

“Effect of organic manures and inorganic fertilizers on growth, yield and quality of onion (*Allium cepa*) var. Nashik Red”.

Abstract: An experiment was conducted during 2021-2022 in *Rabi* season at Vegetable Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (Uttar Pradesh). The results showed that treatment T4 (75% NPK + 25% Poultry manure) was recorded maximum in growth and quality parameters i.e., plant height (62.29 cm), maximum number of leaves (10.38), maximum TSS (14.58 Brix⁰) and maximum ascorbic content of (12.49). whereas, the yield parameters were maximum in treatment T8 (50% NPK + 50% Poultry manure) was recorded with maximum weight of fresh bulb weight (181.70 g), maximum weight of cured bulb (168.07 g), maximum bulb diameter (8.63 cm), maximum yield per plot (23.09 kg) and maximum yield per hectare (15.36 t).

Keywords: *Recommended Dose of Fertilizers (RDF), Nitrogen- Phosphorus- Potassium (NPK), Farm Yard Manure (FYM), Total Soluble Solids (TSS).*

Introduction: Onion (*Allium cepa*) belongs to the family Amaryllidaceae and it is known as "Pyaj" in Hindi. It occupies very important position among spices crops grown all over the world. Onion ranks first position in area under spices in the country and occupies an area of 0.39 million hectare with the second rank in production i.e., 4.58 million tonnes. In the world production Indian shares 12% after China. Onion is cultivated throughout India but Maharashtra, Gujrat, Karnataka, Uttar Pradesh, Andhra Pradesh, Tamil Nādu, M.P., Bihar, and Assam are the important onion producing states. Among the bulb crops onion is the most important bulb vegetable crop and an essential commodity. Onion is considered as cool season crop and grows normally in winter seasonal most all over India. The onion crop is widely consumed throughout the year as salad and culinary purpose for flavouring as spices in pickles, sauce and vegetables. Onion has great value as a medicinal plant. Pungency in onion is due to volatile oil allylprophyl disulphide (C₆H₁₂O₂), which acts as gastric stimulant and promote digestion. Onions are highly prized for their medical characteristics, which include antiseptic and antibacterial capabilities. It relieves heat and is used to treat hysterical outbursts and faintness. It is also used to treat insect bites and sour throats. According to recent studies, onions in the diet can help lower blood sugar, lipid, and cholesterol levels, as well as prevent heart disease and other disorders.

Materials and methods: The experiment was carried out *Rabi* season 2021 at Research farm in Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P). The experiment was laid out in Randomized Block Design (RBD) with thirteen treatments, those were replicated thrice, Nashik

red variety of onion was selected for the study. Which was planted during *Rabi* season in 2021 at 15cm X 10cm spacing and organic manures and inorganic fertilizers were applied in regular intervals. The treatments details were mentioned in table 1. The observations on growth parameters *i.e.*, plant height (cm), number of leaves, bolting percent were recorded from randomly selected plants from each and every plot at various vegetative growth stages. Yield parameters *i.e.*, days to maturity, weight of fresh bulb (g), weight of cured bulb (g), bulb diameter (cm), number of bulbs per kg, yield per plot (kg) and yield per hectare (t) were also recorded. Quality parameters *i.e.*, Total soluble solids (⁰Brix) and ascorbic acid content were recorded. The data was analyzed using the ANOVA approach and a significant difference between the treatments means was checked against the critical difference at a 5% level of significance.

Table 1: Treatment details.

Treatments symbols	Treatment combinations
T ₀	100% RDF (100:50:50 kg NPK)
T ₁	25% NPK+75% FYM
T ₂	25% NPK+75% Vermicompost
T ₃	25% NPK+75% goat manure
T ₄	25% NPK+75% poultry manure
T ₅	50% NPK+50% FYM
T ₆	50% NPK+50% vermicompost
T ₇	50% NPK+50% goat manures
T ₈	50% NPK+50% poultry manure
T ₉	75% NPK+25% FYM
T ₁₀	75% NPK+25% vermicompost
T ₁₁	75% NPK+25% goat manures
T ₁₂	75% NPK + 25% poultry manure

Results and Discussion:

Growth parameters:

