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Effect of Different Levels of Nitrogen on Growth and Yield of Three Onion Varieties

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ABSTRACT

An experiment to study the effect of different levels of nitrogen (0, 40, 80, 120, 160 and 200 kg N ha^{-1}) on three onion varieties was carried out. Seedling bulb size, bulb survival percentage, bulb diameter and marketable yield/plot were not significantly different in all three onion varieties, but leaf length, cull percentage, total yield per plot and total yield t/ha were highly significant at different levels of nitrogen in all the three varieties. Maximum value cost ratio was noticed in Shah Alam followed by Faisalabad Early and Phulkara. In case of different Nitrogen levels all the parameters showed significant behaviour, whereas the Nitrogen level (120 kg N ha^{-1}) proved to be the best for all the parameters studied.

Key Words: Nitrogen; Onion; Vegetable

INTRODUCTION

Onion (*Allium cepa. L*) belongs to the family Amaryllidaceae and is a cool season herbaceous bulb vegetable crop. It is consumed at its young green stage or after its full development and maturity when it is harvested in the form of a dry bulb. In Pakistan, almost all spicy dishes contain onion as one of the important ingredient used for culinary purposes. Onions are extensively used as condiment in the preparation of curry, chutney and pickle etc. Experience has shown that there is always shortage of onion in Pakistan. This could be attributed to less yield per unit area coupled with increase in population.

Since the population is expected to about double with in next few years, therefore, productivity per unit area will have to be increased substantially to meet expected food requirements. This low production of onion is due to improper utilization of fertilizers and growing unsuitable varieties under the agro climatic conditions of an area. Optimum fertilizers application for onion and cultivation of suitable varieties in specific environment are necessary for obtaining good yield of onion. Nitrogen plays an important role to reach the optimum yield of onion and is found essential to increase the bulb size and yield. Patel and Patel (1990) reported that N-level had significant effect on bulb yield. The bulb yield increased with increasing N level up to 90 kg ha^{-1}. Pandy and Ekpo (1991) concluded that highest plant height and number of leaves per plant (63.9 and 130 cm, respectively) were obtained with 160 kg N ha^{-1}. They also observed that maximum bulb yield (460.2 t ha^{-1}) and average bulb weight (197.8 g) were obtained with 120 kg N ha^{-1}. Parwal and Singh (1993) concluded that yield increased in onion with increasing nitrogen levels. Singh *et al.* (1994) found that net plot yield, net weight of 50 onions and total dry weight were best for plots treated with N at 80 kg ha^{-1}. Rana and Sharma (1994) revealed that N application up to 120 kg ha^{-1} gave significantly higher dry matter bulb, 100 bulb weight, bulb diameter and bulb yield. Rops (1996) reported that the split N application had no effect on the yield of onion cultivars Jumbo, Hyfield and Hyskin, but an increase in the total amount of N application led to higher yield. Herison *et al.* (1993) reported that older seedling and higher N-application produced larger plants at transplanting and larger bulb at harvest. Increasing N application reduced the maturation time rightly. Khan *et al.* (2002) reported that maximum yield of onion bulbs (22.90 and 22.82 t ha^{-1}) was obtained from 12 cm plant spacing with 100 kg N ha^{-1}, respectively. Ghaffoor *et al.* (2003) reported that at a fertilizer level of 150:100:50 NPK kg ha^{-1} gave the best results in regard to the number of leaves per plant, bulb survival, bulb diameter, marketable yield, cull percentage and total yield.

Keeping in view the importance of onion production efficacy, the present study was carried out to find the best planting space and dozes of Nitrogen and their effects on the bulb yield and related parameters in onion crop under the existing agro-climatic conditions of the Dera Ismail Khan region.

MATERIALS AND METHODS

The experiment was carried out at the experimental research area, Faculty of Agriculture, Gomal University, D.I. Khan. The experiment was laid out in RCBD design with three replications in Spilt-Plot arrangement. Varieties were assigned to the main plots, whereas the different nitrogen doses along with control treatment were assigned to the sub-plots. The plot size of 2.60 m^2 was kept for all the treatments. The detail of experimental treatments is given as under:

Varieties (Main Plots)	N-Levels (Sub Plots)
V1 Faisalabad Early	T1 Control (No nitrogen)
V2 Phulkara	T2 40 Kg ha^{-1}
V3 Shah Alam	T3 80 Kg ha^{-1}
	T4 120 Kg ha^{-1}
	T5 160 Kg ha^{-1}
	T6 200 Kg ha^{-1}

Seeds of the selected varieties of onion were placed in lines 10 cm apart. The seeds were slightly covered with soil and irrigated with the help of sprinkler. Nursery was kept weed free manually. Seed germination started a week after sowing. The first irrigation was given at the time of sowing and other irrigation was given after an interval of 15 days or according to the need of the crop.

