EFFECT OF NITROGEN AND OFF SEASON BULB SIZE ON ONION SEED PRODUCTION

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ABSTRACT

An experiment was conducted at Sukranagar, Chitwan to assess the effect of nitrogen (N) and off season bulb size on seed production of onion cv. Bemausami-1 (N-8293) during 2009/10. Five levels of nitrogen (0, 40, 80, 120 and 160 kg N/ha) as main plot factor and three bulb size (<1, 1-3 and >3 cm diameter) as sub plot factor were used as treatments and laid out in a split plot design with three replications. Plant height, number of tillers, leaves; scapes, umbels, and flowers per plant were significantly high at higher doses of nitrogen and similar results were found at the bigger sized bulb too. Seed yield was the highest (300.2 kg/ha) at 160 kg N/ha and >3 cm bulb size and the lowest (200.1 kg/ha) at 0 kg N/ha and <1 cm bulb size. B: C ratio was the highest (1.79) at 160 kg N/ha with medium sized bulb (1-3 cm) and the lowest (1.05) at 0 kg N/ha with bulb size of < 1 cm.

Key words: vegetable, storage, export and import

INTRODUCTION

Onion, the important spice crop in Allium, ranks third in production among the vegetable crops in the world after tomato and cabbage (FAO, 1996) and second in area under cultivation among the major vegetables and spices after tomato (Pathak, 1994). Thapa and Paudyal (2000) reported that it ranked 4th position among vegetables in terms of its volume and value of the production in Nepal. There is steady demand of onion bulb throughout the year which is increasing every year in Nepal. Severe scarcity of onion bulbs is seen from August to March in the vegetable markets of Nepal which is fulfilled by import from India in the period (Budhathoki et al., 2004). Nepal invested NRs. 49,93,23,487 to import 4,85,86,882 kg onion and shallot during 2008/09 (NFTS, 2009). Though Nepal is rich in agro-ecological, climatic, topographical and edaphic variation, it is still far behind to fulfill the seed demanded. However, Rukum district producing 200 kg onion seed (VDD, 2009) and 135 kg seed produced at Citrus Development Centre, Palpa (Mr. Buddhi Prakash Ghimire, Planning officer, DADO) but this amount is far beyond to meet the national demand of 1932 mt of onion seed. We are dependent on the seed business to foreign country. The total amount of vegetables seed including onion imported was about 2,49,643 kg which was worth NRs 6,84,65,620 (NFTS, 2008/09).Moreover, onion bulbs require vernalization for flowering, thus bulbs produced during February needs to be stored until the commencement of the cold season. There is a huge problem on storing the bulb at our country and is also a tedious job. In addition, this research will also assist on coping the storage problems and to make the seeds available throughout the year this study was carried out by using the off season bulb size since these bulbs have been harvested during November and are directly transplanted for seed production.

Nitrogen is the major factor governing seed yield and quality of onion. El Hilo et al. (1971) reported that the lack of nitrogen induced yellowing of leaves and flower stalks and caused burning of leaf tips, in contrast to plants treated with nitrogen which remained green throughout the growing season. They also reported that nitrogen fertilizer application resulted in high total nitrogen content in the leaves. Nourai et al. (2003) attributed the increase in seed yield due to the increase in seed

yield of individual plants in response to increased level of nitrogen (150 kg N/ha). Similarly, bulb size generally plays an important role in seed production. Mishra (1994) obtained 659.74 kg/ha seed from onion plants grown from larger bulbs (3.5-4.5 cm diameter) compared to smaller bulbs (1.5-2.5 cm diameter). Best seed yields were obtained from plants grown from larger bulbs as compared to medium and small sizes. A larger mother bulb having a larger food supply and water content than the other sizes enabled the development of vigorous plants and production of higher seed yields (Levy et al., 1981).

