Effect of organic manures and inorganic fertilizers on growth, yield and quality of onion (*Allium cepa*) var. Nashik Red : An Experimental Investigation

Abstract: An experiment was conducted to find out the effect of organic manures and inorganic fertilizers on growth, yield and quality of onion (*Allium cepa* L.) var. Nashik Red during 2021-2022 in *Rabi* season (Nov-Apr) at Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (Uttar Pradesh). Total 13 treatments were replicated thrice in Randomized Block Design (RBD). 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 ^{0}Brix) 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 of the world vegetable production. 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. Now-a-days consumer's preferences have also shifted away from cereals and moved towards vegetables for balanced diet (**Mittal[8] *et al.*, 2006**). 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. Onion has great value as a medicinal plant. Pungency in onion is due to volatile oil allylprophyl disulphide ($C_6H_{12}0_2$), 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. The study was undertaken to estimate the effect of organic manures and inorganic fertilizers on growth, yield and quality of onion (*Allium cepa*). The organic manures help in the improvement of soil physical and physiological structure whereas the inorganic fertilizers can improve yield of the crop and the total nutrient availability. Therefore, application of organic and inorganic in different combinations was carried out in aim to assess the suitable combination to maintain both soil health and yield of crop as well.

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 (ton) were also recorded. Quality parameters *i.e.*, Total soluble solids (^{0}Brix) 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[4] (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[5] *et al.*, (2002)** observed that chicken manure and inorganic fertilizers were more effective than FYM in increasing leaf number per plant in onion. **Jaythilake[3] *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[11] *et al.*, (I960)** stated that premature seed stalk development decreased with addition of nitrogen. **Diaz-Perez[2] *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	Number of leaves	Bolting (%)

		(cm)	per plant	
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
T12	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[6] (1998)**. **Raut[13] (1998)** and **Barekar[1] (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[14] (1997)** and **Lal[7] *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[10] *et al.*, (2000),** and **Mondal[9] *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 ton which is followed by T5 (50%NPK + 50%Farm yard manure) with 14.27 ton whereas, the minimum yield per hectare were recorded in T0 100%RDF (100:50:50 NPK) with 9.49 ton. 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 (ton)
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
T12	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[9] *et al.*, (2004)** in onion, **Kumaran[6] *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
T12	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

Conclusion: Among the various combinations, it was concluded that overall performance of the treatment T_4 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 T_8 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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