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Effect of Different Npk Levels on the Growth and Yield of Three Onion (*Allium cepa* L.) Varieties

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Abstract: Three different Onion varieties i.e. Faisalabad Early, Phulkara and Shah Alam were compared at different NPK levels. Varieties, NPK levels and their interaction significantly affected plant height, leaf length, number of leaves per plant bulb diameter, marketable yield and total yield per hectare. Shah Alam variety at the fertilizer level of 150:100:50 NPK kg ha^{-1} gave the best results with regard to number of leaves per plant (17.57), bulb survival (93.53%), bulb diameter (7.40 cm), marketable yield (3.25 kg $plot^{-1}$), culls percentage (5.24%) and total yield (13.20 t ha^{-1}), while Phulkara variety gave the best results with regard to plant height (56.17 cm) and leaf length (50.27cm) under the same fertilizer level. However, the highest benefit cost ratio of 2.55 was obtained by Shah Alam at the fertilizer level of 120:50:50 NPK kg ha^{-1} as this treatment was not significantly different from that of 150:100:50 NPK kg ha^{-1}. So the highest net return was obtained at 120:50:50 NPK kg ha^{-1}.

Key words: Onion, varieties, NPK, yield, bulb

Introduction

The onion (*Allium cepa* L.) is a herbaceous biennial plant and a member of the Amaryillidaceae (Alliaceae) family. The onion develops distinct bulb. According to the variety, these bulbs vary in size (small, medium and large), colour (white, yellow, or red), shape (flattened, round or globular), texture (fine, or coarse and pungency). The crop is grown for consumption in green state and as mature bulbs. 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. 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. Different levels of nutrients affect the yield and taste of the bulbs even within a variety. The essential nutrients especially, the primary macro nutrients nitrogen, phosphorus and potassium (NPK) are necessary for plant growth, development and yield.

Madan and Sandhu (1985) reported that an excellent plant growth and maximum bulb and dry matter yield in onion were obtained with the application of N: P_2O_5 : K_2O at 120:60:60 kg ha^{-1}. Henriksen (1987) reported that the yield of marketable onion bulbs increased with N application up to 120 kg ha^{-1}. Patel and Patel (1990) reported that the bulb yield increased with increasing N application rate up to 90 kg ha^{-1}. Pandy and Ekpo (1991) observed that maximum bulb yield (460.2 t ha^{-1} and average bulb weight (197.8 gm) were obtained with 120 kg ha^{-1}. Patel and Vachhani (1994) found that yield increased with the rate for N and P, but did not differ significantly with the rate of K application. Pandey *et al.* (1994) reported that both 80 and 120 kg N ha^{-1} gave significantly higher yield than the lower fertilizer rates. Kumar *et al.* (1998) reported that N at 150 kg ha^{-1} gave the best result with regard to plant height, leaf length and diameter of the longest leaf, diameter of the thickest stem, number of leaves per plant, plant spread, bulb maturity time, bulb diameter, bulb FW and DW, length of the longest root and bulb yield. Halder *et al.* (1998) observed that combined application of N and P at higher rates produced excellent performance. Singh and Mohanty (1998) recommended rates for commercial onion production are 160 kg N, 80 kg K_2O and 60 kg P_2O_5 ha^{-1}. Singh *et al.* (2000) concluded that onion productivity could be enhanced considerably by application of 100 kg N, 30.8 kg P and 83 kg K ha^{-1}.

Keeping in view these aspects, the present research work was initiated to determine the optimum dose of NPK fertilizer for onion and to select a best variety among the other which give higher yield with qualitative characters under the agro climate conditions of D.I. Khan.

Materials and Methods

The experiment was conducted at the Research Area of the Faculty of Agriculture, Gomal University, D.I.Khan. The experiment was laid out in split plot design with three

replications, randomizing the varieties in main plots while fertilizer treatments in sub plots keeping the net plot size of 2.60 m^2. Three different varieties of onion were used.

V1 = Faisalabad Early, V2 = Phulkara and V3 = Shah Alam.