METHODOLOGY

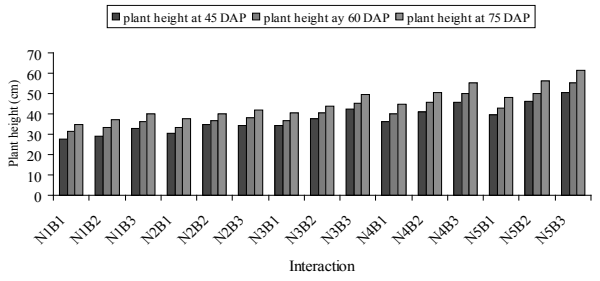
The experiment was laid out in a Split Plot Design. The main factor was five doses of nitrogen (0, 40, 80, 120, and 160 kg/ha) and subplot factor was three levels of bulb diameter: small (<1 cm), medium (1-3 cm), and large (>3 cm). There were 15 treatments which were replicated thrice. Plots were assigned randomly within each main plot. The bulbs were planted at 45×30 cm on every sub plot size having 4 rows with 5 plants per row on the area of 2.7 m2. There were 20 plants per sub plot which were categorized as inner 6 observational plants and other remaining 14 boarder plants.

Each plot was supplied with well rotted FYM, Phosphorous, potassium at 20000: 60:60 kg/ ha as basal dose whereas, the nitrogen was applied at different doses (0, 40, 80, 120 and 160 kg/ha). Half of the nitrogen and full dose of FYM, phosphorus (60 kg/ha) and potassium (60 kg/ha) were applied as basal dose before transplanting. Rest half of nitrogen was top-dressed at 50 days after transplantation. Nitrogen was supplied through Urea (46%N) and DAP, phosphorus through DAP (18% N and 46% P) and potash through Murate of potash (60% K). The field was irrigated at 7 days interval and was reduced during seed maturity stage. The onion seeds were harvested by cutting the umbel along with 10-15 cm stalk for easy handling when 10% of the head showed black color. The seeds were threshed and dried up to safe moisture level.

RESULTS AND DISCUSSION

Plant height, number of tillers and leaves per plant

The maximum plant height of onion was found at Nitrogen level 160 kg/ha (45.32, 49.54and 55.26 cm)and at > 3 cm bulb size (41.01, 44.96 and 49.62 cm) at 45, 60 and 75 days after planting (DAP) respectively. Similarly, the maximum number of tillers were found at 160 kg N/ha (1.53, 2.12 and 2.27) and at > 3 cm bulb size (1.60, 2.05 and 2.18) at 60, 75 and 90 DAP respectively. Moreover, the maximum number of leaves were found at 160 kg N/ha (13.69, 14.85, 16.78 and 9.01) and at > 3 cm bulb size (10.80, 12.05, 12.94 and 8.15) at 60, 75, 90 and 105 DAP respectively (Table 1). There was significant interaction effect of nitrogen level and bulb size on plant height at 45, 60 and 75 DAP and on number of tillers at 60 DAP (Figure 2 and 3). Dahal (2008) and Shakya (2009) reported the plant height which were in agreement with the results obtained. The largest bulb produced the tallest plant followed by medium and smallest bulb (Khan et al., 2005). Nitrogen is a constituent of proteins, enzymes, hormones, vitamins alkaloids, chlorophyll and photosynthesis which led to an increment in plant metabolism and vegetative growth expressed as plant heights, number of leaves per plant, both length and diameter of leaves, leaf area and crop (Kumar et al., and Al-Moshileh et al.,2002). Due to the higher dose of nitrogen (150 kg/ha) the vegetative growth of onion plant was increased which helped to increase the number of tillers per plant (Rahim et al., 1997). Ambulkar et al. (1995) and Hussain et al. (2001) recorded more number of leaves from large sized bulb (5.5-5.99 cm).



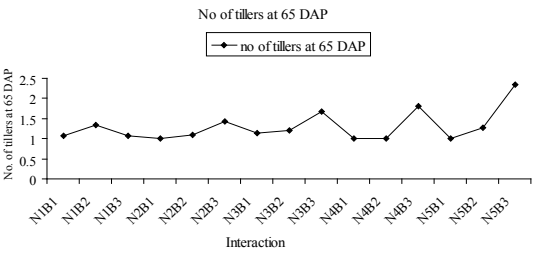


Figure 2 and 3. Interaction effect of nitrogen and bulb size on periodic plant height and number of tillers per plant of onion at Sukranagar, Chitwan, Nepal, 2009/10.