Seedlings of the same size were transplanted with row to row distance of 30 cm and plant to plant distance of 10 cm. All the required cultural practices were kept constant such as irrigation, weeding, pest and disease control etc in all experimental plots.

Data were recorded by selecting plants randomly from each treatment plot and average was calculated for the statistical analysis. The parameters under study were number of bulbs per plot (survival %age), seedling bulb size, leaf length (cm), bulb diameter (cm), skin number, marketable yield, cull percentage, total yield per plot (kg), yield (t ha^{-1}) and benefit cost ratio. The mean data were subjected to the ANOVA (Steel & Torrie, 1984) using the "MSTATC" Computer software package. DMR (Duncan, 1955) was adopted for comparing their means among the treatments.

RESULTS AND DISCUSSION

Number of bulbs per plot (survival %age). The results showed that various nitrogen levels had highly significant effect on the number of bulbs per plot. The maximum number of bulbs survived (95.22%) was recorded in 120 kg N ha^{-1} followed by 160 Kg N ha^{-1} with survival percentage of bulbs (93.55%). Both the treatments were significantly at par with each other. The minimum number of bulbs survived (73%) was recorded in control level of nitrogen. This might be due to the unavailability of major plant nutrients, as a result of which the plants become weaker and produced low number of bulbs. Ghaffoor *et al.* (2003) also reported that survival percentage of onion bulbs were increased when 150 kg N ha^{-1} was applied. The effect of varieties on the number of bulbs survival %age was not significant. The maximum number of bulbs survived (87.66%) was obtained in Phulkara, closely followed by Shah Alam (87.50%). The minimum number of bulbs survived (84.27%) was recorded in Faisalabad Early.

Seedling bulb size (cm). The seedling bulb size also increased significantly with the application of different doses of Nitrogen. No significant increase in seedling bulb size occurred up to 80 kg N ha^{-1} but the effect of Nitrogen at 120 kg N ha^{-1} was pronounced and was recorded as the maximum bulb size (1.54 cm) while the minimum seedling bulb size (0.47 cm) was recorded in control.

Non-significant results were obtained in case of varietial behavior on the seedling bulb size. However, maximum seedling bulb size (1.10 cm) was recorded in Phulkara followed by Shah Alam (1.056 cm) and Faisalabad Early (1.028 cm)

Leaf length (cm). A careful observation of the results revealed that both varieties and fertilizer levels as well as their interaction were highly significant. The maximum leaf length (50.12 cm) was recorded at 160 kg N ha^{-1} closely

Table I. No of bulbs per plot (Survival %), seedling bulb size, leaf length (cm), bulb diameter (cm) and skin number of three onion varieties as affected by different N-levels

Different N Levels	(Faisalabad Early)	(Phulkara)	(Shah Alam)	Mean
Number of bulbs per plot (Survival %)				
Control	71.00	75.00	73.00	73.00d
40 kg ha^{-1}	77.33	81.33	80.667	79.448c
80 kg ha^{-1}	85.00	87.33	90.667	87.667b
120 kg ha^{-1}	94.00	95.00	96.667	95.222a
160 kg ha^{-1}	91.00	95.00	94.667	93.556a
200 kg ha^{-1}	87.33	92.33	89.333	89.667b
Mean	84.278a	87.667a	87.500a	
Seedling bulb size (cm)				
Control	0.500	0.400	0.533	0.478e
40 kg ha^{-1}	0.767	0.767	0.733	0.756d
80 kg ha^{-1}	1.067	1.133	1.000	1.067c
120 kg ha^{-1}	1.433	1.677	1.533	1.544a
160 kg ha^{-1}	1.333	1.433	1.367	1.378b
200 kg ha^{-1}	0.067	1.200	1.167	1.144c
Mean	1.028a	1.100a	1.056a	
Leaf length (cm)				
Control	31.66I	36.561g	33.261hi	33.811d
40 kg ha^{-1}	35.533gh	44.100e	44.367e	41.333c
80 kg ha^{-1}	40.333g	46.600bcde	64.667a	44.533b
120 kg ha^{-1}	45.500de	52.567a	48.000bcd	48.698a
160 kg ha^{-1}	46.733a	54.233a	49.400b	50.122a
200 kg ha^{-1}	46.433cde	53.933a	49.033bc	49.800a
Mean	41.022c	48.000a	45.122b	
Bulb diameter (cm)				
Control	3.300	3.367	3.633	3.433f
40 kg ha^{-1}	3.933	4.333	4.400	4.222e
80 kg ha^{-1}	4.500	5.067	5.267	4.944d
120 kg ha^{-1}	5.867	5.967	6.300	6.044a
160 kg ha^{-1}	5.600	5.667	5.867	5.711b
200 kg ha^{-1}	5.467	5.333	5.400	5.400c
Mean	4.778a	4.956a	5.144a	
Skin number				
Control	3.667	3.667	3.667	3.667 a
40 kg ha^{-1}	3.00	3.00	3.00	3.00b
80 kg ha^{-1}	2.33	2.33	2.667	2.44c
120 kg ha^{-1}	1.00	1.00	1.333	1.11e
160 kg ha^{-1}	1.667	2.00	1.333	1.66d
200 kg ha^{-1}	2.00	2.33	2.333	2.22c
Mean	2.278a	2.389a	2.389a	