Seeds were planted on the 10th of November 2000 and were placed in lines 10 cm apart and were slightly covered with soil and irrigated with the help of sprinkler. Six different levels of NPK fertilizer for three varieties were applied in each replication at the time of transplanting. Urea (46% N), single super phosphate (18% P_2O_5) and muriate of potash (60% K_2O) were used for N, P and K, respectively. Nitrogen was applied in spilt doses, half at the time of transplanting and the rest of the half was applied one month after transplanting. Six different NPK levels were

T1= (00-00-00 kg ha^{-1} NPK), T2= (60-30-30 kg ha^{-1} NPK), T3= (90-50-30 kg ha^{-1} NPK), T4= (120-50-30 kg ha^{-1} NPK), T5= (150-100-50 kg ha^{-1} NPK) and T6= (180-100-100 kg ha^{-1} NPK).

The seedlings were transplanted from nursery to the already prepared field with row to row distance of 30 cm and plant to plant distance of 10 cm. All recommended cultural practices were adopted uniformly according to crop requirements.

Data were recorded by selecting plants randomly from each treatment plot and average was calculated for the statistical analysis. The parameters under study were plant height (cm), leaf length, number of leaves per plant, bulb survival percentage, bulb diameter (cm), marketable yield per plot (kg), culls percentage, total yield per hectare (tones). The mean data were subjected to the Analysis of Variance Technique (Steel and Torrie, 1984) using the "MSTATC" Computer software package. Duncan's Multiple Range Tests (Duncan, 1955) was adopted for comparing their means among the treatments showing significant difference.

Results and Discussion

Plant height (cm): The highly significant data pertaining to plant height of the three varieties of onion as affected by different NPK levels (Table 1) revealed that Phulkara showed tallest plant height (50.63 cm) followed by Shah Alam and Faisalabad Early with 48.18 and 44.22 cm respectively.

In case of fertilizers, the NPK doses affected the vegetative growth, so NPK application increased the height of the plants. T5 (150:100:50 NPK kg ha^{-1}) resulted in the tallest plant height (52.64 cm), closely followed by T6 (180:100:100 NPK kg ha^{-1}) and T4 (120:50:50 NPK kg ha^{-1}) with 52.55 and 51.51 cm plant height (Table 1). All these three treatments were statistically at par to each other. Whereas, the lowest plant height was recorded in T1 (Control Plot) as 36.92 cm. The interaction between treatments and varieties was also significant.

Thus, the present results are in agreement with Pandy and

Table 1: Plant height (cm), Leaf length (cm) and number of leaves per plant as affected by varieties and NPK levels

Treatments NPK doses kg ha^{-1}	V1 Faisalabad Early	V2 Phulkara V2	V3 Shah Alam	Means
Plant height (cm)				
T1 (00-00-00)	34.60	36.57	36.60	36.92d
T2 (60-30-30)	39.53	46.77	48.03	44.77c
T3 (90-50-30)	43.37	49.60	49.77	47.58b
T4 (120-50-50)	48.50	55.36	50.66	51.51a
T5 (150-100-50	49.73	56.17	52.67	52.64a
T6 (180-100-100)	49.60	56.10	51.97	52.55a
Means	44.22c	50.63a	48.18b	
Leaf length (cm)				
T1 (00-00-00)	27.57	34.57	30.27	30.80d
T2 (60-30-30)	34.50	46.37	37.03	39.30c
T3 (90-50-30)	37.30	48.30	43.03	43.14b
T4 (120-50-50)	40.93	49.67	48.37	46.32a
T5 (150-100-50	43.30	50.27	49.50	47.69a
T6 (180-100-100)	49.60	50.17	49.47	47.69a
Means	37.89c	46.55a	43.08b	
Number of leaves/plant				
T1 (00-00-00)	11.30	11.87	13.93	12.37e
T2 (60-30-30)	11.57	12.50	15.40	13.16d
T3 (90-50-30)	12.97	14.17	16.23	14.46c
T4 (120-50-50)	15.70	16.03	16.83	16.18b
T5 (150-100-50)	16.40	17.50	17.57	17.15a
T6 (180-100-100)	16.33	17.47	17.50	17.10a
Means	14.04c	14.92b	16.24a	