Number of scape, umbels, flowers per plant and seed yield in onion plant

The number of scape per plant was significantly the highest at nitrogen level 160 kg/ha (1.95, 2.56 and 1.61) and at > 3 cm bulb size (1.45, 2.06 and 1.30) at 75, 85 and 95 days after planting (DAP) respectively. Similarly, the number of umbels per plant was significantly the highest at nitrogen level 160 kg/ha (2.83, 2.40 and 2.90) and at > 3 cm bulb size (3.16, 2.57 and 2.64) at 85, 95 and 105 days after planting (DAP) respectively. Likewise the number of flowers per plant and seed yield was significantly the highest at nitrogen level 160 kg/ha (668.4 and 278.5 kg/ha) and at > 3 cm bulb size (719.0 and 244.3 kg/ha) respectively (Table 2). Moreover, lowest number of scape, umbels, flowers per plant and seed yield was found at at 0 kg N/ha and < 1 cm bulb size. There was significant interaction effect of nitrogen level and bulb size on seed yield of onion(Figure 4).Mishra (1994) noticed greater number of scape and umbel per plant at 150 kg N/ha and Farag and Koriem (1996) recorded the highest number of scapes and umbels per plant on >5cm bulb size while the lowest at <1 cm diameter.

Table 1. Periodic plant height, number of tillers and leaves per plant at different doses of nitrogen and bulb size at Sukranagar, Chitwan, Nepal, 2009/10

Treatments	Plant height (cm)			Number of tillers per plant			Number of leaves per plant			
	45 DAP	60 DAP	75 DAP	60 DAP	75 DAP	90 DAP	60 DAP	75 DAP	90 DAP	105 DAP
Nitrogen (Main factor)										
N_1 (0 kg N/ha)	29.75^{e}	33.65^{e}	37.32^{e}	1.15^{b}	1.22^{d}	1.33^{c}	6.48^{e}	7.29^{e}	8.01^{e}	6.25^{d}
N_2 (40 kg N/ha)	32.97^{d}	35.98^{d}	39.95^{d}	1.17^{b}	1.62^{c}	1.72^{b}	8.27^{d}	8.95^{d}	9.74^{d}	6.56^{d}
N_3 (80 kg N/ha)	38.07^{c}	40.65^{c}	44.63^{c}	1.33^{ab}	1.55^{c}	1.67^{b}	9.62^{c}	11.02^{c}	11.60^{c}	7.33^{c}
N_4 (120 kg N/ha)	40.92^{b}	45.37^{b}	50.16^{b}	1.26^{b}	1.84^{b}	1.94^{b}	11.08^{b}	12.35^{b}	13.74^{b}	7.99^{b}
N_5 (160 kg N/ha)	45.32^{a}	49.54^{a}	55.26^{a}	1.53^{a}	2.12^{a}	2.27^{a}	13.69^{a}	14.85^{a}	16.78^{a}	9.01^{a}
S E_m	0.55	0.58	0.69	0.06	0.05	0.10	0.11	0.09	0.18	0.12
LSD	1.81	1.89	2.26	0.22	0.18	0.32	0.37	0.31	0.61	0.41
CV%	6.21	8.86	9.75	14.14	9.34	10.43	6.01	5.27	9.57	10.80
Bulb size (Sub factor)										
B_1 (<1 cm)	33.55^{c}	36.88^{c}	41.15^{c}	1.04^{c}	1.35^{c}	1.45^{c}	9.08^{c}	9.90^{c}	10.82^{c}	6.65^{c}
B_2 (1-3 cm)	37.66^{b}	41.27^{b}	45.61^{b}	1.18^{b}	1.61^{b}	1.74^{b}	9.61^{b}	10.72^{b}	12.15^{b}	7.48^{b}
B_3 (>3 cm)	41.01^{a}	44.96^{a}	49.62^{a}	1.60^{a}	2.05^{a}	2.18^{a}	10.80^{a}	12.05^{a}	12.94^{a}	8.15^{a}
S E_m	0.31	0.40	0.44	0.04	0.04	0.04	0.07	0.09	0.11	0.07
LSD	0.91	1.20	1.29	0.13	0.11	0.14	0.22	0.27	0.32	0.21
CV%	6.21	8.86	9.75	14.14	9.34	10.43	6.01	5.27	9.57	10.80

