International Scholars Journals

International Journal of Horticulture and Floriculture ISSN 2167-0455 Vol. 5 (3), pp. 289-294, March, 2017. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Effect of different levels of nitrogen on commercial onion varieties for off season green production in Western Chitwan, Nepal

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Accepted 17 March, 2015

An experiment was carried out to evaluate the effect of nitrogen on commercial onion varieties for off season green production in sandy loam soils at Shukranagar Village Development Committee (V.D.C), Chitwan, Nepal, from July to November 2008. The field experiment was laid out in two factors factorial randomized complete block design (RCBD) with five levels of nitrogen (0, 40, 80, 120 and 160 kg ha^{-1}) and two varieties (Agrifound Dark Red and Nasik-53) with four replications. Green onion yield was the highest (42.38 t ha^{-1}) at 120 kg N ha^{-1} where as it was reduced to 40 t ha^{-1} at 160 kg N ha^{-1}. The combination of 120 kg N ha^{-1} and Agrifound Dark Red (AFDR) produced the highest green yield (43.8 t ha^{-1}). The plant height (59.81cm) and numbers of leaves (9.47) per plant measured at 60 days after seedling transplanting (DAT) were the highest at 120 kg N ha^{-1} which was significantly higher than the control 48.58 days and 7.287 leaves per plant respectively). Number of leaves plant per plant, plant height, percentage doubled plants and immature bulb diameter showed positive correlation with green yield. The earliest maturity (51.88 days) of the crop was at 120 kg N ha^{-1} while the most delayed was in the control (58.75 days). AFDR matured earlier (52.25 days) than N-53 (56.5 days). The highest post harvest loss (29.13 %) was in the treatment of 160 kg N ha^{-1} after 6 days of harvest. Benefit cost ratio of AFDR at 120 kg N ha^{-1} (5.14) was the highest as compared to N-53 (4.46) at same level of N.

Key words: Green onion, Nitrogen, Variety, Off season.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the important vegetable crops in Nepal, ranking 4th position in terms of its volume and value of the production (Thapa and Paudyal, 2000). The per capita consumption of fresh onion in Nepal is 7.7 kg where as the recommended quantity is 18 kg per annum (Koirala *et al.*, 1995). In 1998, the total area of onion production in Nepal was 8000 ha with average yield of 12.4 t ha^{-1} (Ghimire *et al*., 1998) while during 2005; it reached to 8644.5 ha with average productivity of 15 t ha^{-1} (VDD, 2005). According to FAO, it is estimated that onion is grown in 2.71 million hectares in the world, producing 47.67 million tones of onions each year. Approximately, 8 percent of this global onion production is traded internationally.

The term green onion describes an immature onion. Generally green onions are harvested before the maturation of the bulbs. Even the large bulbed onions such as Agrifound Dark Red, Nasik-53, Grano or Granex, Red Creole can be harvested immature and used as salads and other culinary purpose. They have a small, not fully developed white bulb end with long green leaves. Farmers preferred selling onions green rather than keeping the plants for bulb production. Jaiswal and Suvedi (1996) suggested green onion production in the off season because of pre bolting, non bulbing, bulb splitting, and greater losses of bulb onions during storage and high demand of green onion in the market during off season (i.e. October- November). Farmers can get immediate income from selling of green top from off-season onion (Rokaya and Bhandari, 2004; Gautam, 2006). This profitable business gives cost benefit ratio of 3.7:1 (Singh and Singh, 2002).

In Nepal, onion is cultivated from November to early June as a normal or main season crop. The bulbs are harvested

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from mid May to early June and then stored under the prevailing ambient conditions. In recent years, the Vegetable Development Directorate (VDD) under the Department of Agriculture, Nepal has been making efforts to introduce off-season production of onion during October to December by planting small onion bulb known as 'sets'. It is produced by planting the sets during July to August. But it takes long effort to produce sets, store them and then replant them. These operations require more time and space compared to direct seedling transplanting. Off-season onion can be produced by transplanting of onion seedlings which are raised by sowing the seed during June to July (Budathoki, 2006).