Table 2: Bulb survival percentage, bulb diameter (cm) and cull percentage as affected by varieties and NPK levels

Treatments NPK doses kg ha^{-1}	V1 Faisalabad Early	V2 Phulkara V2	V3 Shah Alam	Means
Bulb survival percentage				
T1 (00-00-00)	66.47	73.50	71.17	70.38c
T2 (60-30-30)	79.17	57.00	81.17	72.39c
T3 (90-50-30)	64.46	66.50	83.03	72.33c
T4 (120-50-50)	70.63	74.50	85.07	76.73b
T5 (150-100-50	71.60	76.66	93.53	80.60a
T6 (180-100-100)	68.46	82.00	90.50	80.32a
Means	70.13b	71.69b	84.18a	
Bulb diameter (cm)				
T1 (00-00-00)	4.10	5.03	5.10	4.74e
T2 (60-30-30)	4.30	5.27	5.37	4.98d
T3 (90-50-30)	5.63	6.70	6.47	6.27c
T4 (120-50-50)	6.66	7.03	7.33	7.11a
T5 (150-100-50	7.10	7.17	7.40	7.22a
T6 (180-100-100)	6.93	6.83	7.23	7.00b
Means	5.79b	6.37a	6.48a	
Cull percentage				
T1 (00-00-00)	19.90	14.19	10.86	15.06a
T2 (60-30-30)	15.48	11.31	7.10	11.29b
T3 (90-50-30)	12.78	9.90	6.79	9.86bc
T4 (120-50-50)	10.58	8s.19	5.84	8.17c
T5 (150-100-50	10.18	7.95	5.24	7.79c
T6 (180-100-100)	10.24	7.98	5.26	7.82c
Means	13.19a	9.90b	6.85c	

Means followed by similar letters are not significantly different at 5% probability level.

Table 3: Marketable yield per plot (kg), Total yield per hectare (ton) and Benefit cost ratio as affected by varieties and NPK levels

Treatments NPK doses kg ha^{-1}	V1 Faisalabad Early	V2 Phulkara V2	V3 Shah Alam	Means
Marketable yield per plot (kg)				
T1 (00-00-00)	1.45	1.75	1.98	1.73d
T2 (60-30-30)	1.94	2.28	3.09	2.44c
T3 (90-50-30)	2.32	2.55	3.16	2.68b
T4 (120-50-50)	2.70	2.84	3.22	2.92a
T5 (150-100-50	2.73	2.89	3.25	2.96a
T6 (180-100-100)	2.72	2.88	3.24	2.95a
Means	2.31c	2.53b	2.99a	
Total yield per hectare (tonns)				
T1 (00-00-00)	6.96	7.86	8.33	7.72d
T2 (60-30-30)	8.86	9.87	12.82	10.52c
T3 (90-50-30)	10.23	10.87	13.00	11.37b
T4 (120-50-50)	11.63	11.88	13.17	12.23a
T5 (150-100-50	11.68	12.08	13.20	12.33a
T6 (180-100-100)	11.63	12.05	13.16	12.28a
Means	10.17c	10.77b	12.28a	
Benefit cost ratio				
T1 (00-00-00)	2.20	2.23	2.24	2.223
T2 (60-30-30)	1.96	1.97	2.02	1.983
T3 (90-50-30)	2.18	2.19	2.25	2.206
T4 (120-50-50)	2.50	2.53	2.55	2.526
T5 (150-100-50	2.29	2.30	2.32	2.303
T6 (180-100-100)	2.04	2.09	2.10	2.076
Means	2.195	2.218	2.246	

Means followed by similar letters are not significantly different at 5% probability level.

Ekpo (1991) who reported that highest plant height was obtained with 160 kg N ha^{-1}. Singh and Mohanty (1998) reported that N and K at 160 and 80 kg ha^{-1} resulted in the tallest plant.

Leaf length (cm): A careful observation of the results revealed that both varieties and fertilizer levels as well as their interaction were highly significant.

All the three varieties were significantly different from one another. Phulkara gave the longest leaf length (46.55 cm) followed by Shah Alam (43.08 cm) and Faisalabad Early (37.89 cm) as shown in Table 1.

