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Evaluation for Number and Size of Bulbs in Small Onion (*Allium cepa)* Incorporated with Biofertilizer and Organic Manure under Garden Land Condition

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Abstract: A field experiment was conducted in red soil at KRISAT campus, Madurai, Tamilnadu, India. To study the number and size of bulbs in onion incorporated with biofertilizer and organic manures under gardenland conditions. The experimental design used for a split plot with three replications, 4 main and 4 sub plots were tried. The main plot treatments consist of M_1-Poultry manure @ (1kg/plot), M_2- FYM @ (2.5 kg/plot), M_3- Vermicompost @ (1kg/plot), M_4-Goat manure @ (1.5 kg/plot). The sub plot treatment consists of S_0 (Control)-Organic manure (100%), S_1-Organic manure (100%)+Azospirillum (25%), S_2 -Organic manure +Azospirillum (50%), S_3 -Organic manure +Azospirillum (75%). The growth and yield parameters were recorded at 30,60,90 DAP and during harvest. The highest leaf length (46.25 cm), leaf diameter(1.13 cm), maximum number of leaves (45), Bulb length(5.6 cm), maximum number of bulbs(5), average diameter of bulb(4.74 cm) and bulb yield(134.73q/ha)recorded in FYM with 75% azospirillum treated plot when compared to other organic manures. The organic manures paves to maintain soil fertility and enhanced the soil microbial populations.

Keywords*: Allium Cepa, FYM, Vermicompost, Poultry Manure, Goat Manure, Biofertilizers.*

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I. INTRODUCTION

From ancient times, onions (*Allium cepa* L.) have been prized as both a food and a medicinal plant. It is a vegetable bulb crop that is widely grown, ranked second only to tomatoes, and is enjoyed globally and in most cultures (FAO, 2012). This crop grows at low latitudes and has a short growing season. It is frequently referred to as the "Queen of the kitchen" because of its highly valued flavor, aroma and unique taste as well as the therapeutic qualities of its flavoring compounds. Throughout the year, onions are used in a variety of dishes, including curries, salads, cooking with other vegetables (such boiling or baking), and as a condiment. In addition to its medicinal properties, it is utilized in a variety of processed foods, such as pickles, paste, flakes, and powder.

- *Historical Aspects*

Humans have been using onions since the Neolithic era, and they are still utilized now all over the world. For around 5000 years, onions have been grown in at least 175 nations worldwide. The spherical bulb was considered a symbol of the universe by the ancient Egyptians (Sunil Pareek *et al*., 2017). The word is most likely derived from the Latin unus, which means "one." The onion was brought to Britain by the Romans, and it may have spread to the Americas from there (Burnie *et al*., 1999).

- *Production Statistics*

The onion is a biennial bulb crop that is widely farmed; it produces 74,250,809 tons worldwide on 4,364,000 hectares of land. The world's leading onion-growing nations are China and India, with the United States, Egypt, Iran, Turkey, Pakistan, Brazil, the Russian Federation, and the Republic of Korea following (FAO, 2012). The Republic of Korea has the highest onion productivity (66.16 t/ha), followed by the USA (56.26 t/ha), Spain (53.31 t/ha), and the Netherlands (51.64 t/ha); the global average is 19.79

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t/ha. From an economic perspective, 6.77 million tones of onions are exported internationally. With 1.33 million tons exported, the Netherlands leads the world in onion exports, followed by China, Egypt, Mexico, the United States, Spain, Argentina, and India. The world's top importers of onions are Saudi Arabia, Japan, the UK, Malaysia, Bangladesh, and the Russian Federation (Sunil Pareek *et al*., 2017).

The onion is classified under the Amaryllidaceae family. Depending on the cultivar, it can be either biennial or perennial and emits a stench when crushed (WHO, 1999). The plant has tubular leaves, bulb, and shallow adventitious fibrous roots. In the second year of the plant's existence, the stem reaches a height of 100 to 200 cm. The plant's outer leaves, which store nourishment, are extended by the green leaves. An apical meristem that resembles a ring gives rise to the umbel-like inflorescence. The umbel is made up of 200-600 tiny individual flowers, though this can vary from 50-1000. The umbel is the collection of flowers at different phases of growth (Ross, 2001). It is made up of tiny, white or greenish-white blooms that appear at the stem's tip during the plant's second year. Onions are often red, white, and yellow in color, and their bulb shapes vary from flat to globular to rectangular (Fritsch, 2005).

