Environment and Ecology 41 (3D) : 2219—2223, July—September 2023
Article DOI: https://doi.org/10.60151/envec/BAYZ4087
ISSN 0970-0420

Effect of Organic Manures on Ideal Combinations for Maximum Onion (*Allium cepa* L.) Yield

Birendra Vikram Singh, Najil Mohammad, Amit Bagri

Received 05 May 2023, Accepted 10 July 2023, Published on 20 September 2023

ABSTRACT

A field experiment was conducted during winter season of 2021-22 at the Research Farm, AKS University, Satna (MP) to study the effect of organic manures on growth, yield and economics of onion (*Allium cepa* L.). Among the treatments, poultry manure 7 t/ha + vermicompost 10 t/ha (T_{12}) recorded significantly maximum plant height, leaves/plant, neck diameter, leaf area index and crop growth rate (52.10 cm, 12.56/plant, 2.27 cm, 3.109 and 5.89 g/cm^2/day, respectively) at 120 DAT. While, maximum relative growth rate (49.20 g/g/day) and net assimilation rate (1.435 mg/cm^2/day) at 30 DAT in T_{12} was noted. T_{12} (poultry manure 7 t/ha + vermicompost 10 t/ha) also recorded the higher diameter and length of bulb (6.62 and 7.90 cm, respectively), bulb yield (42.31 t/ha) and net income (Rs 90282/ha) with 2.89 B:C ratio from onion var Agrifound Light Red.

Keywords Onion, Organic manures, Vermicompost, Poultry manure, Yield.

INTRODUCTION

Onion (*Allium cepa* L.) belongs to the family Alliaceae and commonly known as "Pyaj" in Hindi. It is one of the most important commercial vegetable and spice crops grown all over the world. Onion is grown in Western, Northern as well as in Southern part of India. Maharashtra, Gujarat, Uttar Pradesh, Orissa, Karnataka, Tamil Nadu, Madhya Pradesh, Andhra Pradesh and Bihar are major growing states in India. Chemical fertilizers are expensive input and also their use does not necessarily lead to better farming than using natural and organic method in agriculture. Poor soils are becoming a limiting factor more particularly due to reduction in organic carbon status and also due to micronutrients deficiencies. Organic sources of nutrients like farmyard manure, vermicompost, compost, poultry, pig and goat manures are very popular among the farmers. Verma *et al*. (2014) reported that poultry manure has been recognized as a valuable source of plant nutrients like nitrogen (0.84 to 1.21%), phosphorus (0.91 to 1.07%) and potassium (1.35 to 2.35%). There is immense scope for improving production potential of crops by using organic manures and biofertilizers (Mohantry *et al.* 2015). The use of balanced organic manure ensures higher productivity, minimizes expenditure, improves

Dr Birendra Vikram Singh [1], Najil Mohammad[2*], Amit Bagri[3]

[1]Assistant Professor

[1,2,3]Department of Horticulture, AKS University, Satna 485001, MP, India

Email: khannajil1997@gmail.com
*Corresponding author

physical properties of soil, efficiency of added nutrients and ensures good soil health and is also an environment friendly approach. Use of biofertilizers with organic manures may prove viable option for sustaining crop production also.

MATERIALS AND METHODS

The field experiment was conducted during winter season of 2021-22 at the Research Farm, AKS University, Satna (MP) The soil of the experimental field was silty clay-loam having pH 7.91, electrical conductivity 0.18 dS/m, organic carbon 0.47%, available N, P_2O_5 and K_2O 174.62, 12.14 and 200 kg/ha, respectively. The total rainfall received during crop season 2021-22 was 12.01 mm. The treatments comprised three levels of poultry manure (2, 5 and 7 t/ha) and four levels of vermicompost (2, 5, 7 and 10 t/ha). Thus 12 treatment combinations (T_1 - Poultry manure 2 t/ha + vermicompost 2 t/ha,T_2 - Poultry manure 2 t/ha + vermicompost 5 t/ha, T_3 - Poultry manure 2 t/ha + vermicompost 7 t/ha,T_4 - Poultry manure 2 t/ha + vermicompost 10 t/ha, T_5 - Poultry manure 5 t/ha + vermicompost 2 t/ha, T_6 – Poultry manure 5 t/ha + vermicompost 5 t/ha, T_7 - Poultry manure 5 t/ha + vermicompost 7 t/ha,T_8 - Poultry manure 5 t/ha + vermicompost 10 t/ha,T_9 - Poultry manure 7 t/ha + vermicompost 2 t/ha, T_{10} - Poultry manure 7 t/ha + vermicompost 5 t/ha,T_{11} - Poultry manure 7 t/ha + vermicompost 7 t/ha and T_{12} - Poultry manure 7 t/ha + vermicompost 10 t/ha) were laid out in a Randomized Block Design keeping three replications. Onion variety Agrifound Light Red was transplanted on 29 October 2021 following the cultural practices as per treatments. The crop was grown as per recommended package of practices. The crop was harvested on 16 April 2022. The periodical field and laboratory observations were recorded and presented after statistical computation. The TSS in mature bulbs was determined by hand refractometer.

