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Effect of different levels of nitrogen, phosphorus and potassium on growth and bulb yield of onion

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Abstract
Nitrogen, phosphorus and potassium play a vital role in plant metabolic activities in onion which ultimately influence the vegetative growth, yield and quality of bulb and overall performance of crop. In the present experiment three levels of nitrogen i.e. (0, 75,100 kg/ha as N0, N1 and N2, respectively), two levels of phosphorus (0, 50 kg/ha as P0 and P1, respectively) and two levels of potassium (0, 80 kg/ha as K0 and K1, respectively) were applied to see their effect when applied alone and in combination, on performance of onion crop cv. Pusa Madhavi under Lucknow condition, India. The experiment comprised 12 treatments [T1- N0P0K0, T2- N0P0K1, T3- N0P1K0, T4- N0P1K1, T5- N1P0K0, T6- N1P0K1, T7- N1P1K0, T8-N1P1K1, T9- N2P0K0, T10- N2P0K1, T11- N2P1K0, T12- N2P1K1], was replicated thrice and was laid out in randomized block design. It was found that the combined application of highest dose of nitrogen, phosphorus and potassium i.e. 100:50:80 kg/ha (T12 –N2P1K1) was significantly better in the comparison to the other treatments for satisfactory improvement of growth parameters i.e. maximum plant height (49.64 cm), average number of leaves per plant (7.2), diameter of bulb neck (1.35 cm), fresh weight of leaves (21.38 g), fresh weight of bulb (55.33 g),dry weight of leaves (2.52 g), dry weight of bulb (47.53 g), polar diameter of bulb (4.70 cm), Physical parameters i.e. volume of bulb (45.19 ml), specific gravity of bulb (1.11) and yield (1.34 kg/plot) of onion crop cv. Pusa Madhavi followed by T8- N1P1K1 (NPK 75:50:80 kg/ha).

Keywords: nitrogen, phosphorus, potassium, growth, bulb yield, onion

Introduction
Onion "Queen of kitchen" is one of the most important bulb crops of India and cultivated under 834.0 million hectare area. Onion is most widely used vegetable in the world after potato. Onion belongs to the Amaryllidaceae family, which is related to a great number of other species of similar Odour and taste *viz*. – garlic, leak, chive, welsh onion etc. It is sensitive to photoperiod with respect to bulb formation. Early seeding and transplanting is therefore essential. Cool weather during early growth of the plant promotes formation of seed stalks (bolting). It is a shallow rooted crop so it is necessary to maintain a fairly high concentration of plant nutrient in the upper foot of the soil by heavy application of manure and fertilizers. Nitrogen (N) and phosphorus (P) are often referred to as the primary macronutrients because of the probability of plants being deficient in these nutrients and because of the large quantities taken up by plants from the soil relative to other essential nutrients (Marschner, 1995) [3]. Among the macro elements, nitrogen is one of the most important plant nutrients, which primarily encourage vegetative growth and provide deep green colour to the leave. The major form of nitrogenous compound within the plant is protein, including amino acids, chlorophyll, nucleotides, phosphatides alkaloids, as well as enzymes, hormones and vitamins. Protein is major constituent of plant protoplasm, so that shortage of nitrogen inhibits cell division consequently causing reduction in growth. Nitrogen comprises 7% of total dry matter of plants and is a constituent of many fundamental cell components (Bungard *et al.*, 1999) [1]. Information on bulb yield as affected by the nitrogen for Uttar Pradesh condition is meager. Phosphorus is essential for root development and when the availability is limited, plant growth is usually reduced. In onions, P deficiencies reduce root and leaf growth, bulb size and yield and can also delay maturation (Brewester, 1994) [2]. Potassium helps in the photosynthesis, translocation and utilization of synthesized carbohydrate. However, very encouraging results could not be obtained by its application in onion (Srivastava *et al.*, 1965). Timely application promotes bulb formation and improves its quality by raising the total sugar contents. The plant suffering from potassium deficiency remained smaller than the normal ones with retarded growth, leaves seems pale green and tops of the plant start dying and turning brown (tip burn). Hence the present experiment was under taken to study the effect of different levels of nitrogen, phosphorus and potassium on growth parameters and bulb yield of onion.