When using organic manure in the production of onions, it is anticipated that the nitrogen will boost the plants' vegetative growth, resulting in more leaves, longer leaves, etc., which will ultimately raise the bulb weight and yield. This discussion also supported the fact that organic manures improved the size and weight of onion bulbs. Cow dung, poultry manure, vermicompost, goat manure, and their mixtures have a very limited impact on onion output. Therefore, the goal of the current study is to evaluate how various organic manures affect the development and yield performances of onion types.

II. MATERIALS AND METHODS

A field experiment was carried out at Krishna College of Agriculture and Technology in Usilampatti in 2019-2020. The red loamy soil used for the experiment had a pH of 6.5, available potassium (293 kg ha^{-1}), available phosphorus (16 kg ha^{-1}), and available nitrogen (231 kg ha^{-1}). Situated at 9º 58' N latitude and 77º 48' E longitude, the experimental farm is 218 meters above mean sea level. Split Plot Design (SPD) was used to set up the experiment, which included three replications and sixteen treatments. M_1S_0 – Poultry Manure (control), M_1S_1 – Poultry Manure + 25% Azospirillum, M_1S_2 – Poultry Manure + 50% Azospirillum, M_1S_3 - Poultry Manure + 75% Azospirillum , M_2S_0 – FYM (control), M_2S_1 – FYM + 25% Azospirillum , M_2S_2 – FYM + 50% Azospirillum , M_2S_3 – FYM + 75% Azospirillum, M_3S_0 – Vermicompost (control), M_3S_1 – Vermicompost + 25% Azospirillum, M_3S_2 – Vermicompost + 50% Azospirillum, M_3S_3 – Vermicompost + 75% Azospirilli, M_4S_0 – Goat Manure (control), M_4S_1 – Goat Manure + 25% Azospirillum, M_4S_2 – Goat Manure + 50% Azospirillum, M_4S_3 – Goat Manure + 75% Azospirillum.

The Co 3 onion bulb variety was planted with 30 x 10 cm spacing between each bulb. The prescribed dosage of farmyard manure (FYM) at 12.5 t/ha^{-1} was applied in conjunction with 25 kg N, 50 kg P_2O_5, and 25 kg K_2O. Half doses of K_2O, N and the entire amount of FYM, P_2O_5 were applied during field preparation. The final half-doses of K_2O and N were administered at 25 and 45 DAS. Using a knapsack sprayer with a flood jet nozzle, the foliar nutrients and growth regulators were applied in accordance with the treatments. Leaf Length (cm), Leaf Diameter, and Number of Leaves per Plant were noted, along with Bulb Size, Number of Bulbs, and Bulb Yield. The Snedecor and Cochran (1967) approach was used to tabulate and statistically analyze the data collected on different factors. At the 5% level of probability, the treatment levels were compared by critical difference.

III. RESULTS AND DISCUSSION

A. Effect on Growth Parameters

- *Leaf Length, Leaf Diameter & Number of Leaves per Plant*

The length of the leaves is important as an economic component as well as a site of photosynthesis. The maximum leaf length was recorded in M_2S_3 (47.87±0.41cm) which was statistically followed by M_3S_3 (46.91 cm). The use of FYM considerably increased the plant height (55.83 cm) in soy beans compared to the control (9.2 cm) (Jain *et al*., 1995) and the plant height (76.10 cm) in wheat compared to the control (70.60 cm) (Aditya Kalirawna *et al*., 2022).

The maximum leaf diameter (Table 1) was recorded in M_2S_3 (1.13 cm) which was followed by M_3S_3 (0.94 cm). Similar outcomes were noted for onion and garlic leaves treated with FYM (2.95 cm) compared to control (2.53 cm) (Fisseha 1983; Soni *et al*., 2016). The maximum number of leaves was recorded in M_2S_3 (45.0), which was followed by M_3S_3 (42.2) (Table 1). Meena *et al.* (2015) reported that, there is a notable increase in the number of leaves (11.05 compared to 9.30) in onions grown with FYM at 2.5 t/ha and with FYM and Vermicompost combined.

