http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (12): 2069-2071, 2000

Onion Yield and Yield Components as Function of the Levels of Nitrogen and Potassium Application

Noman Syed[1], Muhammad Munir[1], Atiq Ahmed Alizai[2] and Abdul Ghaffoor[1]
[1]Department of Horticulture, Faculty of Agriculture, Gomal University, D.I. Khan, Pakistan
[1]Agricultural Research Institute, D.I. Khan, Pakistan

Abstract: Experiment was conducted to study the effect of FYM only and different combinations of nitrogen and potassium on the onion bulbs (var. Swat-I) production. Phosphorous at 100 kg ha^{-1} was used as a constant dose. Treatments included control, FYM only, 0-100-90, 60-100-90, 90-100-90, 120-100-90, 90-100-0, 90-100-60 and 90100-120 kg NPK ha^{-1}. Control plots and those treated with FYM produced maximum number of culls (un-marketable bulbs) i.e. 29,25 and 27.75 per plot, respectively. Application of fertilizers reduced the number of culls per plot. No significant differences were found among the treatments for bulbs obtained with thick neck. However, increasing rate of N resulted in greater number of thick neck bulbs. Number of double bulbs counted were also increased with the increase of nitrogen. High nitrogen dose improved the bulb size significantly. Greater number of small-sized bulbs were produced from the plots received no fertilizer or FYM only. Significantly highest yield (14.04 t ha^{-1}) was obtained from the plots treated with maximum amount of N (120-100-90). All treatments did not show any significant effect on the percent moisture content, dry weight and TSS.

Key words: Onion, nitrogen, potassium, FYM, growth, yield

Introduction

As with any crop, the success of onion production is dependent on soil nutrients. Different levels of nutrients affect the yield and taste of the bulbs even within a variety. Higher rate of nitrogen with an optimum dose of potassium increases onion yield (Rehman *et al*., 1978). A deficiency of nitrogen will reduce the size of onion bulbs by accelerating their development. Conversely, excess nitrogen can cause a shift in the normal maturity index, which increases bulb size and delays maturity. Generally, excess nitrogen application increases the yield of bulbs and lowers the storage quality, while phosphorus and potassium improve it. In D.I. Khan the production of onion bulbs is low due to improper utilization of fertilizers by the growers. Taking in view the above mentioned situations, this experiment was conducted to determine the optimum dose of nitrogen and potassium for higher yield of onion bulbs. Shukla *et al*. (1989) reported that highest bulb weight and yield of cvs. 'Arka Kalyan' and 'Arka Niketan' obtained by high application of N (120 to 160 kg ha^{-1}) while Jayabharathi (1989) recommended 75 kg NPK ha^{-1} for obtaining maximum onion yield. Patel and Patel (1990) reported that bulb yield increased with increasing N application rate up to 90 kg ha^{-1}. From a trial, Pandey and Ekpo (1991) concluded that highest plant height and number of leaves per plant were obtained with 160 kg N ha^{-1} while maximum yield and bulb weight were obtained with 120 kg N ha^{-1} Baloch *et al*. (1991) reported highest yield of cv. 'Pulkara' with 125 kg N + 75 kg K_2O ha^{-1} while highest plant height, number of leaves per plant and bulb weight were obtained with 125 kg N + 100 kg K_2O ha^{-1}. In a trial, Porwal and Singh (1993) evaluated three levels of N (50, 100 and 150 kg N ha^{-1}) and concluded that yield increased with increasing nitrogen levels. Similarly, Singh *et al*. (1994) recommended that N at 80 kg N ha^{-1} for higher yield, bulb weight and total dry weight of onion cv. 'Pusa Red'.

Materials and Methods

The trial was conducted at Agricultural Research Institute, Dera Ismail Khan during the year 1996. The experiment was laid out on the methodology of Randomized Complete Block Design having tour replications. Each block was then divided into nine plots (Treatments). The treatments included FYM (36 ton ha^{-1}), NPK at 0-0-0, 0-100-90, 60-100-90, 90-100-90, 120-100-90, 90-100-0, 90-100-60 and 90-100-120 kg each ha^{-1}, in addition to control.