In case of different fertilizer application T5 (150:100:50 NPK kg ha^{-1}) and T6 (180:100:100 NPK kg ha^{-1}) produced the longest leaf length (47.69 cm) which was at par with T4 (120:50:50 NPK kg ha^{-1}) with leaf length of 46.32 cm. The shortest leaf length (30.80 cm) was observed in control, and was significantly different from fertilizer treatments. The result revealed that an increase in fertilizer application caused an increase in leaf length of onion varieties. The interaction between varieties and NPK doses was also significant.

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}.

Number of leaves per plant: As Table 1 showed that all the three varieties were significantly different form one another. Shah Alam gave maximum number of leaves per plant (16.24) followed by Phulkara (14.92) and Faisalabad Early (14.04), respectively.

As far as the fertilizer levels are concerned, T5 (150:100:50 NPK kg ha^{-1}) gave maximum number (17.15) leaves per plant, which was at par with T6 (180:100:100 NPK kg ha^{-1}) with 17.10 leaves per plant and significantly different from T4 (120:50:50 NPK kg ha^{-1}) producing 16.18 leaves per plant. The significantly minimum number of leaves/plant (12.37) was observed in control. Further increase in the NPK dose resulted in the decline of leaves. The interaction between varieties and NPK doses was also significant.

These results are further supported by Baloch *et al.* (1991) who reported that the highest number of leaves per plant (17.0) was obtained with 125-100 NK kg ha^{-1}. Singh and Mohanty (1998) also reported that number of leaves per plant were greatest with 160-80 NK kg ha^{-1}.

Bulb survival percentage: The data regarding bulb survival percentage revealed that all the three varieties had significantly affected bulb survival percentage (Table 2). Shah Alam gave maximum bulb survival percentage (84.18%) followed by Phulkara and Faisalabad Early with 71.69 and 70.13 percent, respectively. Phulkara and Faisalabad Early were not significantly different from each other.

The NPK dose increased bulb survival percentage. Maximum bulb survival percentage (80.60%) was recorded in T5 (150-100-50 NPK kg ha^{-1}) closely followed by T6 (180-100-100 NPK kg ha^{-1}) with 80.32 % bulb survival. Further increase in the NPK doses resulted in the decline of bulb survival percentage. The interaction between varieties and NPK doses was remained non significant.

These results are in accordance with those of Ajay *et al.* (2000) also reported that application of 75 kg P gave the best seedling survival.

Bulb diameter (cm): The data pertaining to bulb diameter showed that all the three varieties affected significantly bulb diameter (Table 2). Shah Alam produced the largest bulb diameter (6.48 cm) which was at par with Phulkara (6.37 cm), while Faisalabad Early gave the smallest bulb diameter (5.79 cm).

The NPK doses increased significantly bulb diameter. T5 (150:100:50 NPK kg ha^{-1}) produced the largest bulb diameter (7.22 cm) which was at par with T4 (120:50:50 NPK kg ha^{-1}) with bulb diameter (7.11 cm). Further increase in the NPK dose showed decline in the bulb size. The smallest bulb diameter (4.74 cm) was produced by

control and was significantly different from fertilizer treatments.

As far as the interaction is concerned, the two factors interacted significantly with each other. The largest bulb diameter was observed by Shah Alam in T5 (150:100:50 NPK kg ha^{-1}) followed by T4 (120:50:50 NPK kg ha^{-1}) and T6 (180:100:100 NPK kg ha^{-1}), respectively of the same variety. These results were confirmed by Madan and Sandhu (1985) who mentioned that maximum bulb diameter was obtained with the application of N:P_2O_5 : K_2O at 120:60:60 ha^{-1}. Mangrio *et al.* (1987) suggested that the highest dose of 100 kg P_2O_5 ha^{-1} gave heavier bulb diameter.

Culls percentage: All the three varieties were significantly different from one another. Faisalabad Early produced significantly maximum culls (13.19%), followed by Phulkara (9.90%) and Shah Alam (6.85%) as shown in Table 2.