RESULTS AND DISCUSSION

Growth parameters

Amongst the organic treatments, T_{12} having poultry manure 7 t/ha + 10 t/ha vermicompost resulted in significantly higher plant height, leaves/plant, neck diameter, leaf area, leaf area index, relative growth rate, crop growth rate and net assimilation rate at 30, 60, 90 and 120 DAT stages. At 120 days stage, T_{12} produced the maximum plant height, leaves/plant, neck diameter, leaf area index and crop growth rate, and recorded 52.10 cm, 12.56/plant, 2.27 cm, 3.109 and 5.89 g/cm^2/day, respectively. On the other hand, maximum leaf area (407.20 cm^2) was recorded at 90 DAT. T_{12} also noted maximum relative growth rate (49.20 g/g/day) and net assimilation rate (1.435 mg/cm^2/day) at 30 DAT. This was followed by T_{11} and T_{10} treatments having organic sources of poultry manure 7 t/ha + 7 t/ha vermicompost and poultry manure 7 t/ha + 5 t/ha vermicompost. The lower level of nitrogen through each of the poultry manure and vermicompost brought about significant reduction in these growth parameters of onion (Table 1). Applied organic fertilizer through poultry manure 7 t/ha + vermicompost 10 t/ha encouraged the plant foliage and boosted plant growth at every stage, because it is an integral part of the chlorophyll, all proteins, enzymes and structural materials.

Leaf area index (LAI) which expresses the ratio of leaf surface (one side only) to the ground area occupied by the crop (Gardner *et al*. 1985), was also deviated in the same manner as in case of plant height and leaves. The LAI was maximum (3.109) in case of T_{12} treatment, followed by T_{10} (2.501), T_9 (2.332) and then T_9 (2.105). The fifth position was attained by T_8 (1.909). Whereas in T_1 (Poultry manure 2 t/ha + vermicompost 2 t/ha), it was only 0.781.

The leaf area enhanced very fast upto 90 DAT stage, after that tended to decrease. At 30 DAT stage, LA ranged from 28.44 to 51.52 cm^2 whereas at 90 DAT stage, it gained upto maximum extent (198.20 to 407.20 cm^2).

In general, the leaf area index enhanced at the faster rate upto 120 DAT stage. At 30 DAT stage, it ranged from 0.106 to 0.236 which went upto 0.781 to 3.109 at 120 DAT stage. The relative growth rate tended to decrease with increase in crop growth stage and recorded 32.1 to 49.2 g/g/day at 30 DAT stage, and 4.31 to 6.98 g/g/day at 120 DAT stage.

In case of crop growth rate (CGR), it generally

Table 1. Growth and yield attributes of onion as influenced by different organic treatments.