From the below table 2, the results revealed that significantly the maximum plant height (62.29 cm), was recorded in the treatment T4 (75% NPK + 25% Poultry manure) followed by T6 with (60.85 cm), while the minimum plant height was recorded in T0 *i.e.*, 100% RDF (100:50:50 NPK) (57.33 cm). The increase in plant height is due to the integrated use of nutrient helpful in development of rapid cell division and cell elongation in meristematic region of plant due to production of plant growth substance and this may be due to abundant supply of plant nutrients and nitrogen which led in the growth of onion. In general, height of the plant was found to be more when plots applied with 75 per cent RDF (inorganic source) + 25 per cent organic manures. The results obtained in the present study are supported by the findings reported by Kannan (1990), indicated that combination of 12.5 t/ha poultry manure with 50 kg N/ha increased plant height.

The maximum number of leaves were recorded in treatment T4 (75%NPK + 25% Poultry manure (10.38) statistically at par with T2 (75%NPK + 25% Vermicompost) (10.12) followed by 50%NPK + 50% Farmyard manure (9.93) while the minimum number of leaves were recorded in 100% RDF (50%NPK + 50%Goat manure) (8.44). It can be seen that organic source of nutrient along with inorganic fertilizer showed better response in terms of increasing number of leaves per plant as compared to inorganic source alone. Significant differences were observed at all the treatments at all growth stages of observation. More number of leaves per plant was obtained when the plants applied with organic manures along with inorganic fertilizer as compared to application of chemical fertilizer alone. This effect could be attributed to the quick fermentation and solubilization effect of plant nutrients of poultry manure. Also, poultry manure might have enhanced use efficiency of chemical fertilizer. The result obtained in the present study are supported by the findings reported by Khalil *et al.*, (2002) observed that chicken manure and inorganic fertilizers were more effective than FYM in increasing leaf number per plant in onion. Jaythilake *et al.*, (2002) reported that integrated effect of inorganic fertilizers, organic manure and biofertilizers gave a greater number of leaves in onion.

The minimum bolting was recorded in (T8) 50%NPK + 50% Poultry manure (5.86 %) followed by (T5) 50%NPK + 50%Farm yard manure (6.09%) while the maximum bolting was recorded in (T0) 100%RDF (100:50:50 NPK) (10.61%). Bolting in onion crop is most undesirable character which adversely affects the quality and storage life of onion bulbs. Bolting is usually variable from year to year and among cultivars. These results were in accordance with those of Peterson *et al.*, (1960) stated that premature seed stalk development decreased with addition of nitrogen. Diaz-Perez *et al.*, (2003) reported that the N fertilization rates increased bolting N fertilization rates applied ranged from the infra-optimal to the super optimal from (102 to 302/ha N).

Table 2: Effect of organic manures and inorganic fertilizers on growth parameters of onion.

Treatments symbols	Treatment combinations	Plant height (cm)	Number of leaves per plant	Bolting (%)
T ₀	100% RDF	57.33	9.05	10.61
T ₁	75%NPK + 25% Farm yard manure	57.09	9.43	6.65
T ₂	75%NPK + 25% Vermicompost	60.85	10.12	6.16
T ₃	75%NPK + 25% Goat manure	60.49	8.80	8.33
T ₄	75%NPK + 25% Poultry manure	62.29	10.38	7.09
T ₅	50%NPK + 50% Farm yard manure	60.12	9.93	6.09
T ₆	50%NPK + 50% Vermicompost	60.15	9.22	6.12
T ₇	50%NPK + 50% Goat manure	59.76	8.44	8.14
T ₈	50%NPK + 50% Poultry manure	59.52	8.65	5.86
T ₉	25%NPK + 75%Farm yard manure	56.97	9.09	7.60
T ₁₀	25%NPK + 75% Vermicompost	57.84	8.61	7.91
T ₁₁	25%NPK + 75% Goat manure	57.09	8.52	8.86
T ₁₂	25%NPK + 75% Poultry manure	58.56	8.84	8.75
	F-Test	S	S	S
	C.D at 5%	0.61	0.29	0.13
	S.Ed.	0.30	0.14	0.06
	C.V.	0.61	1.88	1.05

Yield parameters:

The results revealed that, significantly minimum number of days for maturity (106.30) were recorded in treatment T₈ (50%NPK + 50%Poultry manure) which is followed by T₅ (50%NPK + 50%Farm yard manure) (108.12) whereas, maximum days for maturity were recorded in T₀ with 100%RDF (100:50:50 NPK) 117.82 days. The probable reason for early maturity may be that the hormones and organic acid secreted by organic manures during decomposition which enhanced early maturity. The results in present study are supported by the findings of Kumaran (1998). Raut (1998). Mengistu and Singh (1999) and Barekar (2000) in onion.