The NPK doses decreased culls percentage significantly. Control gave significantly maximum culls (15.06%) followed by T2 (60:30:30 NPK kg ha^{-1}) with 11.29%. Minimum culls (7.79%) were observed in T5 (150:100:50 NPK kg ha^{-1}) which was at par with T6 (180:100:100) and T4 (120:50:50) with 7.82% and 8.17%, respectively. The interaction between treatments and varieties was found non significant.

Marketable yield per plot (kg): The data concerning marketable yield per plot showed that all the three varieties affected significantly marketable yield per plot. Shah Alam gave the highest marketable yield (2.99 kg per plot) followed by Phulkara (2.53 kg) and Faisalabad Early (2.31 kg) (Table 3). The NPK doses increased marketable yield per plot significantly. Highest marketable yield (2.96 kg) was rercorded in T5 (150-100-50 NPK kg ha^{-1}) which was at par with T6 (180:100:100 NPK kg ha^{-1}) and T4 (120:50:50 NPK kg ha^{-1}) with 2.95 kg and 2.92 kg marketable yield per plot, respectively. The lowest marketable yield (1.73 kg per plot) was produced in control and was significantly different fertilizer treatments. As far as the interaction is concerned, the two factors interacted significantly between each other. The highest marketable yield (3.25 kg) was observed in Shah Alam with fertilizer level (150:100:50 NPK kg ha^{-1}). These results are in agreement with Henriksen (1987) who reported that the yield of marketable onion bulbs increased with N application up to 120 kg ha^{-1}. Singh *et al.* (1997) reported that 100:50: 50NPK kg ha^{-1} increased the marketable yield. El-Rehim (2000) reported that application of P_2O_5 increased marketable yield.

Total yield ha^{-1} (tonnes) : All the three varieties were significantly different from one another. Shah Alam produced the significantly highest yield (12.28 t ha^{-1}) followed by Phulkara (10.77 t ha^{-1}) and Faisalabad Early (10.17 t ha^{-1})

The NPK doses increased yield per hectare significantly. Increase in NPK dose up to T5 (150: 100: 50 NPK kg ha^{-1}) resulted in the increase in total yield per hectare. Further increase in fertilizer levels declined the total yield. The interaction between these two factors was also significant.

These results are in line Gaviola *et al.* (1998) reported that the greatest total bulb yield (34.5 t ha^{-1}) was obtained with 100:30 NP kg ha^{-1}. Singh *et al.* (2000) concluded that onion productivity could be enhanced considerably by application of 100:30.8:83 NPK kg ha^{-1} .

Benefit cost ratio (B.C.R): All the three varieties were significantly different from one another. The highest benefit cost ratio (2.246) was recorded in case of Shah Alam followed by Phulkara (2.218) and Faisalabad Early (2.195). Highest benefit cost ratio (2.526) was observed in T4 (120:50:50 NPK kg ha^{-1}) followed by T5 (150:100:50 NPK kg ha^{-1}) and control with 2.303 and 2.223 kg ha^{-1}, respectively. The lowest benefit cost ratio (1.983) was observed in 60:30:30 kg ha^{-1}. These results are further supported by Vishnu and Parabhakar (1989) who reported that the benefit cost ratio was optimal at the closest spacing, N at 75 kg and P_2O_5 at 60 kg ha^{-1}. Singh *et al.* (1997) reported that the highest net return (32651 Rs ha^{-1}) was obtained with 100:25:25 NPK Kg ha^{-1}. Nagich *et al.* (1999) reported that the highest net return of Rs. 30742 ha^{-1} was recorded at 80 kg K_2O ha^{-1}.

References

Ajay, K., J.V. Singh, S. Chetan, A. Kumar and C. Singh, 2000. Influence of phosphorus on growth and yield of onion (*Allium cepa* L.). Indian J. Agri. Res., 34: 51-54.

Baloch, M.A., A.F. Baloch, G. Baloch, A.H. Ansari and S.M. Qayyum, 1991. Growth and yield response of onion to different nitrogen and potassium fertilizer combination levels. Vegetable crops. In, Horticulture. Edited by Elena Bashir Robyn Bantel National Book foundation Islamabad Pakistan, pp: 501.