DAP= Days after planting of the bulb, N_1, N_2, N_3, N_4 and N_5 represents 0, 40, 80, 120 and 160 kg N/ha respectively and B_1, B_2 and B3 represents <1 cm, 1-3 cm and >3 cm bulb size respectively. Treatment means followed by common letter (s) are not significantly different from each other based on DMRT at 5% level of significance

Table 2. Number of scape, umbels, flowers per plant and seed yield in onion at periodic stages of growth at different doses of nitrogen and bulb size at Sukranagar, Chitwan, Nepal, 2009/10

Treatments	Number of scapes per plant			Number of umbels per plant			Number of flowers per plant	Seed yield
	75 DAP	85 DAP	95 DAP	85 DAP	95 DAP	105 DAP	95 DAP	Kg/ha
Nitrogen (Main factor)								
N_1 (0 kg N/ha)	0.52 ^{e}	0.94 ^{e}	0.45 ^{e}	0.83 ^{e}	1.21 ^{d}	1.38 ^{d}	324.6 ^{b}	211.9 ^{c}
N_2 (40 kg N/ha)	0.81 ^{d}	1.31 ^{d}	0.66 ^{d}	1.53 ^{d}	1.62 ^{c}	1.76 ^{c}	491.0 ^{ab}	216.6 ^{c}
N_3 (80 kg N/ha)	1.03 ^{c}	1.62 ^{c}	1.05 ^{c}	1.84 ^{c}	1.73 ^{c}	1.83 ^{c}	561.8 ^{a}	220.4 ^{c}
N_4 (120 kg N/ha)	1.51 ^{b}	2.02 ^{b}	1.36 ^{b}	2.24 ^{b}	2.06 ^{b}	2.51 ^{b}	543.6 ^{a}	241.7 ^{b}
N_5 (160 kg N/ha)	1.95 ^{a}	2.56 ^{a}	1.61 ^{a}	2.83 ^{a}	2.40 ^{a}	2.90 ^{a}	668.4 ^{a}	278.5 ^{a}
S E_m	0.04	0.04	0.03	0.07	0.06	0.07	59.76	5.20
LSD	0.14	0.15	0.10	0.25	0.22	0.25	194.9	16.98
CV%	13.79	6.62	10.17	14.22	9.92	9.54	15.83	2.11
Bulb size (Sub factor)								
B_1 (<1 cm)	0.87 ^{c}	1.34 ^{c}	0.73 ^{c}	0.90 ^{c}	1.22 ^{c}	1.50 ^{c}	344.4 ^{c}	218.8 ^{c}
B_2 (1-3 cm)	1.17 ^{b}	1.67 ^{b}	1.06 ^{b}	1.50 ^{b}	1.62 ^{b}	2.09 ^{b}	490.2 ^{b}	238.3 ^{b}
B_3 (>3 cm)	1.45 ^{a}	2.06 ^{a}	1.30 ^{a}	3.16 ^{a}	2.57 ^{a}	2.64 ^{a}	719.0 ^{a}	244.3 ^{a}
S E_m	0.04	0.02	0.02	0.06	0.04	0.05	21.16	1.27
LSD	0.12	0.08	0.79	0.20	0.13	0.15	62.43	3.754
CV%	13.79	6.62	10.17	14.22	9.92	9.54	15.83	2.11

DAP= Days after planting of the bulb, N_1, N_2, N_3, N_4 and N_5 represents 0, 40, 80, 120 and 160 kg N/ha respectively and B_1, B_2 and B3 represents <1 cm, 1-3 cm and >3 cm bulb size respectively. Treatment means followed by common letter (s) are not significantly different from each other based on DMRT at 5% level of significance.

Nehra *et al.* (1989) noticed the greatest number of flowers per plant emerged from large sized bulbs. Bhardwaj *et al.* (1991) and Patel and Vachhani (1994) also reported the greater number of flowers per plant at 150 kg N/ha. Ali *et al*. (1998) reported that 5.5-7 cm bulb produced significantly high seed yield as compared to the > 1 cm.