Materials and Methods

The present investigation was carried out at the Horticulture Research Farm of the Department of Applied Plant Science (Horticulture) Babasaheb Bhimrao Ambedkar University Vidya Vihar Raebareli Road Lucknow, Uttar Pradesh, India, during Rabi season of 2009-2010. Onion cultivar Pusa Madhavi was selected for present study. The treatment comprised three levels of nitrogen (0, 75,100 kg/ha as N0, N1 and N2, respectively), two levels of phosphorus (0, 50 kg/ha as P0 and P1, respectively) and two levels of potassium (0, 80 kg/ha as K0 and K1, respectively) and experiment was laid out in randomized block design with three replications. The treatment combinations were as follows: T1- N0P0K0, T2- N0P0K1, T3- N0P1K0, T4- N0P1K1, T5- N1P0K0, T6- N1P0K1, T7- N1P1K0, T8- N1P1K1, T9-N2P0K0, T10- N2P0K1, T11- N2P1K0, T12- N2P1K1. The evaluated traits were bulb yield, quality traits and various horticulture characters namely, growth parameters i.e. height of plant (using measuring scale), number of leaves per plant, fresh weight of leaves, fresh weight of bulbs, dry weight of leaves (using physical weighing balance), neck thickness (using vernier calipers), length of stem; physical parameters i.e. dry weight of bulbs, bulb size, volume of bulb, specific gravity of bulb and quality attributes i.e. bulb yield per plot.

Results and discussion

Different data related to all parameters *viz*., bulb yield, quality traits and various horticulture characters namely, growth parameters i.e. height of plant, number of leaves per plant, fresh weight of leaves, dry weight of leaves, neck thickness, length of stem; physical parameters i.e. dry weight of bulbs, bulb size, volume of bulb, specific gravity of bulb, fresh weight of bulbs, quality attributes i.e. bulb yield per plot. All traits were significantly influenced by levels of nitrogen, phosphorus and potassium.

Growth parameters

Various levels of nitrogen, phosphorus and potassium affected the height of plant after transplanting. Maximum height (49.64cm) was recorded with 100 kg N/ha followed by 75 kg N/ha (Table1). The highest number of leaves (7.2) maximum fresh weight of leaves (21.38gm) and dry weight of leaves (2.52gm) was recorded due to the application of 100kg N, 50kg P and 80 kg K/ha (T12) followed by 75kg N, 50kg P and 80 kg K/ha (T8) (Table1) and maximum diameter of bulb(1.35 cm) (Table3)., All the levels of nitrogen were significantly superior over control because nitrogen is builder of protein. It forms the main constituent of protoplasm in the plant and protein allowed plants to attain faster increase in growth structure which finds support from other workers such as Singh *et al.* (1982) [7], Batra and Pandita (1984) [8] and Singh and Dhankar (1989) [9]. Data presented in Table-1 showed that number of leaves per bulb tended to increase with increasing levels of nitrogen. It may be stated that applied amount of nitrogen improved the carbohydrate contents of the plants ultimately the fresh weight was increased. The synthesis of carbohydrates which are complex nitrogenous compound required for building up of new tissues, are more closely associated with the fresh weight of leaves. Similar results were also reported by Pande *et al.* (1969) [10], Chauhan and shekhawat (1971) [11] and Agrwal *et al.* (1981) [12]. Stimulatory influence of nitrogen on dry weight of leaves and bulbs was also reported by several workers like Singh (1972) [13], Horneck (2004) [4], Meena *et al.* (2014) [5].

Maximum polar diameter of bulb (4.70cm), maximum equatorial diameter of bulb (5.03), cheek diameter of bulb (4.56cm) and maximum number of scale leaves (7.23) was recorded with 100 kg N/ha (Table3). Potassium plays a vital role in maintenance of cellular organization by regulating the permeability of cellular membrane and keeping the protoplasm in a proper degree of hydration by stabilizing emulsions of highly colloidal properties. Similar result has also been reported by Srivastava *et al.* (1970) and Singh *et al.* (1972) [13].

Physical parameters

Physical parameters *viz*., highest volume of bulb (45.19ml), maximum specific gravity of bulb (1.11) was obtained by application of 100 kg N, 50 kg P and 80 kg K/ha followed by control (1.058) (Table 3). Data recorded due to varying levels of potassium application were statistically found to be significant. These results corroborate the findings of Burgart (1971) [15] Randhawa and Singh (1974) [16] and Henriksen (1987) [17]. The present findings are in agreement with the results reported by several workers like Narag and Dastane (1971) [18], Satyanarayan and Araora (1984) [19], Abdissa *et al.*, (2011) [6].