The maximum weight of fresh bulb was recorded in T₈ (50%NPK + 50%Poultry manure) 181.70g which is followed by T₂ (75%NPK + 25% Vermicompost) 171.27g whereas, the minimum weight of fresh bulb was recorded in T₀ 100%RDF (100:50:50 NPK) with 100.25g.

The maximum weight of cured bulb was recorded in T₈ (50%NPK + 50%Poultry manure) 168.07 g which is followed by T₂ (75%NPK + 25% Vermicompost) 159.59g whereas, the minimum weight of cured bulb was recorded in T₀ 100%RDF (100:50:50 NPK) 96.13g. The treatments receiving 50 % RDF + 50 % poultry manure produced more average bulb weight. The increase in average bulb weight was mainly due to increased bulb diameter, the relative significant increase in the number of green leaves due to the combined effects in those treatments may have

helped to accumulate more carbohydrates resulting in increased diameter of the bulb which results in increase in fruit weight. Similar results were obtained by Singh (1997) and Lal *et al.*, (2002).

The maximum bulb diameter was recorded in T8 (50%NPK + 50%Poultry manure) with 8.63 cm which is followed by T5 (50%NPK + 50%Farm yard manure) with 8.27 cm whereas, the minimum bulb diameter was recorded in T0 100%RDF (100:50:50 NPK) 6.43 cm. The total number of leaves the plants generated had a direct impact on the size of the bulb. Given that the bulb is the onion's storage organ and that whatever carbohydrates were produced in the leaves were stored in the bulbs, resulting in larger sized bulbs as indicated, the relative significant increase in the number of green leaves due to the combined effects in those treatments may have helped to accumulate more carbohydrates resulting in increased diameter of the bulb. These results were in agreement with those reported by Nagaraju *et al.*, (2000), and Mondal *et al.*, (2004) in onion.

The minimum number of bulbs per kg were recorded in T8 (50%NPK + 50% Poultry manure) 5.91, followed by treatment T10 (25%NPK + 75% Vermicompost) 7.48 whereas, the maximum number of bulbs per kg were recorded in T2 (75%NPK + 25% Vermicompost) with 10.34. This might be because of more fresh and cured weight of bulbs accommodating less number of bulbs per kg.

The maximum yield per plot were recorded in T8 (50%NPK + 50% Poultry manure) with 23.09 kg which is followed by T5 (50%NPK + 50%Farm yard manure) with 21.41 kg whereas, the minimum yield per plot were recorded in T0 100%RDF (100:50:50 NPK) with 14.24 kg. The maximum yield per hectare were recorded in T8 (50%NPK + 50% Poultry manure) with 15.39 t which is followed by T5 (50%NPK + 50%Farm yard manure) with 14.27 t whereas, the minimum yield per hectare were recorded in T0 100%RDF (100:50:50 NPK) with 9.49 t. According to the highest plants and leaf count, the increase in yield appeared to be the result of higher plant growth.

Table 3: Effect of organic manures and inorganic fertilizers on yield parameters of onion (*Allium cepa*).

