RESEARCH ARTICLE

EFFECT OF DIFFERENT NITROGEN LEVELS ON GROWTH AND YIELD OFPOTATO (*SOLANUMTUBERSOUM* L.) VARIETIES IN NORTHERN PLAINS OF INDIA

Amit Verma[1], A.K. Bhatia[1], V.P.S. Panghal[1] and Monika*[1]

[1]Department of Vegetable Science, CCS Haryana Agricultural University, Hisar- 125004, Haryana, India
Email: khichimonika97@gmail.com

Received-28.08.2022, Revised-09.09.2022, Accepted-21.09.2022

Abstract: This experiment was conducted at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during rabi season of 2019-20. The treatments comprising three potato varieties (KufriPukhraj, KufriGaurav, and AICRP-P-39) and four levels of nitrogen (0, 80, 160, and 240 kg/ha) were laid out in a randomized block design (factorial). The results revealed that among the various nitrogen levels, the nitrogen dose of 240 kg/ha gave superior results for various field parameters, viz., plant height at 60, 75, and 90 DAP, number of leaves per hill at harvest, leaf and stem weight per hill at harvest, the yield of tubers in different grades (up to 25, >25-50, >50-75, and >75g) per square meter and total tuber yield (q/ha), which were statistically at par with the nitrogen dose of 160 kg/ha. As far the variety is concerned, KufriPukhraj performed significantly better for all the recorded parameters. Hence, potato variety KufriPukhraj is recommended with the application of 160 kg nitrogen per hectare for cultivation in the northern plains of India.

Keywords: Growth, Nitrogen, Potato, Variety, Yield

INTRODUCTION

Potato is the most vital crop after wheat and rice and is being cultivated in over 150 nations of the world (Singh, 2008). India, being the 2nd major potato-growing nation in the world, following China, produces 50.19 million MT tubers annually over an area of 2.17 million hectares with average productivity of 23.1 MT ha^{-1}. The crop can be grown in almost all states under very diverse conditions. About 75% of the total area under potato and 80% of total production is accounted for by the states of UP, West Bengal, and Bihar. The per capita availability of potatoes in India is 17.7 kg which constitutes 1/3rd of the world average.

Potato is considered the “King of Vegetables” and is a high-valued vegetable crop of Haryana as well. It is majorly cultivated in Ambala, Panchkula, Yamunanagar, Kurukshetra, Hisar,and Karnal districts of Haryana. Potato, being a highly nutritive crop, requires essential plant nutrients in the optimum concentration for the successful production of the crop. Among different essential nutrients, nitrogen is the most essential and limiting factor for the growth and development of the potato crop. It is involved in structure and configuration of nucleic acids, protein, free amino acids, and enzymes in the plant. Nitrogen is an integral part of the chlorophyll molecule besides its role in the formation of proteins. An optimum dose of N is critical for balancing tuber yield and quality (Millard and Marshall, 1986). A fully matured crop of potato yielding 25-30 t/ha tubers utilizes 120-140 kg N/ha (Malik and Ghosh, 2002). Potato crop growth and development are particularly sensitive to nitrogen (N) application (Hopkins *et al*., 2008). Excess N leads to delayed tuber set, lower tuber dry matter content and ultimately reduced yields. Overuse of N fertilizers result in nitrate leaching causing serious concerns from an environment point of view. Improvement of N efficiency is a supreme goal in potato cropping systems using nutrient management. Potato requires a modest amount of N early in the season for adequate canopy development. Also, nitrogen has an effect on plant disease development, crop weed competition, and insect infestations by direct or indirect influence on plant growth characteristics, intermediate metabolites, root exudates and induced biological controls.Different potato cultivars differ in their growth characteristics, and yield potential, so it becomes necessary to evaluate different varieties for their attributes. Keeping in view the above-stated facts, this experiment was conducted to assess the effect of different levels of nitrogen on various potato varieties, *viz.*,KufriPukhraj, KufriGaurav and AICRP-P-39.