Keeping in the view the large-scale onion imports from India, the Government initiated the campaign called "Mission Onion" in major onion producing districts as an effort to involve more farmers and gradually substitute onion imports from southern neighbor. Mission onion aims to replace imports by increasing the land devoted to onion production from 15,062 hectares to 27,292 hectares across the country by fiscal year 2011/2012.

Nitrogen fertilizer is one of the principle factors that materially set up onion growth and production. Moursy et al. (2007) found that application of 190.4 kg N/ha gave significantly increased in onion yield, bulb diameter and TSS content as compared with using nitrogen at rate of 95.2 kg N/ha. Yaso et al. (2007) revealed that increasing mineral nitrogen levels led to significant increases on plant height, number of leaves, average bulb weight, marketable and total bulbs yield, and total soluble solid (TSS) of onion.

Off season onion is one of the major sources of income for Nepalese farmers, but little research and development work have been done especially in the aspect of green production. Keeping this in view, the present study was undertaken to assess the impact of different levels of nitrogen on commercial onion varieties for off season green production.

MATERIALS AND METHODS

The experiment was conducted at Shukranagar Village Development Committee (V.D.C), Chitwan, Nepal, from July to November 2008. The field experiment was laid out in two factors factorial randomized complete block design (RCBD) with five levels of nitrogen (0, 40, 80, 120 and 160 kg ha^{-1}) and two varieties (Agrifound Dark Red and Nasik-53) with four replications. The plot size was 1.35 m x 1.2 m with 108 plants. Raised nursery bed (raised 15 cm for facilitating the drainage in the rainy season) in half plastic tunnel was prepared for protecting the seed bed from direct splash of rain water. Basal dose of FYM at the rate of 10 kg m^{-2}, urea, diammonium phosphate and each @5 gm m^{-2} was applied for raising onion seedlings. Soil treatments were done Murate of potash with 40% formalin at the rate of 4000 lit ha^{-1}. Soil was covered with plastic for 24 hours. The onion seeds were sown in line in well prepared raised bed on 16thJuly, 2008. Uniform sized, 45 days old seedlings were transplanted in the experimental plots on 31st August, 2008**.** The row to row spacing was 15 cm and plant to plant spacing was 10 cm. Gap filling were done after a week of onion transplanting to maintain a desired plant population in the experimental plots.

The observations on plant height, leaf number, doubled bulbed plants; total biological yield and dry matter content in leaves were recorded. The data were statistically analyzed with the help of MSTSTC programme. The means of the observed characters were compared by using LSD at the 5% level of significance. For the economic analysis, B: C ratio was calculated by the following formula. B: C ratio = Gross return(R) / Cost of cultivation(C)

RESULTS AND DISCUSSION

Plant Height at Different DAT

The levels of nitrogen application had significant effect on plant height at all the maturity stages of the crops (Table 2). The highest plant height (28.14 cm at 30 DAT, 49.74 cm at 45 DAT and 59.81 cm at 60 DAT) was at 120 kg N ha^{-1} which was higher than the plant height at 40 kg N ha^{-1} (26 cm at, 30 DAT, 44.33 cm at 45 DAT and 53.67 at 60 DAT). The varieties did not differ on plant height at all the maturity stages of the crops. The interaction effect of nitrogen and variety was also non significant. The authors reported the effect of varying levels of nitrogen (Subedi 2001) on plant height. Batra and Pandita (1984) observed that total biological yield, and plant height increased with increment in the level of nitrogen application up to 120 kg N ha^{-1}.

Number of Leaves Per Plant at Different DAT

The levels of N showed significant effect on the number of leaves per plant at different DAT of the crops (Table 3). The application of N increased number of leaves per plant up to 120 kg N ha^{-1} and it was started to decline at 160kg N ha^{-1} at 60 DAT. However, the differences in level of N from 40 to 160 kg ha^{-1} could not show significant differences on this parameter. The varieties also did not differ significantly in the number of leaves per plant.

Double Bulbed Plants (%)

Nitrogen had significant effect on doubling behavior of bulbs in the plants. The highest percentage of doubling (22.14%) was at 160 kg N ha^{-1} which was significantly higher than the control (14.46 %) (Table 4). The variety had non-significant effect on doubling behavior (Table 4).

Table 1. Details of treatments and their combinations used in the field experiment (2008).