Means having common letters are non significant at 5% level of significance

Table II. Marketable yield per plot (kg), cull percentage, total yield per plot, total yield t ha^{-1} and benefit cost ratio of three onion varieties as affected by different levels of nitrogen

Different N Levels	(Faisalabad Early)	(Phulkara)	(Shah Alam)	Mean
Marketable yield per plot (Kg)				
Control	3.300	3.367	3.633	3.433e
40 kg ha^{-1}	3.933	4.333	4.400	4.222d
80 kg ha^{-1}	5.500	5.067	5.267	4.944c
120 kg ha^{-1}	5.867	5.967	6.300	6.044a
160 kg ha^{-1}	5.600	5.667	5.867	5.711b
200 kg ha^{-1}	5.467	5.333	5.400	4.400b
Mean	4.778a	4.956a	5.144a	
Cull percentage (%age)				
Control	0.293	0.337	0.270	0.300a
40 kg ha^{-1}	0.260	0.290	0.220	0.257b
80 kg ha^{-1}	0.227	0.243	0.177	0.216c
120 kg ha^{-1}	0.150	0.157	0.120	0.142d
160 kg ha^{-1}	0.133	0.133	0.097	0.121e
200 kg ha^{-1}	0.160	0.167	0.127	0.151d
Mean	0.204ab	0.221a	0.168b	
Total Yield /plot (kg)				
Control	1.300j	1.33j	1.400j	1.344e
40 kg ha^{-1}	2.133I	2.467hi	2.767gh	2.456d
80 kg ha^{-1}	3.233fg	3.633f	4.133e	3.667c
120 kg ha^{-1}	5.300ab	4.633cde	5.767a	5.233a
160 kg ha^{-1}	5.033bc	4.433de	5.567a	5.011ab
200 kg ha^{-1}	4.900bcd	4.300e	5.067bc	4.756b
Mean	3.650b	3.467b	4.117a	
Total yield (t /ha)				
Control	5.0I	5.133I	5.413i	5.182d
40 kg ha^{-1}	8.200hi	9.467gh	10.400gh	9.356c
80 kg ha^{-1}	12.433fg	13.967ef	15.900de	14.100b
120 kg ha^{-1}	20.367ab	17.800bcd	22.167a	20.111a
160 kg ha^{-1}	19.40abcd	17.833bcd	21.433a	19.556a
200 kg ha^{-1}	18.83abcd	16.533cde	19.467abc	18.278a
Mean	14.039b	13.456b	15.797a	
Benefit Cost Ratio				
Control	0.5	0.5	0.5	0.5
40 kg ha^{-1}	0.8	0.9	1.1	0.9
80 kg ha^{-1}	1.2	1.4	1.6	1.4
120 kg ha^{-1}	1.9	1.7	2.2	1.9
160 kg ha^{-1}	1.7	1.6	1.9	1.7
200 kg ha^{-1}	1.6	1.5	1.7	1.6
Mean	1.3	1.2	1.5	

Means having common letters are non significant at 5% level

followed by 200 and 120 kg N ha^{-1} with 49.80 cm and 48.69 cm, respectively and all these three treatments were statistically at par with each other while the minimum leaf length (33.81cm) was recorded at control level of nitrogen. These results are in line with Kumar *et al.* (1998) who reported that application of N at 150 kg ha^{-1} gave the best results with regard to leaf length. Singh and Chaure (1999) mentioned that leaf length increased up to 150 kg N ha^{-1}. The effect of variety in leaf length was also highly significant. Maximum leaf length (48.00 cm) was recorded in Phulkara, while the minimum leaf length (41.02 cm) was recorded in Faisalabad Early. Ghaffoor *et al.* (2002) also reported the same results in regard to the varietial effect of onion on leaf length.