B. Effect on Yield Parameters

- *Bulb Size, Number of Bulbs and Bulb Yield*

The maximum Bulb length and diameter (Table.2) was observed in the M_3S_3(5.9 cm) and M_2S_3(4.74 cm) which was followed by M_2S_3(5.3 cm) and M_3S_3(4.48 cm). Significantly increased in the size of bulbs was reported for FYM, recorded in garlic bulb diameter (3.95cm) over control (3.53cm) and for onion (Fisseha, 1983; Soni *et al.*, 2016; Dhaker *et al.*, 2017). The average number of bulbs was noted maximum in M_2S_3 (5.00), followed by M_3S_3 (4.3). Comparable results were found for the number of bulbs (5 over 4) for FYM @ 2.5 t/ha and for the combination of FYM in onions (Meena *et al*., 2015). FYM application in onions likewise increased the number of bulbs (5.3) over the control (3.5) (Reddy and Reddy 2005).

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The highest bulb yield was recorded (Table.2) in M_2S_3 (134.73 Kg) which followed by M_3S_3 (128.24 Kg). The use of FYM in various combinations with other inorganic fertilizers has been shown to enhance bulb weight; the maximum bulb weight was found to be 33.3 t/ha, which is higher than the control of 18.97 t/ha (Yohannes *et al*., 2013).

C. Economics

Among the various treatments tried, M_2S_3 - FYM @ 12.5t/ha with 75% Azospirillum @ (470 ml/ha) mixed well and broadcasted 2 days before sowing recorded the highest return rupee^{-1} invested of (4.17). Followed by M_3S_3-Vermicompost @ 3t/ha with 75% Azospirillum (470 ml/ha) was recorded the return rupee^{-1} invested of (3.73) while the least return rupee^{-1} invested of Rs. 2.43 was observed in the treatment ($M_1S_{0)}$-Poultry Manure (control).

IV. CONCLUSION

Based on these results, various organic manures tried, M_2S_3 - FYM @ 12.5t/ha with 75% Azospirillum (470 ml/ha) recorded the highest leaf length (46.25 cm), leaf diameter (1.13 cm), maximum number of leaves (45), Bulb length (5.6 cm), maximum number of bulbs (5), average diameter of bulb (4.74 cm) and bulb yield (134.73q/ha), highest BC ratio (4.17) was recorded" The results showed that it is much better than all other treatments, followed by M3S3-Vermicompost @ 3 t/ha and 75% Azospirillum (3.73).

The findings of this investigation showed that the bulb yield, number of bulbs and bulb size was highest with the response to Farm Yard Manure @12.5 t/ha along with 75% Azospirillum. The organic manures paves to maintain soil fertility and enhanced the soil beneficial microbial populations.

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Table 1. Leaf Length, Diameter and No of leaf influenced by different treatments in onion (*Allium cepa*)

Treatments	Leaf length (cm)			Leaf diameter (cm)			Number of Leaves		
	30 Days	60 Days	90 Days	30 days	60 days	90 days	30 days	60 Days	90 Days
M_1S_0 – Poultry Manure (control)	20.56	34.56	49.33	0.28	0.40	0.90	20.56	34.56	49.33
M_1S_1 – Poultry Manure + 25% Azospirillum	19.65	35.65	45.99	0.32	0.47	1.00	19.65	35.65	45.99
M_1S_2 – Poultry Manure + 50% Azospirillum	17.86	39.45	48.65	0.38	0.51	1.43	17.86	39.45	48.65
M_1S_3 - Poultry Manure + 75% Azospirillum	21.50	37.69	45.05	0.42	0.58	1.60	21.50	37.60	45.00
M_2S_0 – FYM (control)	28.34	39.65	52.08	0.32	0.56	0.80	28.30	39.65	52.80
M_2S_1 – FYM + 25% Azospirillum	24.76	40.05	54.68	0.42	0.54	1.10	24.76	40.05	54.60
M_2S_2 – FYM + 50% Azospirillum	*31.45*	*42.87*	*47.77*	*0.56*	*0.63*	*1.80*	31.45	35.77	51.87
M_2S_3 – FYM + 75% Azospirillum	***30.56***	***47.06***	***57.03***	***0.60***	***0.80***	***2.00***	***30.66***	***47.06***	***57.30***
M_3S_0 – Vermicompost (control)	27.43	34.40	40.98	0.31	0.42	0.85	27.33	34.40	40.90
M_3S_1 – Vermicompost + 25% Azospirillum	26.34	32.73	43.56	0.38	0.49	1.20	26.40	32.73	43.50
M_3S_2 – Vermicompost + 50% Azospirillum	32.54	38.98	47.54	0.40	0.56	1.50	32.54	38.90	47.40
M_3S_3 – Vermicompost + 75% Azospirillim	34.67	43.45	50.69	0.43	0.60	1.80	29.87	39.76	56.87
M_4S_0 – Goat Manure (control)	18.45	31.09	43.44	0.30	0.23	0.45	18.45	32.44	43.54
M_4S_1 – Goat Manure + 25% Azospirillum	17.67	37.03	41.20	0.39	0.45	0.66	17.60	37.00	42.44
M_4S_2 – Goat Manure + 50% Azospirillum	26.34	38.43	48.76	0.42	0.51	1.40	26.64	38.40	48.76
M_4S_3 – Goat Manure + 75% Azospirillum	24.67	36.54	51.34	0.30	0.45	1.80	25.70	33.60	46.30
Min	17.67	31.09	40.98	0.28	0.23	0.45	17.60	32.44	40.90
Max	34.67	47.06	57.03	0.60	0.80	2.00	32.54	47.06	57.30
Mean	25.17	38.10	48.00	0.38	0.51	1.26	24.95	37.31	48.45
S.Ed	5.48	4.11	4.56	0.09	0.12	0.46	5.065	3.67	5.05
C.D	21.79	10.81	9.51	23.17	23.9	36.79	20.29	9.83	10.44

