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EFFECTS OF INTEGRATED NUTRIENT MANAGEMENT ON DIFFERENT HORTICULTURAL TRAITS IN ONION

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Abstract

A field experiment was conducted to evaluate the effects of integrated nutrient management on growth and yield in onion (*Allium cepa* L.) under sub-tropical conditions of Himachal Pradesh. Thirteen treatments were arranged including control. Minimum days to marketable maturity, maximum plant height, number of leaves, leaf length, average bulb weight, bulb length, bulb breadth, bulb yield per plot and neck thickness were found in treatment T_7. Therefore, consolidation of plant nutrients through growth promoting rhizobacteria, organic manure and inorganic fertilizer ameliorate the plant growth and development, inflate soil nutrient status and nurture sustaining crop fecundity.

Introduction

Onion is one of the most important commercial vegetable crops cultivated in India, belongs to family Alliaceae. The increase in microbial population in the presence of organic manures may be attributed to greater availability of organic carbon and mineralized nutrients for their proliferation and further cellular development (Marathe *et al.* 2012). High yield and good quality of onion can be obtained through efficient and balanced use of organic and inorganic compounds.

Role of bio-fertilizer on the crop growth and yield was documented by Vijayakumar *et al.* (2000) and Ramakrishnan and Thamizhiniyan (2004). Plant growth promoting micro-organisms affect plant growth directly or indirectly by producing growth substances (Verma *et al.* 2010), fix nitrogen from the atmosphere (Boddey and Dobereiner 1995) and are antagonistic towards phytopathogenic micro-organisms (Velivelli *et al.* 2012), solubilization of nutrients and siderophores production etc. (Bhattacharya and Jha 2012). *Bacillus subtilis* and *Pseudomonas fluorescens* increase the root growth as applied to the seed or directly in the soil. Therefore, the study was aimed to find out the role of integrated nutrient management on different horticultural traits in onion.

Materials and Methods

The field experiment was carried at the Experimental Research Farm of the Department of Vegetable Science at College of Horticulture and Forestry, Neri, Hamirpur, Himachal Pradesh (31o41'47.6" N latitude and 72o28'6.3" E longitude). The experiment comprised of thirteen treatments viz., T_1 [Control], T_2 [*B. subtilis* + FYM (250 q/ha)], T_3 [*P. fluorescens* + FYM (250 q/ha)], T_4 [75 % RD of NPK + *B. subtilis* + FYM (250 q/ha)], T_5 [75 % RD of NPK + *P. fluorescens* + FYM (250 q/ha)], T_6 [50 % RD of NPK + *B. subtilis* + FYM (250 q/ha)], T_7 [50% RD of NPK + 40 kg S/ha + *P. fluorescens* + FYM (250 q/ha)], T_8 [75 % RD of NPK + 40 kg S/ha

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+ *B. subtilis* + FYM (250 q/ha)], T_9 [75 % RD of NPK + 40 kg S/ha + *P. fluorescens* + FYM (250 q/ha)], T_{10} [50 % RD of NPK + 40 kg S/ha + *B. subtilis* + FYM (250 q/ha)], T_{11} [50 % RD of NPK + 40 kg S/ha + *P. fluorescens* + FYM (250 q/ha)], T_{12} [100 % RD of NPK + 40 kg S/ha] andT_{13} [100 % RD of NPK (125:75:60 kg/ha)]. The onion variety Agrifound Dark Red was arranged in Randomized Complete Block Design (RCBD) with three replications in a plot size of 1 m × 0.75 m at spacing of 15 × 10 cm accommodating 50 plants per plot.

Calculated amount of inorganic fertilizers such as nitrogen, phosphorous, potassium and sulphur (125:75:60:40 kg/ha) were applied in the form of urea (203.8 kg/ha), SSP (356.25 kg/ha), MOP (75 kg/ha) and Sulphur (40 kg/ha) in respective treatments before transplanting of seedlings. One third dose of N along with the full doses of P, K and S were applied as basal dose. Remaining dose of N was given in two splits; 30 and 60 days after transplanting (DAT). Organic manures such as FYM (250 q/ha) were applied during field preparation in the respective treatments. Seedling roots were dipped in plant growth promoting rhizobacteria *viz*., *Bacillus subtilis* and *Pseudomonas fluorescens* prior to sowing for 30 min as per the treatments and immediately transplanted in the field. The mean values of data were subjected to analysis of variance as described by Gomez and Gomez (1984) for RCBD.

Results and Discussion

Analysis of variance revealed significant differences among the treatments for growth and yield parameters under study. The results so obtained in Table 1 revealed that days to marketable maturity ranged from 108.00-114.66 days. Minimum days to marketable maturity (108.00 days) were recorded in treatment T_7. Plant height is an important trait for growth and yield of crop. The mean value for plant height ranged from 38.50-44.48 cm and maximum plant height (44.48 cm) was recorded in treatment T_7, might be due to use of plant growth promoting rhizobacteria such as *Bacillus* and *Pseudomonas* (Mekonnen and Kibret 2021). Similar findings are in conformity with Hassan *et al.* (2018), Hassouna *et al.* (2020) and Prasad (2022).