Before transplantation, soil samples were analysed at Soil Analysis Laboratory, Agricultural Research Institute, Dera Ismail Khan. The experimental plot had clay loam soil with pH 8.5, organic matter 0.80% with 5 ppm phosphorus, 120 ppm potassium and 0.02% nitrogen.

Uniform eight weeks old seedlings of variety Swat-I were transplanted on February 19, 1996. Rows were spaced at 30 cm and plant to plant distance was maintained at 30 cm. After transplanting, the seedlings were irrigated immediately. The sources of fertilizers for nitrogen, phosphorus and potash were urea, single super phosphate and potassium sulphate. respectively. Nitrogen fertilizer was applied in two split doses. First dose along with phosphorus and potash was applied at the time of transplantation while the remaining half was applied 30 days after transplantation.

All the data were analysed statistically by using analysis of variance method (Le Cierg *et al*., 1972). To test the differences among means procedure of Duncan's Multiple Range Test was adopted (Steel and Torrie, 1980). All statistical analysis were made by using computer software MSTATC.

Results and Discussion

Number of Leaves per plant: Leaf is an important parameter to study the growth of any crop. Number of leaves therefore were counted to examine the effects of several fertilizer rates on the onion plant growth. Though statistically non-significant, data in Table 1 indicate that the application of fertilizer either organic and inorganic improved the plant growth. Maximum number of leaves were counted in plots applied with 60-100-90, 90-100-90, 120-100-90, 90-100-0 and 90-100-120 kg ha^{-1} of NPK. These treatments produced almost similar number of leaves/plant i.e. 7.00, 7.50, 7.50 and 7.50, respectively. Plots with no fertilizer application showed minimum number of leaves (6.00 per plant). Applying FYM also increased number of leaves i.e. 7.25 leaves/plant. It seems to be true that higher nitrogen rates help in improving plant growth as Baloch *et al*. (1991) has also reported almost similar findings. They reported that maximum number of leaves per plant was obtained with 125 kg N and 100 kg K_2O ha^{-1}.

Table 1: Effect of N and K on plant height, number of leaves, small and large bulbs per plant

Treatments		Number of leaves per plant	Plant height (cm)	Number of small bulbs per plot	Number of large bulbs per plot
T_1	Control	6.00	30.98	63.00	4.50d[1]
T_2	FYM	7.25	34.28	66.75	10.75cd
T_3	0-100-90	6.75	33.43	63.50	13.75bcd
T_4	60-100-90	7.00	38,00	41.75	32.00a
T_5	90-100-90	7.50	32.98	59.25	12.75bcd
T_6	120.100-90	7.50	35.70	59.75	21.75abc
T_7	90-100-0	7.50	37.33	51.00	26.75ab
T_8	90-100-60	6.75	33.48	62.25	14.75bcd
T_9	90-100-120	7.50	35.68	62.25	17.75abcd

[1]Means followed by different letters are significantly different at 5% level of probability using DMRT

Table 2: Effect of N and K on number of culls, thick neck, double bulbs and total bulbs survived per plant

Treatments		Number of culls	Number of thick neck	Number of double bulbs	Total bulbs survived per plant (%)
T_1	Control	29.25 a[1]	12.25	0.25b[1]	67.98
T_2	FYM	27.75 ab	11.25	1.50ab	73.13
T_3	0-100-90	22.75 abc	12.75	0.50b	64.58
T_4	60.100-90	9.25 d	9.75	2.00ab	68.58
T_5	90-100-90	20.00 abcd	14.25	0.25b	66.55
T_6	120-100-90	14.00 cd	14.00	3.00a	70.33
T_7	90-100-0	12.00 cd	10.00	0.75h	62.80
T_8	90-100-60	16.50 bcd	9.50	0.25h	64.53
T_9	90-100-120	22.25 abc	9.25	0.75b	71.25