Yield and their attributes

The results obtain with NPK combination had very appreciable effect on the yield and yield attributing characters of onion bulbs. These results are in conformity with the findings of Chauhan and Sekhawat (1971) and Agrwal *et al.* (1981) [12]. The effect of potassium alone and with nitrogen and phosphorus show significant alternation on the specific gravity of the bulbs (Table 3). Reduction in bolting with the increase nitrogen in fertilization might be due to continuous growth leading to building and therefore, to bulb development without giving any change for formation of bolters. The observations are in agreement with earlier report of Verma *et al.* (1972) and Bottcher and Kolbe (1975).

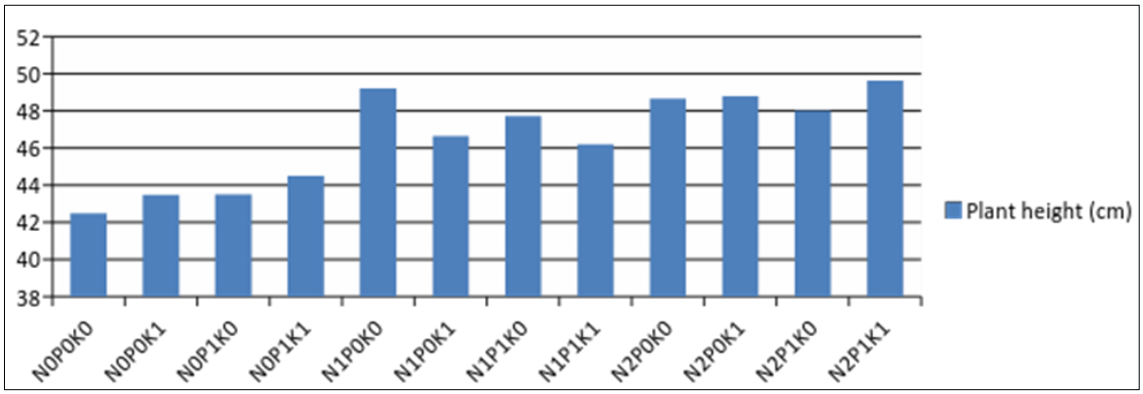

Fig 1: Plant height (cm) of onion under different doses of nitrogen, phosphorus and potassium

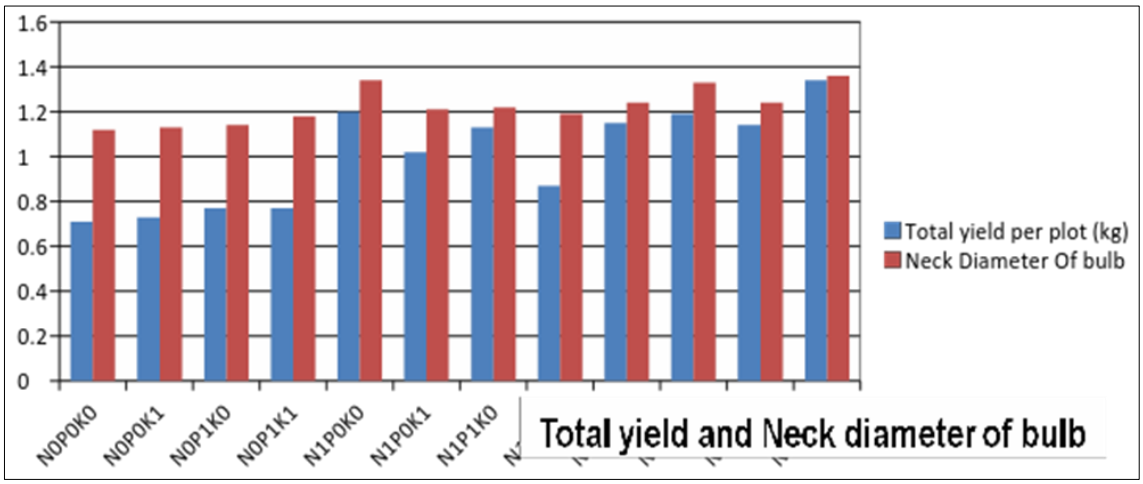

Fig 2: Total yield per plot and Neck diameter of onion under different doses of nitrogen, phosphorus and potassium.