The data recorded for number of leaves varied from 5.46-9.73 (Table 1). Maximum number of leaves (9.73) was recorded in treatment T_7 as *Bacillus* and *Pseudomonas* are able to produce plant growth auxins, which acts to stimulate root growth and provides it with maximum number of leaves and larger surface area as reported by Hassouna *et al*. (2020). These findings are in close confirmity with the results obtained by Wulansari *et al.* (2017) and Bektas and Kusek (2021). Leaf length values varied from 38.74-46.26 cm and highest (46.26 cm) was recorded in treatment T_7, may be due to *Bacillus* and *Pseudomonas* as they facilitate plant growth directly by either assisting in the acquisition of nutrients or regulation of the hormone levels as reported by Mekonnen and Kibret (2021). Use of *Bacillus* along with organic manure increase the vegetative growth of onion plants as reported by Saharan and Nehra (2011), Singh *et al*. (2015) and Hassan *et al.* (2018).

The average bulb weight ranged from 66.87-82.36 g and maximum average bulb weight (82.36 g) was observed in treatment T_7 due to the positive effect of organic manure and *Bacillus* (Table 1) (Hassan *et al.* 2018, Prasad 2022). Inorganic fertilizers (NPKS) and FYM helped to increase the availability of major nutrients which being the constituent of protein and protoplasm, vigorously inducing the vegetative development of the plants as reported by Gupta *et al.* (2021). Data for bulb length varied from 3.65-4.46 cm and highest bulb length (4.46 cm) was obtained in treatment T_7 due to the application of *Bacillus* and *Pseudomonas* as reported by Prasad (2022). Bulb breadth varied from 4.91-5.74 cm and maximum (5.74 cm) was obtained in treatment T_7 (Table 1). These results are in conformity with the findings of Colo *et al.* (2013) and Gau *et al.* (2021).

Table 1. Effects of integrated nutrient management on different horticultural traits in onion.

Treatment Code	Days to marketable maturity	Plant height (cm)	Number of leaves per plant	Leaf length (cm)	Average bulb weight (g)	Bulb length (cm)	Bulb breadth (cm)	Bulb yield per plot (kg)	Neck thickness (cm)
T_0	114.66	38.50	5.46	38.74	66.87	3.65	4.91	1.28	0.81
T_1	112.00	39.09	6.80	40.20	68.70	3.93	5.08	1.49	0.83
T_2	112.33	38.90	6.20	39.13	67.85	3.68	4.99	1.47	0.82
T_3	110.33	41.42	8.20	42.20	76.50	4.14	5.35	2.00	1.00
T_4	111.00	41.29	7.80	40.97	75.24	4.07	5.34	1.98	0.92
T_5	112.00	39.44	6.93	39.71	74.65	4.02	5.29	1.95	0.88
T_6	112.33	39.40	6.86	39.24	69.40	3.95	5.23	1.93	0.84
T_7	108.00	44.48	9.73	46.26	82.36	4.46	5.74	2.41	1.20
T_8	109.33	43.68	9.40	45.06	80.41	4.41	5.63	2.34	1.16
T_9	111.33	43.31	8.93	43.15	78.45	4.26	5.54	2.28	1.05
T_{10}	111.66	42.48	8.26	41.13	78.34	4.24	5.36	2.25	0.97
T_{11}	110.66	41.82	7.53	41.14	76.35	4.25	5.42	2.18	1.13
T_{12}	112.33	40.78	7.33	41.10	76.26	4.22	5.36	2.15	1.00
Mean	111.38	41.12	7.65	41.39	74.72	4.10	5.32	1.97	0.97
$CD_{(0.05)}$	2021	1.81	0.58	1.38	2.00	0.08	0.14	0.14	0.09
SE(m)	0.75	0.61	0.20	0.47	0.68	0.03	0.05	0.05	0.02
C.V	1.17	2.60	4.53	1.97	1.57	1.27	1.61	4.37	4.18

Data regarding bulb yield per plot ranged from 1.28-2.41 kg and maximum bulb yield per plot (2.41 kg) was recorded in treatment T_7 (Table 1), due to use of nitrogen fertilizer and biofertilizers including *Bacillus.* Similar conformity was given by Hassan *et al.* (2018). Increase in bulb yield may be due to the role of sulphur in photosynthetic activity, improving nutrient uptake through root system, increased chlorophyll content, and protein content in crop plants as stated by Patidar *et al.* (2017). Visualization of data revealed that neck thickness varied from 0.81-1.2 cm and highest (1.20 cm) was recorded in treatment T_7 (Table 1) might be due to the role of NPK and biofertilizer (Prasad 2022).

Treatment T_7 was found supercilious for growth and yield parameters followed by treatment T_8. Hence, it can be concluded that, combined application of organic manure (FYM) and inorganic fertilizer (NPKS) along with plant growth promoting rhizobacteria *viz*., *Bacillus subtilis* and *Pseudomonas fluorescens* enrich the growth and yield characters and also improves the soil available nutrients.

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