MATERIALS AND METHODS

The present study was conducted at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar (29°09’N and 75°43’E, elevation 215 m) during the *rabi* season of 2019-20. The soil of the experimental site was sandy loam with approximately 0.48 organic carbon and pH 7.6. The treatments comprising three potato varieties (KufriPukhraj, KufriGaurav, and AICRP-P-39) and four levels of nitrogen (0, 80, 160, and 240 kg/ha)

*Corresponding Author

were laid out in a randomized block design (factorial) with three replications keeping the net plot size 3.0x3.0 m and plant spacing 60x20 cm. The crop was planted on 23rd October 2019. All recommended packages of practice were followed uniformly as per the crop requirements. Observations were recorded for different growth and yield parameters, *viz*., plant emergence, plant height at 60, 75 and 90 DAP, number of leaves per hill, weight of stem& leaves per hill at harvest, yield of tubers in different grades and total tuber yield per hectare. Potato was harvested manually on 21th February 2020. Statistical analysis of experimental data was conducted using the OPSTAT software package.

RESULTS AND DISCUSSION

In the present investigation under different treatments of nitrogen, the plant emergence was recorded in the range of 94.44 to 95.37% (Table 1). The nitrogen levels and varieties of potato, as well as their interaction, had a non-significant effect on plant emergence at 30 days after planting. This might be because enough food material was already available in the seed tubers which provided an initial push to the emerging shoots. The results of the experiment are in line with the findings of Adhikari, 2009, Singh and Lal, 2012 and Sriom*et al*., 2017.

The data presented on plant height (Table 2) taken at 60, 75 and 90 days after planting showed significant differences among the treatments of nitrogen levels, potato varieties and their interaction. The plant height for different nitrogen levels at 60, 75 and 90 days after planting was recorded in the range of 46.9-61.4, 49.9-66.5 and 56.3-69.5 cm, respectively. The nitrogen dose of 240 kg/ha resulted in the significantly tallest plants, closely followed by nitrogen dose of 160 kg/ha at 60, 75 and 90 days after planting. This increase in the plant height can be attributed to the increased formation of proteins in the plant cells, due to adequate supply of nitrogen, which allows the plants to grow faster. The findings of present experiment conformto the findings of Banjare*et al*., 2014. Among the varieties, maximum plant height was recorded in the variety KufriPukhraj at 60, 75 and 90 days after planting. The interaction effect of nitrogen and variety for plant height was found to be significant when KufriPukhraj was supplied with the nitrogen dose of 240 kg/ha followed by 160 kg/ha at 60, 75 and 90 days after planting.

A significant difference was observed among the nitrogen treatments and potato varieties for the number of leaves per hill, leaf and stem weight per hill (g) at harvest. The number of leaves per hill, leaf and stem weight per hill (g) at harvestunder different nitrogen treatments was recorded in the range of 34.6-57.1, 185.33-251.83 g and 100.30-145.16 g (Table 1), respectively, and all these parameters were recorded significantly highest for the nitrogen dose of 240 kg/ha closely followed by nitrogen dose of 160 kg/ha. Among the varieties, significantly the highest number of leaves per hill at harvest, leaf and stem weight per hill (g) at harvest was observed for the variety KufriPukhraj as compared to the variety KufriGaurav and AICRP-P-39.The application of higher nitrogen concentration stimulated the assimilation of carbohydrates and protein, which in turn increased cell division and formation of more tissues that resulted in vigorous vegetative growth of the plant and also in the production of stem and axillary branches. The results of the present investigation are supported by the findings of Banjare*et al*., 2014.