Thus, it is logically interpreted that N (0kg/ha), P (75kg/ha) and K (100kg/ha) have a significant effect on increasing the vegetative as well as the bulb parameters which ultimately results in an increase in yield which is obvious from the present study.

Table 1: Effect of different levels of NPK on plant height, fresh and dry weight of leaves and number of leaves of onion

Sl. No.	Treatment combination (N-P-K kg/ha)	Plant height (cm)	Fresh weight of leaves (gm)	Dry weight of leaves (gm)	No. of leaves per bulb
1	0-0-0	42.48	17.73	1.96	6.03
2	0-0-80	43.47	17.94	2.02	6.06
3	0-50-0	43.52	18.76	2.05	6.10
4	0-50-80	44.49	19.04	2.07	6.13
5	75-0-0	49.20	20.72	2.50	6.60
6	75-0-80	46.65	19.48	2.21	6.23
7	75-50-0	47.72	19.64	2.26	6.26
8	75-50-80	46.21	19.09	2.15	6.16
9	100-0-0	48.66	19.93	2.33	6.36
10	100-0-80	48.79	20.68	2.34	6.70
11	100-50-0	48.00	19.78	2.27	6.33
12	100-50-80	49.64	21.38	2.53	7.23
	C.D. at 5%	2.99	1.16	0.30	0.48
	Standard error	1.44	0.56	0.14	0.23

Table 2: Effect of different levels of NPK on plant height, fresh weight, dry weight, stem length of the bulbs and number of scale leaves per bulb of onion

Sl. No.	Treatment combination (N-P-K kg/ha)	Fresh weight of bulb (gm)	Dry weight of bulb (gm)	Stem length of bulb (cm)	No. of scale leaves per bulb
1	0-0-0	40.40	25.66	0.38	5.86
2	0-0-80	40.53	27.00	0.39	6.06
3	0-50-0	42.80	33.06	0.40	6.13
4	0-50-80	44.06	34.86	0.41	6.16
5	75-0-0	51.20	41.26	0.49	6.26
6	75-0-80	47.46	36.40	0.43	6.30

7	75-50-0	48.93	37.46	0.44	6.33
8	75-50-80	47.06	35.23	0.41	6.56
9	100-0-0	49.66	40.06	0.47	6.43
10	100-0-80	49.80	40.13	0.48	6.46
11	100-50-0	49.00	37.46	0.44	6.40
12	100-50-80	55.33	47.53	0.50	6.60
	C.D. at 5%	5.40	4.54	0.03	0.36
	Standard error	2.60	2.19	0.10	0.17

Table 3: Effect of different levels of NPK on polar, equatorial, cheek, neck diameter and weight, volume, specific gravity, yield of bulbs

Sl. No.	Treatment combination (N-P-K kg/ha)	Polar diameter of bulb (cm)	Equatorial diameter of bulb (cm)	Cheek diameter of bulb (cm)	Neck diameter	Weight of bulb (gm)	Volume of bulbs (ml)	Specific gravity of bulbs	Total yield per plot
1	0-0-0	3.66	3.76	3.62	1.12	25.66	23.78	1.058	0.71
2	0-0-80	3.81	4.05	3.70	1.13	27.00	24.33	1.059	0.73
3	0-50-0	3.91	4.21	3.83	1.14	33.06	30.05	1.073	0.77
4	0-50-80	3.92	4.21	3.85	1.18	34.86	32.17	1.076	0.77
5	75-0-0	4.61	4.80	4.49	1.34	41.26	38.46	1.104	1.20
6	75-0-80	3.92	4.40	3.91	1.21	36.40	33.98	1.079	1.02
7	75-50-0	3.96	4.62	3.93	1.22	37.46	34.91	1.080	1.13
8	75-50-80	3.95	4.27	3.86	1.19	35.13	32.25	1.077	0.87
9	100-0-0	4.32	4.57	4.41	1.24	40.06	37.23	1.084	1.15
10	100-0-80	4.40	4.63	4.37	1.33	40.13	38.04	1.087	1.19
11	100-50-0	4.06	4.53	3.94	1.24	37.34	36.60	1.081	1.14
12	100-50-80	4.70	5.03	4.56	1.36	47.53	45.19	1.111	1.34
	C.D. at 5%	0.36	0.37	0.24	0.09	4.54	2.15	0.029	0.16
	Standard error	0.17	0.18	0.11	0.04	2.19	1.04	0.014	0.08

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