Duncan, D.B., 1955. Multiple Range and Multiple F-Test. Biometrics, 11: 1-42.

El-Rehim, G.H.A., 2000. Effect of phosphorus fertilization on yield and quality of onion bulb under upper Egypt condition. Assiut-Journal of Agricultural Science El-Azhar University, Egypt, 31: 115-121.

Gaviola, S., V.M. Lipinski and L. Nijensohn, 1998. Response of onion for drying to fertilization. Ciencia-del-suelo, 16: 119-121.

Halder, N.K., M.W.U. Zaman, M.M.U. Chowdhury, M.H. Ullah and B.L. Nag, 1998. Effect of nitrogen and phosphorus on the uptake of different nutrient elements by onion bulb. Bangladesh Journal of Scientific and Industrial Res., 33: 404-408.

Henriksen, K., 1987. Effect of N and P fertilization on yield and harvest time in bulb onion, (*Allium cepa* L.). Acta Hort., 198: 207-2 15.

Kashi, A. and B.R. Frodi, 1998. Effects of nitrogen on the yield, quality and storability of edible onion cultivars *(Allium cepa* L.). Iranian J. Agri. Sci., 29: 589-597.

Kumar, H., J.V. Singh, K. Ajay, S. Mahak, A. Kumar and M. Singh, 1998. Studies on the influence of nitrogen on growth and yield of onion Cv. Patna Red. Indian J. Agric. Res., 32: 88-92.

Madan, S.P.S. and J.S. Sandhu, 1985. Infuluence of nitrogen, phosphorus and potash levels on the growth, bulb yield and dry matter production of white onion variety Punjab-48 Punjab Veg. Grower, 20: 17-24.

Mangrio, H.K., A.F. Baloch and M.A. Baloch, 1987. The size and yield of onion bulbs in response to application of phosphorus (P_2O_5) and potassium (K_2O). Sarhad J. Agri. 3: 477-483.

Nagich, K.N., S.K. Trivedi, L. Rajesh and R. Lekhi, 1999. Effect of sulphur and potassium fertilization in onion *(Allium cepa* L.). Horticulture J. India 12: 25-31.

Patel, J.J. and A.T. Patel, 1990. Effect of nitrogen and phosphorus levels on growth and yield of onion *(Allium cepa* L.) cultivar Pusa Red Gujrat Agri. Uni. Res. J., 15: 1-5.

Patel, Z.G. and M.U. Vachhani, 1994. Effect of NPK fertilization on the yield and quality of onion. Horticultural Journal, 7: 75-77.

Pandey, U.B., D.S. Panwar and V.P. Sharma, 1994. Effect of spacings and levels of nitrogen on growth and seed yield of kharif onion. Seed Research, 20: 147-148.

Pandy, U.C. and U. Ekpo, 1991. Response of nitrogen on growth and yield of onion *(Allium cepa* L.) in Maidaguri region of Borno state, Nigeria Res. and Development Report, 8: 5-9.

Singh, J. and N.K. Chaure, 1999. Effect of age of seedling and nitrogen levels on growth and yield of onion *(Allium cepa* L.). Advances in Horticulture and Forestry, 6: 73-77.

Singh, L., S.R. Bhonde and V.K. Mishra, 1997. Effect of different organic manures and inorganic fertilizers on yield and quality of Rabi onion. Newsletter, National Horticultural Research and Development Foundation India, 17: 1-3.

Singh, R.P., N.K. Jam and B.L. Poonia, 2000. Response of Kharif onion to nitrogen, phosphorus and potash in eastern plains of Rajasthan. Indian J. Agri. Sci., 70: 871-872.

Singh, S.P. and C.R. Mohanty, 1998. A note on the effect of nitrogen and potassium on the growth and yield of onion. Orissa J. Horti., 26: 70-71.

Steel, R.G.D and T.H. Torrie, 1984. Principles and procedures of statistics. 2nd. ed. McGraw Hill Book Co. Singapore, 172-177.

Vishnu, S. and B.S. Parabhakar, 1989. Response of onion to spacing, nitrogen and phosphorus levels. Indian J. Horti., 46: 379-381.