Table. 2. Effect of different treatments on bulb size, number of bulbs per plant and bulb yield(kg/plot) & economics

Treatments	Bulb length (cm)	Bulb diameter (cm)	Number of bulbs per plant	Bulb yield (q/ha)	Gross Return	Cost of Cultivation	Net Returns	BCR
M_1S_0 – Poultry Manure (control)	4.3	2.44	3.37	86.84	130260	53500	76760	2.43
M_1S_1 – Poultry Manure + 25% Azospirillum	4.7	3.21	2.3	91.81	137715	53650	84065	2.57
M_1S_2 – Poultry Manure + 50% Azospirillum	5.1	3.11	3.0	106.24	159360	53800	105560	2.96
M_1S_3 - Poultry Manure + 75% Azospirillum	5.1	2.42	4.0	119.59	179385	53950	125435	3.33
M_2S_0 – FYM (control)	4.2	3.14	2.3	103.85	155775	48000	107775	3.25
M_2S_1 – FYM + 25% Azospirillum	4.5	3.54	2.6	109.69	164535	48150	116385	3.42
M_2S_2 – FYM + 50% Azospirillum	4.9	3.8	3.0	120.15	180225	48300	131925	3.70
M_2S_3 – FYM + 75% Azospirillum	*5.5*	***4.74***	***5.0***	***134.73***	***202095***	***48450***	***153645***	***4.17***
M_3S_0 – Vermicompost (control)	4.1	3.44	1.6	103.8	155700	51500	104200	3.02
M_3S_1 – Vermicompost + 25%	4.0	2.47	2.6	105.16	157740	51650	106090	3.05

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Azospirillum								
M_3S_2 – Vermicompost + 50% Azospirillum	4.5	3.43	2.3	121.08	181620	51800	129820	3.51
M_3S_3 – Vermicompost + 75% Azospirillim	***5.9***	4.48	4.3	128.24	192360	51950	140410	3.73
M_4S_0 – Goat Manure (control)	3.8	3.25	1.6	98.45	147675	58500	89175	2.52
M_4S_1 – Goat Manure + 25% Azospirillum	3.9	3.81	2.0	106.11	159165	58650	100515	2.71
M_4S_2 – Goat Manure + 50% Azospirillum	4.9	3.26	2.6	117.63	176445	58800	117645	3.00
M_4S_3 – Goat Manure + 75% Azospirillum	4.9	3.43	3.6	122.35	183525	58950	124575	3.11
Min	3.8	2.42	1.6	86.84				
Max	5.9	4.74	5.0	134.73				
Mean	4.67	3.24	2.8	110.98				
S.Ed	0.61	0.61	1.1	13.13				
C.D	13.45	18.81	39.1	11.83				

*(Cost of Onion Bulb Rs.15/kg)