similar results are in conformity by Meena *et al.* (2015).

Neck thickness of bulb(cm) -The data pertaining to neck thickness of bulb has been presented in table-2 perusal of data in table indicated significant effects of different treatments on neck thickness of bulb during both the years. During 2021-22, the neck thickness of bulb was minimum (0.90cm) with application of T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha), while the maximum neck thickness of bulb (1.35cm) was recorded in case of control (T_0). During 2022-23, the minimum neck thickness of bulb (0.98cm) 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) which was at par with T_{13}.The maximum neck thickness of bulb (1.45cm) was recorded in case of control (T_0). These similar results are in conformity by Chavan *et al.* (2016).

Number of scales/bulb-Perusal of data in table-2 indicated significant effects of different treatments on number of scales/bulb during both the years. The maximum number of scales/bulb during 2021-22 (9.78cm) 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). The minimum number of scales/bulb (4.21cm) was recorded in case control (T_0). During 2022-23, the maximum number of scales/bulb (9.11cm) 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). The minimum number of scales/bulb (4.59cm) was recorded in case of control (T_0).These finding are in conformity with Dudhat*et al.*(2011), Brar *et al.* (2015).

Total bulb yield (q/ha) -As evident from the data present in table number-2 treatment effect on total bulb yield (q/ha) was significant during both the years. During 2021-22, the maximum total bulb yield (258.79 q/ha) was recorded with T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5Kg/ha) which was at par with $T_{7,}$ T_8 and T_{13}. On the other hand, the minimum (124.53 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 (259.72 q/ha) in case T_9- 75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5Kg/ha) which was at par with $T_{7,}$ T_8 and T_{13}. The minimum total bulb yield (126.85q/ha) was found in control (T_0).Similar results was found by Kaur and Singh (2019).

Results showed that equatorial diameter, polar diameter, neck thickness, weight of bulb and total 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 bulb diameter, average bulb weight,number of scales and total 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 mighthave 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 Dudhat*et al.*(2011), Brar *et al.* (2015), Meena *et al.* (2015), Chavan *et al.* (2016), Sharma *et al.* (2017), Prusty *et al.* (2019), Kaur and Singh (2019), Dhakad *et al.* (2019), Sahoo *et al.*(2022), Kalirawna *et al.* (2022), Upadhyay *et al.*(2023).

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 ofonion. Integrated approach of Vermicompost, FYM and biofertilizer performed better with respect to yield parameters average bulb weight (99.36g), polar diameter (6.22cm), equatorial diameter (6.2cm), neck thickness (0.94cm), number of scales/bulb (9.44) and total bulb yield (259.25q/ha) onion bulb.

Table.1. Effect of integrated nutrient management on average bulb weight (g), polar diameter (cm) and equatorial diameter (cm) of onion (*Allium cepa* L.)

Treatment Details		**Average bulb weight (g)**		**Polar diameter (cm)**		**Equatorial diameter (cm)**	
		2021-22	**2022-23**	**2021-22**	**2022-23**	**2021-22**	**2022-23**
T_0	Control (without fertilizers)	43.34	44.35	3.95	3.85	3.80	3.82
T_1	100% RDF (NPK@150:50:80 Kg/ha)	72.78	73.84	4.13	4.23	4.29	4.30
T_2	100% RDF + FYM (10 t/ha)	73.46	74.92	4.43	4.53	4.38	4.41

T_3	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	75.25	76.28	4.60	4.80	4.70	4.81
T_4	100% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	77.33	78.45	4.88	4.98	4.98	4.99
T_5	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	79.20	80.20	5.29	5.39	5.18	5.19
T_6	75% RDF + FYM (10 t/ha)	76.89	77.89	5.53	5.63	5.40	5.42
T_7	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	81.56	82.56	5.65	5.75	5.52	5.53
T_8	75% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	89.78	90.72	5.75	5.85	5.69	5.70
T_9	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	98.86	99.87	6.12	6.32	6.21	6.24
T_{10}	50% RDF + FYM (10 t/ha)	83.44	84.52	5.28	5.38	5.26	5.29
T_{11}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	85.34	86.45	5.67	5.77	5.11	5.24
T_{12}	50% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	87.87	88.88	5.56	5.66	5.02	5.02
T_{13}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	94.56	95.57	5.85	5.95	5.97	5.98
SE(m) ±		0.972	0.697	0.053	0.056	0.064	0.07
CD (P=0.05)		2.828	2.028	0.155	0.163	0.188	0.204

Table. 2. Effect of integrated nutrient management on neck thickness (cm), number of scales/bulb and total bulb yield (q/ha)) of onion (*Allium cepa* L.)

Treatment Details		**Neck thickness (cm)**		**Number of scales/bulb**		**Total bulb yield (q/ha))**	
		2021-22	**2022-23**	**2021-22**	**2022-23**	**2021-22**	**2022-23**
T_0	Control (without fertilizers)	1.35	1.45	4.21	4.59	124.53	126.85
T_1	100% RDF (NPK@150:50:80 Kg/ha)	1.24	1.25	5.65	5.12	201.85	203.70

T_2	100% RDF + FYM (10 t/ha)	1.22	1.33	6.68	5.25	209.72	211.57
T_3	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	1.20	1.31	6.55	5.34	220.83	223.61
T_4	100% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	1.28	1.43	6.10	5.67	218.98	220.83
T_5	100% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	1.31	1.41	5.78	6.15	230.55	232.87
T_6	75% RDF + FYM (10 t/ha)	1.19	1.29	6.26	6.20	236.57	238.88
T_7	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	1.14	1.24	6.79	6.66	240.74	242.59
T_8	75% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	1.00	1.10	7.03	7.59	244.44	248.61
T_9	75% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	0.90	0.98	9.78	9.11	258.79	259.72
T_{10}	50% RDF + FYM (10 t/ha)	1.17	1.18	5.46	6.97	218.05	219.90
T_{11}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha)	1.09	1.12	6.74	6.44	232.87	234.72
T_{12}	50% RDF + FYM (10 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	1.10	1.13	6.10	7.09	219.90	222.68
T_{13}	50% RDF + FYM (5 t/ha) + Vermicompost (2 t/ha) + Azotobacter (5 Kg/ha) + PSB (5 Kg/ha)	0.99	1.01	8.76	8.24	242.12	246.29
SE(m) ±		0.011	0.014	0.209	0.215	6.879	6.961
CD (P=0.05)		0.033	0.040	0.608	0.626	19.997	20.237

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