Treatments	Plant height (cm) at 120 DAT	Number of leaves/ plant at 120 DAT	Neck diameter (cm) at 120 DAT	Leaf area (cm) at 120 DAT	Leaf area index at 120 DAT	Relative growth rate (g/g/day) at 30 DAT	Crop growth rate (g/cm^2/ day) at 120 DAT	Net assimilation rate (mg/cm^2/ day) at 30 DAT
T_1 Poultry manure 2 t/ha + vermicompost 2 t/ha	42.1	7.56	1.29	195.7	0.781	32.1	3.35	1.123
T_2 Poultry manure 2 t/ha + vermicompost 5 t/ha	44.2	8.34	1.55	202.1	0.822	34.3	3.49	1.135
T_3 Poultry manure 2 t/ha + vermicompost 7 t/ha	43.7	8.21	1.32	270.1	1.103	37.5	3.79	1.149
T_4 Poultry manure 2 t/ha + vermicompost 10 t/ha	41.9	9.56	1.38	294.3	1.401	39.1	3.91	1.178
T_5 Poultry manure 5 t/ha + vermicompost 2 t/ha	39.8	10.12	1.21	263.6	1.419	40.6	4.15	1.213
T_6 Poultry manure 5 t/ha + vermicompost 5 t/ha	44.4	8.65	1.81	290.8	1.565	41.7	4.32	1.239
T_7 Poultry manure 5 t/ha + vermicompost 7 t/ha	40.8	9.21	1.27	301.1	1.723	42.9	4.54	1.254
T_8 Poultry manure 5 t/ha + vermicompost 10 t/ha	45.6	10.23	1.75	301.4	1.909	43.4	4.73	1.269
T_9 Poultry manure 7 t/ha + vermicompost 2 t/ha	48.2	11.56	1.69	325.6	2.105	44.7	4.86	1.281
T_{10} Poultry manure 7 t/ha + vermicompost 5 t/ha	44.6	10.11	1.81	398.2	2.332	46.1	4.98	1.296
T_{11} Poultry manure 7 t/ha + vermicompost 7 t/ha	49.2	9.56	1.55	319.1	2.501	47.3	5.62	1.354
T_{12} Poultry manure 7 t/ha + vermicompost 10 t/ha	52.1	12.56	2.27	360.2	3.109	49.2	5.89	1.435
CD 5%	**2.609**	**1.489**	**0.349**	**7.519**	**0.048**	**2.193**	**0.412**	**0.031**

enhanced at the faster rate upto 120 DAT. At 30 DAT stage, CGR ranged from 0.91 to 1.98 g/cm^2/day. While at 120 DAT it was maximum extent and ranged from 3.35 to 5.89 g/cm^2/day. As regards with the net assimilation rate (NAR), it tended to decrease with the increase in growth of plant. NAR ranged from 1.123 to 1.435 mg/cm^2/day at 30 DAT stage, while 0.031 to 0.137 mg/cm^2/day was noted at 120 DAT stage.

The variable trend in decrease or increase in these growth analysis parameters with the advancement of plant growth is a naturally controlled phenomenon which may, more or less, influence due to advancement of plant growth and nutrient supply through organic manures. These results are in the line with the findings of Damse *et al*. (2014), Gopakkali and Sharanappa (2014), Singh and Singh (2014), Mohantry *et al*. (2015) and Sharma *et al*. (2021).

Yield-attributes

Yield can be considered to be final expression of the

Table 2. Yield of onion as influenced by different organic treatments.

Treatments	Fresh weight of bulb (g)	Dry weight of bulb (g)	Bulb diameter S (cm)	Length of bulb (cm)	Bulb yield (kg/plot)	Bulb yield (t/ha)
T_1 Poultry manure 2 t/ha + vermicompost 2 t/ha	48.1	8.11	5.61	6.01	15.2	30.16
T_2 Poultry manure 2 t/ha + vermicompost 5 t/ha	42.7	8.32	5.73	6.59	17.4	30.84
T_3 Poultry manure 2 t/ha + vermicompost 7 t/ha	43.4	8.45	5.84	6.26	18.1	31.52
T_4 Poultry manure 2 t/ha + vermicompost 10 t/ha	45.3	8.53	5.95	7.04	18.6	31.34
T_5 Poultry manure 5 t/ha + vermicompost 2 t/ha	49.2	8.59	6.13	6.74	19.3	32.09
T_6 Poultry manure 5 t/ha + vermicompost 5 t/ha	52.7	8.64	6.17	7.82	20.7	32.53
T_7 Poultry manure 5 t/ha + vermicompost 7 t/ha	44.1	8.68	6.22	7.81	21.2	33.02
T_8 Poultry manure 5 t/ha + vermicompost 10 t/ha	55.1	9.01	6.31	6.35	21.9	33.91
T_9 Poultry manure 7 t/ha + vermicompost 2 t/ha	52.9	9.35	6.38	6.97	22.4	35.36
T_{10} Poultry manure 7 t/ha + vermicompost 5 t/ha	53.6	9.49	6.44	7.26	22.5	37.94
T_{11} Poultry manure 7 t/ha + vermicompost 7 t/ha	59.1	9.64	6.53	7.34	22.7	39.25
T_{12} Poultry manure 7 t/ha + vermicompost 10 t/ha	65.1	10.21	6.62	7.90	23.3	42.31
CD 5%	**3.178**	**0.774**	**0.337**	**0.427**	**2.429**	**4.348**