Treatments	Combinations	Symbols
T1	0 kg Nitrogen ha^{-1} + AFDR	N0V1
T2	40 kg Nitrogen ha^{-1} + AFDR	N1V1
T3	80 kg Nitrogen ha^{-1} + AFDR	N2V1
T4	120 kg Nitrogen ha^{-1} + AFDR	N3V1
T5	160 kg Nitrogen ha^{-1} + AFDR	N4V1
T6	0 kg Nitrogen ha^{-1} + N-53	N0V2
T7	40 kg Nitrogen ha^{-1} + N-53	N1V2
T8	80 kg Nitrogen ha^{-1} + N-53	N2V2
T9	120 kg Nitrogen ha^{-1} + N-53	N3V2
T10	160 kg Nitrogen ha^{-1} + N-53	N4V2

Table 2. Plant height at different levels of Nitrogen on commercial onion varieties for off season green production,(2008).

Treatments Nitrogen Levels (kg ha^{-1})	30 DAT (cm)	45 DAT (cm)	60 DAT (cm)
0	22.49	40.20	48.58
40	26.00	44.33	53.67
80	27.89	48.44	56.25
120	28.14	49.74	59.81
160	27.36	47.83	56.81
Mean	26.37	46.10	55.02
SE_m	0.67	1.21	1.09
LSD	1.95**	3.51**	3.17**
CV%	7.23	7.42	5.62
Variety			
AFDR	26.23	46.45	55.35
N-53	26.52	45.76	54.71
Mean	26.37	46.10	55.02
S E_m	0.42	0.46	0.32
LSD	Ns	Ns	Ns
CV%	7.23	7.42	5.62

Table 3. Leaves number per plant at different levels of nitrogen on commercial onion varieties for off season green production, 2008.

Treatments Nitrogen levels (kg ha^{-1})	30 DAT	45 DAT	60 DAT
0	4.10	6.16	7.28
40	4.72	7.21	8.75
80	4.88	7.78	9.30
120	4.90	7.97	9.47
160	4.82	7.72	8.76
Mean	4.7	7.37	8.71
S E_m	0.13	0.25	0.20
LSD	0.3**	0.73**	0.60**
CV%	8.07	9.75	6.72
Variety			
AFDR	4.64	7.40	8.69
N-53	4.75	7.34	8.74
Mean	4.7	7.37	8.71
S E_m	0.08	0.16	0.13
LSD	Ns	Ns	Ns
CV%	8.07	9.75	6.72

Table 4. Double bulbed plants, biological yield and dry matter content in leaves in off season green onion production, 2008.

Treatments	Doubled plants (%)	Biological yield (kg/net plot)	Dry matter (%)
Nitrogen levels (kg ha^{-1})			
0	14.46	3.30	9.26
40	18.03	3.86	9.35
80	19.10	4.25	9.28
120	21.96	4.45	9.15
160	22.14	4.20	9.35
Mean	19.13	4.01	9.28
S E_m	0.69	0.11	0.40
LSD	2.02**	0.34**	Ns
CV%	10.31	8.44	11.99
Variety			
AFDR	19.07	4.00	9.22
N-53	19.21	4.023	9.34
Mean	19.13	4.01	9.28
S E_m	0.44	0.07	0.24
LSD	Ns	Ns	Ns
CV%	10.31	8.44	9.71

Table 5. Days to harvesting for off season green onion production, Chitwan (2008).

Treatments	Days to harvest
Nitrogen levels (kg ha^{-1})	
0	58.75
40	55.63
80	53.13
120	51.88
160	52.50
S E_m	1.01
LSD	2.95**
CV%	5.3
Variety	
AFDR	52.25
N-53	56.50
S E_m	0.64
LSD	1.87**
CV%	5.3

Sharma *et al*., (1995) reported 27.2 % doubling of plants during off season. Doubling behavior of plants was affected by season, nutrition, soil type and varietal characteristics. Pike and Lopes (1988) reported that bulb doubling or splitting was strongly influenced by both environmental and non-environmental factors.