[1]Means followed by different letters are significantly different at 5% level of probability using DMRT

Table 3: Effect of N and K on yield it/ha), moisture, dry weight and total soluble solids percentage

Treatments		Yield (t/ha)	Moisture (%)	Dry weight (%)	T.S.S. (%)
T_1	Control	4.80 d[1]	86.40	13.60	8.12
T_2	FYM	8.70 bcd	86.55	13.45	8.12
T_3	0-100-90	6.68 cd	87.35	12.65	6.53
T_4	60-100-90	12.81 ab	88.30	11.70	8.44
T_5	90-100-90	6.34 cd	87.80	12.20	6.88
T_6	120-100-90	14.04 a	86.95	13.05	7.81
T_7	90-100-0	9.86 abc	86.00	14.00	9.06
T_8	90.100-60	6.89 cd	86.15	13.85	8.12
T_9	90-100-120	8.29 bcd	86.90	13.10	7.50

[1]Means followed by different letters are significantly different at 5% level of probability using DMRT

Plant height (cm): The data in Table 1, Col. 3 indicate that there were no significant differences among the treatments. However, it was observed that plots which received different fertilizers produced taller plants as compared to control that showed minimum plant height i.e. 30.98 cm. Maximum plant height (38.00 cm) was obtained with 60-100-90 kg ha^{-1} followed by combination 90-100-0 137.33 cm) and 120-10090 (35.70 cm). Slight improvement in plant height (34.28 cm) was also observed in Treatment-2 (FYM only) as compared to the treatment with no fertilizer. These results are in line with Baloch *et al*. (1991) who obtained maximum height of 38.50 cm with 125 kg N/ha + 100 kg K_2O/ha.

Number of small bulbs/plot: Bulbs harvested were graded into two sizes i.e. small (up to 3 cm in diameter) and large (3 to 5 cm in diameter). Statistical analysis of the data in Table 1 revealed that number of small bulbs per plot was not significantly affected by different fertilizer levels. However greater number of small sized bulbs was produced from the plots received no fertilizer or FYM only. Plots with zero nitrogen also showed maximum number of small sized bulbs i.e. 63.50 bulbs per plot which is similar to bulbs produced by control. Minimum number of small bulbs/plot (41.75) were counted with 60-100-90 combination of NPK kg ha^{-1}. These results corroborate with the report of Patil *et al*. (1986) who concluded that bulb diameter was the largest (6.344) with nitrogen at 150 kg ha^{-1}.

Number of large bulbstplot: Observation of the data presented in Table 1 Col.5 indicated that high nitrogen dose improved the bulb size significantly. Maximum large sized bulbs (32.00 per plot) were noted in plots received 60-100-90 NPK ha^{-1} followed by 90-100-0 (26.75), 120-100-90 (21.75). 90-100-120 (17.75), 90-100-60 (14.75), 0-100-90 (13.75) and 90-100-90 (12.75). While control and FYM only produced minimum number of large bulbs i.e. 4.50 and 10.75 per plot, respectively. Results obtained for smaller sized bulbs support these results of larger bulbs that treatments with no fertilizer or low nitrogen rates produced greater number of smaller bulbs and lesser number of larger bulbs. The results of Patil *et al*. (1986) are of primary importance who in a trial on onion cv. 'White Local' concluded that bulb diameter was largest with N at 150 kg ha^{-1} as compared to the bulbs obtained from control.

Number of culls: Data regarding number of culls (unmarketable bulbs) are presented in Table 2. It was observed that increase in nitrogen decreased the number of culls produced. Minimum number of culls (9.25 per plot) were counted in plots receiving NPK at 60-100-90 kg ha^{-1}. Control plots produced maximum number of culls (29.25) while plots received only FYM produced almost similar to that of control. Similar findings have been obtained by Henriksen (1987) who reported that the yield of marketable onion bulbs increased with nitrogen application.