physiological and metabolic activities of plant. The factors which are directly responsible for ultimate bulb production are fresh and dry weight of bulb, diameter and length of bulb. The best treatment was T_{12} having poultry manure 7 t/ha + 10 t/ha vermicompost. Accordingly, the maximum fresh weight of bulb 65.10 g, dry weight 10.21 g, bulb diameter 6.62 cm and length of bulb 7.90 cm was noted in T_{12} (Table 2). The second best treatment was T_{11} having poultry manure 7 t/ha + 7 t/ha vermicompost sources, which recorded 59.10 g fresh bulb weight, dry weight of bulb (9.64 g) and 6.53 cm of bulb diameter. This was followed by T_{10} (Poultry manure 7 t/ha + vermicompost 5 t/ha). The organic manures given in T^1 (Poultry manure 2 t/ha + vermicompost 2 t/ha) recorded significantly lowest length of bulb (6.01 cm), dry weight (8.11 g) and diameter of bulb (5.61 cm).

The significant variation in yield attributes due to applied organic sources of nutrients might be owing to variations in their nutrient composition, decomposition of organic residues, C:N ratio, nutrient release pattern, climatic and soil characteristics. Photosynthesis process is also increased in the presence of nitrogen, which ultimately synthesizes more food material for increasing yield-attributes. The results corroborate the findings of many researchers (Singh and Singh 2014, Mohantry *et al*. 2015, Choudhary *et*

al. 2017, Kaswan *et al*. 2017 and Sharma *et al*. 2021).

Yield

Application of poultry manure 7 t/ha + vermicompost 10 t/ha (T_{12}) recorded significantly higher bulb yield (42.31 t/ha) over the remaining organic treatments. This was followed by T_{11} (Poultry manure 7 t/ha + 7 t/ha vermicompost, T_{10} (Poultry manure 7 t/ha + vermicompost 5 t/ha) and then T_9 giving 39.25, 37.94 and 35.36 t/ha yield, respectively. The reduced supply of fertilizers as in T_1 and T_2 treatments further deceased the yield and gained 30.16 and 30.84 t/ha, respectively. The increased supply of nitrogen in T_{12}, T_{11}, T_{10} and T_9 treatments brought about maximum growth parameters as a result of higher rate of photosynthesis which is always associated with the higher productivity. These results are in close agreement with those of Singh *et al*. (2001), Sanwal *et al*. (2007) and Choudhary *et al*. (2017).

REFERENCES

Choudhary S, Choudhary BR, Kumhar SR (2017) Genetic variability in the garlic genotypes for growth, yield and yield-attributing traits. *Annals Pl Soil Res* 19 (1):115-120.

Damse DN, Bhalekar MN, Pawar PK (2014) Effect of integrated nutrient management on growth and yield of garlic. *An Int Quaterly J Life Sci* 9 (4): 1557-1560.

Gopakkali P, Sharanappa (2014) Effect of organic farming practices on growth, yield, quality and economics of onion in dry zone of Karnataqka. *Ind J Agronomy* 59 (2): 336-340.

Kaswan PK, Yadav PK, Jakhar RK, Kumawat A, Kumar H (2017) Effect of different varieties and FYM levels on yield and quality of onion in Arid Western Rajasthan. *Ind J Current Microbiol Applied Sci* 6 (6): 497-503.

Mohantry, Anita, Behera P, Harichandan S (2015) Effect of nutrient management on the growth and productivity of onion. *Agri Sci Digest* 35 (3): 241-243.

Sanwal SK, Laxminarayana K, Yadav RK, Rai Yadav DS, Bhuyan Mousumi (2007) Effect of organic manures on soil fertility, growth, physiology, yield and quality of turmeric. *Ind J Hortic* 61 (1): 71-73.

Sharma, Anjali, Asati KP, Yadav, Shailendra Singh, Namdeo KN (2021) Impact of organic and inorganic fertilizers on growth, yield and economics of garlic. *Annals Pl Soil Res*12 (4): 477-480.

Singh BV, Singh Rajesh (2014) Effect of sources of nutrients on physiological growth parameters and yield of onion varieties. *Annals Pl Soil Res* 16 (4):362-366.

Singh RP, Jain PK, Poonia BL (2001) Integrated nutrient management in rainy season onion. *Ind J Agric Sci* 71 (5): 310-312.

Verma S, Dipika SM, Synrem GJ (2014) Effect of combined use of organic and inorganic fertilizers on maize. *Annals Pl Soil Res* 16 (1):77-78.