Bulb diameter (cm). The effect of Nitrogen on maximum bulb diameter in different nitrogen level showed a significant variation (Table I). Maximum bulb diameter (6.04 cm) was recorder at 120 kg N ha^{-1} followed by160 and 200 kg N ha^{-1} with 5.71 and 5.40 cm, respectively. The minimum bulb diameter (3.4 cm) was observed at a control level of nitrogen, which was significantly different from other treatments. Ghaffoor *et al.* (2003) also reported that the nitrogen doze of 120 kg N ha^{-1} proved the best for the maximum bulb diameter of onion. The effect of varieties on maximum bulb diameter was not significant. Maximum bulb diameter was recorded in Shah Alam (5.14 cm) followed by the Phulkara (4.95 cm) and Faisalabad Early (4.77 cm). Ghaffoor *et al.* (2003) also reported that Shah Alam is the maximum diameter producing variety of onion.

Skin number. Table I shows that the effect of various nitrogen levels on the skin number was highly significant. The skin number decreased with an increase in Nitrogen level upto 120 kg N ha^{-1}, after which it started to rise again. Maximum skin number (3.66) was recorded at controlled level followed by skin number of 3.00 in 40 kg N ha^{-1} while minimum skin number (1.11) was observed at 120 kg N ha^{-1}. The effect of varieties on the skin number was not significant. The maximum skin number (2.38) was recorded in Shah Alam and Phulkara, while the minimum skin number (1.11) was found in Faisalabad Early.

Marketable yield/plot (kg). The highest (6.04 kg) marketable yield per plot was obtained in 120 kg N ha^{-1}, which was significantly different from other treatments, followed by 160 kg N ha^{-1} with 5.71 kg/plot (Table II). Similarly the minimum marketable yield/plot (1.38 kg) was produced from control plots. So it is clear from these results that an increase in N application beyond 120 kg N ha^{-1} is merely an increase in the cost of production. The effect of varieties on Marketable yield/plot was non-significant. However, maximum marketable yield/plot (5.14 kg) was produced in Shah Alam while minimum marketable yield per plot (4.78 kg) was noticed in Faisalabad early.

Cull percentage. The effect of nitrogen on cull percentage in different levels of nitrogen shows highly significant variation (Table II). The maximum cull percentage (0.30) was recorded at controlled level of Nitrogen, which was significantly different from other treatments. The minimum cull %age (0.12) was recorded in160 kg N ha^{-1}. The effect of varieties on cull percentage was highly significant. Maximum cull percentage (0.22) was recorded in Phulkara followed by Faisalabad Early and Shah Alam with 0.204 and 0.168, respectively.

Total yield/plot (kg). The effect of nitrogen on total yield per plot in different nitrogen levels showed a significant variation. The results showed that onion bulb yield/plot increased with an increase in the N level up to 120 kg ha^{-1}, but below this N level onion bulb yield started to decrease. The maximum yield / plot (5.23 kg) was recorded in 120 kg N ha^{-1} which was followed by the 160 and 200 kg ha^{-1} with 5.01 and 4.75 kg, respectively, while minimum yield /plot

(1.34 kg) was recorded at controlled N-level as shown in Table II. Khan *et al.* (2002) also reported that by applying a doze of 100 kg N ha^{-1}, maximum yield of onion was achieved. The effect of varieties on yield / plot was highly significant. Maximum yield per plot (4.11 kg) was observed in Shah Alam followed by the Faisalabad Early and Phulkara. Ghaffoor *et al.* (2003) also reported that Shah Alam produced the maximum total yield of onion bulb /plot.

Total yield (t ha^{-1}). The results reveal that various doses of Nitrogen had significant effect on total yield of onion (Table II). The results showed that with the increase in dose of Nitrogen up to 120 kg N ha^{-1} the yield t ha^{-1} was increased, but below this level the total yield t h^{-1} begins to decrease. The maximum yield (20.11 t ha^{-1}) was produced in 120 kg N ha^{-1} closely followed by 160 and 200 kg N ha^{-1} with 19.55 and 18.27 t ha^{-1}, respectively. While the minimum yield (5.18 t ha^{-1}) was observed at controlled N level. Among the varieties maximum yield (15.79 t ha^{-1}) was recorded in Shah Alam followed by Faisalabad Early. Similarly the minimum yield (13.45 t ha^{-1}) was recorded in Phulkara. The results are in the agreement with Abbes *et al.* (1995).

Benefit cost ratio (B.C.R.). The results showed that different Nitrogen dozes as well as varieties significantly affected B.C.R. of the crop. The fertilizer dose of 120 kg N ha^{-1} gave the highest benefit cost ratio (1.9). While the lowest benefit cost ratio (0.5) was recorded at controlled level of nitrogen. Similarly highest benefit cost ratio (2.1) was recorded in Shah Alam, followed by Faisalabad Early and Phulkara.

CONCLUSION

It was concluded that onion variety Shah Alam is the best variety and 120 kg N ha^{-1}optimum dose for obtaining maximum onion growth and yield under the agro-climatic condition of Dera Ismail Khan.

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