Number of thick neck bulbs: A glance of the data in Table 2 revealed non significant differences among the various treatments. However, it was observed that increasing rate of nitrogen resulted in greater number of thick neck bulbs. It is the only disadvantage of applying nitrogen at higher rates. Thick neck bulbs are susceptible to several diseases during storage. However as it is mentioned earlier that differences found among the various treatments were non-significant.

Maximum number of thick neck bulbs (14.25 per plot) was observed in plots applied with 90-100-90 kg ha^{-1} NPK. Treatments 60-100-90, 90-100-0, 90-100-60 and 90-100-120 kg ha^{-1} produced almost similar number of thick neck bulbs i.e. 9.75, 10.00, 9.50 and 9.25, respectively. Almost similar number of thick neck bulbs counted in plots received no fertilizer and plots with zero nitrogen (T_3). It is clear that increasing rate of nitrogen resulted in greater number of thick neck bulbs but not significantly while highest level of potassium resulted in minimum number of thick neck bulbs.

Number of double bulbs: Data in Table 2 showed that different fertilizer levels significantly affected the number of double bulbs. It was observed that number of double bulbs counted increased with increase in amount of nitrogen applied. Maximum number of double bulbs were obtained from Treatment-6 (3.00 per plot). Almost similar results have been obtained from treatment T_1, T_3, T_4, T_7, T_8 and T_9 i.e. 0.25. 0.50, 0.25, 0.75, 0.25 and 0.75, respectively. Application of FYM only (T_2) produced a little bit increase in number of double bulbs as compared to control (T_1,). Although maximum number of doubles were. recorded from plots received higher nitrogen rates but it was only 5 bulbs per plot. Hassan (1984) observed that increasing nitrogen application increased bulb doubling in onion while the application of potassium showed minimum number of double bulbs.

Total bulbs survived/plot: Percent survival was calculated from the total seedlings planted and plants survived at the end of growing season. Statistical analysis of the data in Table 2 revealed that total bulbs survived per plot was not significantly affected by different fertilizer levels. However, maximum number of total bulbs survived (73.13%) were recorded in Treatment-2 (FYM only) while 120-100-90 and 90-100-120 kg ha^{-1} also exhibited maximum survival numbers i.e. 70.33 and 71.25, respectively. Minimum bulb survival data (62.80) was recorded in 90-100-0 kg ha^{-1}. From the table it can be generalized that both organic as well as inorganic fertilizer resulted in increased total bulbs survived/plot as compared to control. Rehman *et al*. (1978) found similar results.

Yield in ton per hectare: The data presented in Table 3 revealed that significantly highest yield was obtained from the plots treated with maximum amount of nitrogen and the lowest from plots with no fertilizer at all. Plots fertilized with NPK at the rate of 120-100-90 kg ha^{-1} produced maximum yield i.e. 14.04 t ha^{-1} followed by 60-100-90, 90-100-0, 90-100-120, 90-100-60, 0-100-90 and 90-100-90 kg ha^{-1} producing yield of 12.81, 9.86, 8.29, 6.89, 6.68 and 6.34 t ha^{-1}, respectively. Slight increase in yield (8.70 t ha^{-1}) was also observed in T_2 (FYM only) as compared to T_1 (control). Almost similar results have been reported by Hegde (1986), Shukla *et al*. (1989), Pandey and Ekpo (1991) and Porwal and Singh (1993) that yield increased with increasing nitrogen levels. Results are supported by the findings related to smaller and larger bulbs, as plots with greater number of larger sized bulbs resulted in higher yield.

Moisture percentage: Data pertaining to moisture percentage are given in Table 3 which indicated non significant differences among all treatments. However, maximum moisture (88.30%) was observed in bulbs of Treatment-4 followed by T_5 (87.80%) and T_3 (87.35%). While the remaining treatment i.e. control, FYM only, 120-100-90, 90-100-0, 90-100-60 and 90-100-120 kg ha^{-1} showed similar results i.e. 86.40, 86.55, 86.95, 86.00, 86.15 and 86.90 percent, respectively.