Total Biological Yield (Kg/Net Plot)

The nitrogen plays a significant role in the production of biological yield. The highest biological yield (4.45 kg) was at 120 kg N ha^{-1} which was significantly different from 40 kg N ha^{-1} (3.86 kg) and the control (3.3 kg). However, it was at par with 80 and 160 kg N ha^{-1} (Table 4). The variety had non-significant effect on biological yield (Table 4).

Gautam and Pande (2005) reported the effect of nitrogen on off season onion production in Kanpur, India. The linear increment found in fresh production with the increment in nitrogen application supported the present findings.

Dry matter content in leaves

Individually, nitrogen and variety had no significant effect on dry matter content in leaves (Table4).

Days to Harvest

The nitrogen application had significant effect on maturity of crops for green harvest (Table 5). The plot receiving 120 kg N ha^{-1} matured earliest (51.88 days) for green harvest but it was at par with 80 and 160 kg N ha^{-1} differed significantly from 40 kg N ha^{-1} (55.63 days) and the control, which took the highest number of days to green harvest (Table 5). The variety had also significant effect on

Table 6. Effect of different levels of nitrogen and varieties on post harvest life of off season green onion in ordinary room temperature at Shukranagar VDC, Chitwan (2008).

Treatments	After 2 day of harvest (% loss)	After 4 day of harvest (% loss)	After 6 days of harvest (% loss)
Nitrogen levels (kg ha^{-1})			
0	5.38	10.32	21.05
40	5.56	14.79	23.32
80	8.18	15.03	24.97
120	8.56	15.29	24.74
160	10.35	17.10	29.13
Mean	7.60	14.50	24.63
S E_m	0.39	0.66	0.71
LSD	1.15**	1.94**	2.07**
CV%	14.78	13.05	8.21
Variety			
AFDR	7.64	14.60	25.10
N-53	7.57	14.41	24.17
Mean	7.60	14.50	24.63
S E_m	0.25	0 .42	0.45
LSD	Ns	Ns	Ns
CV%	14.78	13.05	8.21

maturity of crops (Table 5). The variety AFDR matured earlier (52.25 days) as compared to N-53 (56.5days). The plot receiving the higher amount of nitrogen attained faster vegetative growth promoting early harvest of the green crop.

Post Harvest Loss After 2 Days of Harvest

Nitrogen showed significant effect on post harvest losses (Table 6). The green onion produce which received higher doses of nitrogen had greater amount of post harvest loss. The highest percentage of post harvest loss was found (10.35%) at 160 kg N ha^{-1} which was significantly higher than the control (5.831%). The variety had non significant effect on post harvest loss after 2 days of harvest. The interaction effect of nitrogen and variety was also non significant. However, the highest percentage of post harvest loss was recorded (10.38%) at 160 kg N ha^{-1} in AFDR.

Post Harvest Loss After 4 Days of Harvest

The nitrogen plays a significant role on post harvest loss after 4 days of harvest (Table 6). The highest amount of post harvest loss (17.1%) was found in 160 kg N ha^{-1} which was significantly higher than the control. The variety had no significant effect on post harvest loss after 4 days of harvest.

Post Harvest Loss After 6 Days Of Harvest

The effect of nitrogen on post harvest loss after 6 days of harvest was found highly significant (Table 6). The signi-

Table 6. Total variable cost, total production, total return, net return and B/C ratio of the off season green onion production, 2008.

Treatment	Cost of nursery preparation,(USD ha^{-1})	Cost of main field preparation ($ ha^{-1})	Total variable cost ($ ha^{-1})	Total production (mt ha^{-1})	Market price ($ mt^{-1})	Total return ($ ha^{-1})	Net return($$ha^{-1}$)	B/C ratio
T1	700.26	1265.00	1965.26	28.33	255.56	7240.01	5274.76	2.68
T2	700.26	1376.62	2076.88	37.85	277.78	10513.97	8437.10	4.06
T3	700.26	1408.86	2109.11	41.44	300.00	12432.00	10322.89	4.89
T4	700.26	1440.20	2140.46	43.80	300.00	13140.00	10999.54	5.14
T5	700.26	1471.56	2171.81	39.28	300.00	11784.00	9612.19	4.42
T6	642.00	1265.00	1907.00	34.52	255.56	8821.93	6914.93	3.62
T7	642.00	1376.62	2018.62	35.83	255.56	9156.71	7138.09	3.53
T8	642.00	1408.86	2050.86	39.52	255.56	10099.73	8048.88	3.92
T9	642.00	1440.20	2082.20	40.95	277.78	11375.09	9292.89	4.46
T10	642.00	1471.56	2113.56	40.71	255.56	10403.85	8290.29	3.92