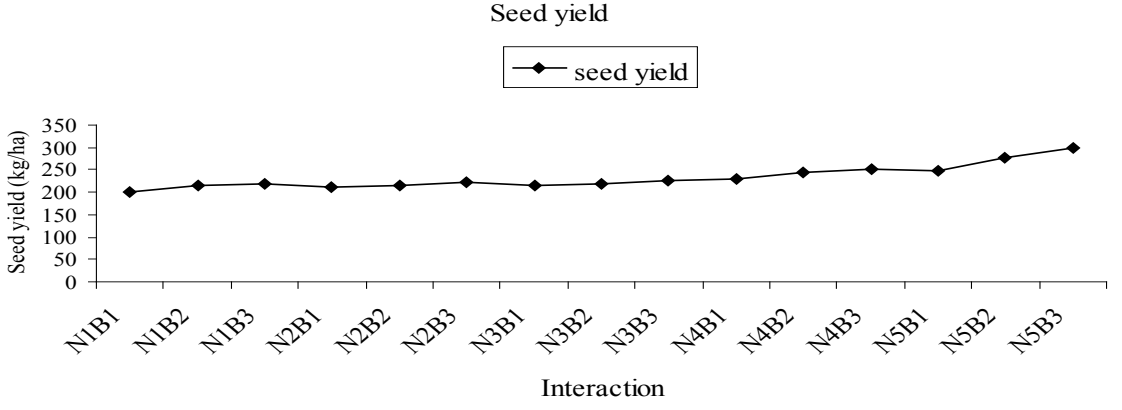


Figure 4. Interaction effect of nitrogen and bulb size on seed yield (kg/ha) of onion at Sukranagar, Chitwan, 2009/10.

Table 3. Economic analysis of seed production of onion at different doses of nitrogen and bulb size at Sukranagar, Chitwan, 2009/10

Treatment	Seed yield (kg/ha)	Rate of bulb (N Rs/kg)	Gross income (NRs/ha)	Total production cost (NRs/ ha)	Net return (NRs/ha)	B/C ratio
N1 B1	200.2	1000	200200	141324	58876	1.41
N1 B2	215.3	1000	215300	160372	54928	1.34
N1 B3	220.4	1000	220400	207991	12409	1.05
N2 B1	210.2	1000	210200	142444	67756	1.47
N2 B2	216.8	1000	216800	161492	55308	1.34
N2 B3	222.6	1000	222600	209111	13489	1.06
N3 B1	213.5	1000	213500	143564	69936	1.48
N3 B2	220	1000	220000	162612	57388	1.35
N3 B3	227.6	1000	227600	210231	17369	1.08
N4 B1	230.4	1000	230400	144684	85716	1.59
N4 B2	244.3	1000	244300	163732	80568	1.49
N4 B3	250.5	1000	250500	211351	39149	1.18
N5 B1	240	1000	248000	145804	94196	1.64
N5 B2	295.23	1000	295230	164852	130378	1.79
N5 B3	300.2	1000	300200	212471	87729	1.41

Though the production was the highest at 160 kg N/ha and bulb size of >3 cm diameter but its B/C ratio was lower as compared to 160 kg N/ha and bulb size of 1-3 cm diameter since high investment was required to purchase larger bulb as compared to other bulbs (Table 3). Thus it is economical to use medium i.e. 1-3 cm bulb size for onion seed production. Jilani (2004), Mirshekari *et al*., (2008), and Mosleh ud- Deen (2008) also reported the similar results.

CONCLUSION

The parameters i.e. plant height, number of leaves, number of tillers, number of scapes, number of umbels, number of flowers per plant and seed yield was found to be highest at 160 kg/ha and > 3 cm diameter bulb. But, from the economic analysis of seed production of onion, B/C ratio was the highest (1.79) at 160 kg N/ha and 1-3 cm i.e. medium bulb size with the lowest B/C (1.059) at 0 kg N/ha and >3 cm bulb size. Thus, it is recommended160 kg N/ha and bulb of 1-3 cm size would be suitable combination for the seed production of onion for export promotion and import substitution of the crop.

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