Dry weight percentage: Table 3 also showed that different fertilizer levels did not significantly affect the percent dry weight. However, treatment-7 showed maximum dry weight percentage i.e. 14.00% while minimum was observed in (11.70%) T_3 and T_5 showed similar bulb dry weight percentage. Likewise, control, FYM only 120-100-90, 90-100-60 and 90-100-120 kg ha^{-1} showed almost same results i.e. 13.60, 13.45, 13.05, 13.85 and 13.10 percent, respectively.

Percent TSS: Data recorded for percent total soluble solids are given in Table 3 which revealed non significant differences among the treatments. Highest percent TSS was observed in bulbs of T_7 i.e. 9.06% while that of the lowest in T_3 (6.56%) and closely followed by T_5 (6.87%). Almost similar percent TSS was observed in T_6 and T_9 i.e. 7.81% and 7.50%, respectively. The results showed by control, FYM only, 60-100-90 and 90-100-60 kg ha were also similar to each other. Differences among the treatments for moisture content, dry weight and total soluble solids were found non significant. It seems that fertilizers did not account in the assimilation of protein, carbohydrates etc. which should have contributed to percent dry weight or TSS.

Looking at the result obtained, it can be concluded that application of inorganic fertilizer at the rate of 120-100-90 kg/ha improved the plant growth and increased the bulb diameter hence increasing the final yield tons/ha.

References

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. Sarhad J. Agric., 7: 63-66.

Hassan, M.S., 1984. Effects of frequency of irrigation and fertilizer nitrogen on yield and quality of onions (*A. cepa*) in the arid tropics. Acta Hortic., 143: 341-346.

Hegde, D.M., 1986. Effect of irrigation and N fertilization on water relations, canopy temperature, yield and N uptake and water use of onion. Indian J. Agric. Sci., 56: 858-867.

Henriksen, K., 1987. Effect of N- and P-fertilization on yield and harvest time in bulb onions (*Allium cepa* L.). Acta Hortic., 198: 207-216.

Jayabharathi, M., 1989. Influence of different doses of NPK on the yield and quality of aggegratum onion cv. Co-4. Madras Agric. J., 78: 150-155.

Le Cierg, E.L., W.H. Leonard and A.G. Clark, 1972. Field Plot Techniques. 2nd Edn., Burgess Publishing Co., Minneapolis, USA., pp: 143.

Pandey, U.C. and U. Ekpo, 1991. Response of nitrogen on growth and yield of onion (*Allium cepa* L.) in Maiduguri region of Borno State. Niger. Res. Dev. Rep., 8: 5-9.

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 Agric. Univ. Res. J., 15: 1-5.

Patil, P.Y., V.K. Mahorkar and V.K. Patii, 1986. Effect of nitrogen, phosphorus and potash on the bulb size of onion (*Allium cepa* L.). Punjabhro Krishi Vidyapeeth Res. J., 8: 67-68.

Porwal, M.K. and M.M. Singh, 1993. Effect of nitrogen and weed management on onion (*Allium cepa*). Indian J. Agron., 38: 74-77.

Rehman, S., M.R. Talukdur and A.M. Mian, 1978. Effect of NPK on the Bulb Size and Yield of Onion. In: Vegetable Crops, Bashir, E. and R. Bantel (Eds.). National Book Foundation, Islamabad, Pakistan, pp: 501.

Shukla, V., K.P.G. Roa and B.S. Prabhakar, 1989. Effect of nitrogen on bulb yield and keeping quality of onion cultivars. Prog. Hortic., 21: 244-245.

Singh, D.K., G. Lal, P.N. Rai and G. Lal, 1994. Response to nitrogen on yield and keeping quality of onion bulb (*Allium cepa* L.). Ann. Agric. Res., 15: 407-409.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics. 2nd Edn., McGraw Hill Book Co., New York, pp: 232-249.