Treatments symbols	Treatment combinations	Days to Maturity	Weight of fresh bulb (g)	Weight of cured bulb (g)	Bulb diameter(cm)	Number of bulbs per kg	Yield per plot (kg)	Yield per hectare (t)
T ₀	100% RDF	117.82	100.25	96.13	6.43	7.35	14.24	9.49
T ₁	75%NPK + 25% Farm yard manure	110.13	129.07	120.15	7.90	6.50	19.76	13.17
T ₂	75%NPK + 25% Vermicompost	112.61	171.27	159.59	7.92	10.34	18.41	12.27
T ₃	75%NPK + 25% Goat manure	111.55	137.09	112.15	7.68	6.58	18.59	12.39
T ₄	75%NPK + 25% Poultry manure	109.37	144.58	134.30	8.07	6.31	19.45	12.96
T ₅	50%NPK + 50% Farm yard manure	108.12	151.57	147.73	8.27	6.41	21.41	14.27
T ₆	50%NPK + 50% Vermicompost	113.20	146.54	141.86	7.67	6.92	18.40	12.26
T ₇	50%NPK + 50% Goat manure	113.46	142.82	138.17	7.69	6.53	17.31	11.53
T ₈	50%NPK + 50% Poultry manure	106.30	181.70	168.07	8.53	5.91	23.09	15.39
T ₉	25%NPK + 75% Farm yard manure	111.70	140.38	135.71	6.87	7.38	19.16	12.77
T ₁₀	25%NPK + 75% Vermicompost	111.62	137.50	133.41	7.47	7.48	17.20	11.46
T ₁₁	25%NPK + 75% Goat manure	112.54	140.78	135.64	7.39	7.20	16.92	11.27
T ₁₂	25%NPK + 75% Poultry manure	110.36	149.11	144.99	7.70	6.89	17.58	11.71
	F-Test	S	S	S	S	S	S	S
	C.D at 5%	0.36	2.54	0.65	0.10	0.09	0.25	0.17
	S.Ed.	0.18	1.23	0.32	0.05	0.05	0.12	0.08
	C.V.	0.19	1.05	0.28	0.75	0.79	0.81	0.80

Quality Parameters:

The maximum TSS were recorded in T4 (75%NPK + 25% Poultry manure) with 14.58 which is statistically at par with T8 (50%NPK + 50% Poultry manure) with 14.21 followed by T5 (50%NPK + 50% Farm yard manure) with 14.10 whereas, the minimum TSS were recorded in T0 100%RDF (100:50:50 NPK) with 12.89. The total soluble solids were observed to increase over the prescribed dose of inorganic fertilizers in all other treatment combinations of organic and inorganic fertilizers with respective levels.

The maximum ascorbic acid content was recorded in T4 (75%NPK + 25% Poultry manure) with 12.49 which is followed by T5 (50%RDF + 50% Farm yard manure) with 11.76 whereas, the minimum ascorbic acid content was recorded in T3 (75%NPK + 25% Goat manure) with 10.07. This might be due to physiological influence of poultry manure and FYM in combination with inorganic sources of nutrients on activity of number of enzymes and due to more energy and food material available to the bulbs due to strong vegetative growth. Similar results were also reported by Mondal *et al.*, (2004) in onion, Kumaran *et al.*, (1998) in tomato.

Table 4: effect of organic manures and inorganic fertilizers on quality parameters in onion.

Treatments symbols	Treatment combinations	TSS	Ascorbic acid
T ₀	100% RDF	12.89	10.09
T ₁	75%NPK + 25% Farm yard manure	13.48	11.30
T ₂	75%NPK + 25% Vermicompost	13.15	11.20
T ₃	75%NPK + 25% Goat manure	13.15	10.07
T ₄	75%NPK + 25% Poultry manure	14.58	12.49
T ₅	50%NPK + 50% Farm yard manure	14.10	11.76
T ₆	50%NPK + 50% Vermicompost	13.16	10.29
T ₇	50%NPK + 50% Goat manure	12.97	10.26
T ₈	50%NPK + 50% Poultry manure	14.21	11.59
T ₉	25%NPK + 75%Farm yard manure	13.82	11.40
T ₁₀	25%NPK + 75% Vermicompost	13.12	10.11
T ₁₁	25%NPK + 75% Goat manure	12.92	10.09
T ₁₂	25%NPK + 75% Poultry manure	13.50	11.01
	F-Test	S	S
	C.D at 5%	0.41	0.09
	S. Ed.	0.20	0.04
	C.V.	1.80	0.50

Conclusion: Among the various combinations, it was concluded that overall performance of the treatment T4 which received 75 per cent NPK through chemical fertilizers along with 25 per cent poultry manure per hectare as organic manure enhanced vegetative growth and quality of onion. The treatment T8 receiving 50% NPK and 50% poultry manure enhanced yield with higher gross return (923600 INR) and highest benefit cost ratio which was superior over all other treatments.

These results are based on one season study and for confirmation few more experimental trials are needed.

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