T1= 0 kg N +AFDR, T2=40kg N +AFDR, T3= 80kg N +AFDR, T4= 120kg N + AFDR, T5= 160kg N + AFDR, T6=0kg N+N-53, T7=40kg N + N-53, T8=80kg N + N-53, T9=120kg N + N-53, T10=160kg N + N-53

ficantly highest percentage of post harvest loss (29.13 %) was found at the highest levels of nitrogen i.e. 160 kg N ha^{-1}. The 40, 80 and 120 kg N ha^{-1} did not differ among each other on post harvest losses on six days after harvest, but differed from the control (21.06 %) (Table 6). The variety had non significant effect on post harvest losses after 6 days of harvest (Table 6).

The higher losses due to rotting of leaves, yellowing of leaves, tip burnt, etc. might have been due to higher vegetative growth and succulence of the plant at higher levels of nitrogen application. Pandey and Pandey (1994) observed that due to application of higher dose of nitrogen during production, post harvest losses due to rotting, moisture loss and weight loss was found to be increased in green mass of the onion, which supported the present findings.

Economic Analysis

Cost of Cultivation

The cost of cultivation of off season green onion depends on the levels of inputs such as seed, manure, fertilizer, labor, tractor, chemicals and irrigation used. The cost of cultivation of AFDR was higher as compared to N-53 due to its higher seed cost which was almost double than the seed cost of N-53. The highest total cost of cultivation was \$ 2171.81 ha^{-1} (Table 6), at 160 kg Nha^{-1} in AFDR while the lowest total variable cost (\$ 1907.00 ha^{-1}) was at 0 kg Nha^{-1} in N-53.

Total Return

The total return per hectare was depended up on the levels of nitrogen and variety (Table 6). In both varieties, the total return increased up to 120 kg N ha^{-1}. In AFDR, the highest total return (\$ 13140.00 ha^{-1}) was found at 120 kg N $ha^{-1}$and then it was declined at 160 kg N ha^{-1}. Similarly in the case of N-53, the highest total return (\$ 11375.09 ha^{-1}) was at 120 kg N ha^{-1} but it was reduced to \$ 10403.85 ha^{-1} at 160 kg N ha^{-1}. The total return was calculated by multiplying the total biological yield with farm gate price during harvesting time. As AFDR was harvested earlier, its total return was higher as compared to N-53 due to the higher farm gate price at the time of harvesting.

Benefit Cost Analysis

The highest B: C ratio (5.14) of the off season green onion cultivation was at 120 kg N ha^{-1} in the variety AFDR which was exceedingly higher than the ratio. In the variety N-53, the highest B:C ratios (4.46) was at 120 kg N ha^{-1}. These B:C ratios indicated that the off season onion cultivation was a very profitable enterprise and could be adopted at commercial scale in western Chitwan. The lowest B: C ratio (2.68) was at 0 kg N ha^{-1} in the variety AFDR (Table 6).

CONCLUSION

The highest biological yield (42.38 t ha^{-1}) was recorded at

120 kg N ha^{-1} which was significantly higher than the control (31.42 t ha^{-1}). The variety had no significant effect on total green yield. The AFDR produced highest green yield (43.8 t ha^{-1}) at 120 kg N ha^{-1} . The maturity (days to harvesting) of the crop differed significantly with the levels of nitrogen. The crop which received 120 kg N ha^{-1} and 160 kg N ha^{-1} matured earlier as compared to the control. AFDR matured earlier (52.25days) as compared to N-53 (56.5days).

The highest B: C ratio (5.14) of off season green onion cultivation was found in the combination of the 120 kg N ha^{-1}in AFDR which was exceedingly higher than the required ratio to be just profitable. This very high benefit-cost ratio indicated that the off season onion cultivation could be very profitable enterprise which can be cultivated at commercial scale in Chitwan.

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