The effect of different levels of nitrogen on yield (kg) of different grades of tubers, *viz*., up to 25g, >25-50g, >50-75g and >75g grade, per square meter was recorded significantly highest when nitrogen was applied at the rate of 240 kg/ha closely followed by nitrogen dose of 160 kg/ha (Table 3). The decrease in unmarketable (smallest grade, *i.e*., up to 25g) tuber yield due to the supply of nitrogen might be attributed to the increment in both marketable and total tuber number and yield as well as to the improvement in the proportion of larger grade tuber number and yield. The results of the present investigation are supported by the findings of Sahu*et al*., 2016 and Banjare*et al*., 2014, who reported the highest potato tuber yield in >50-75g and >75g grade per plot with the application of nitrogen at the rate of 225 kg/ha. Except for the tubers of the smallest grade, *i.e*., up to 25g grade, Chongtham*et al*., 2015 noticed a significant increase in the potato tuber yield due to the increased application of nitrogen fertilizer. Potato tuber yield in the three classes (grades) of tubers,*viz*., first, second and third, was significantly influenced by the nitrogen doses and varieties, increasing the yield of tubers to a certain level when nitrogen was applied up to 200 kg/ha (Guler, 2009). The highest potato tuber yield in grades>50-75g and >75 g per plot was reported from the cultivar KufriPukhraj.

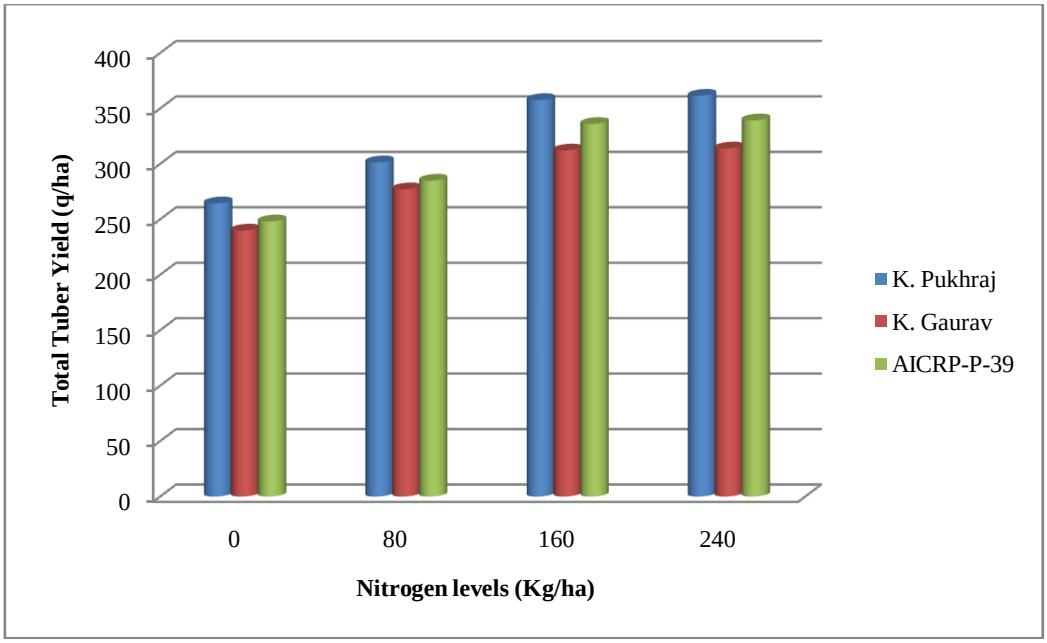

Fig. 1 Effect of different nitrogen levels and potato varieties on total tuber yield

The data in Table 2reveals that different doses of nitrogen and varieties of potato significantly affected the total tuber yield and maximum was recorded with the application of 240 kg N/ha, showing at par results with the dose of 160 kg N/ha (Fig. 1). Sahu *et al*., 2016 also noticed the highest potato tuber yield per plot with the application of 225 kg N/ha. Among the varieties, significantly highest total tuber yield (q/ha) was observed with KufriPukhraj as compared to the variety KufriGaurav and AICRP-P-39. These findings are in agreement with the findings of Yadav *et al*., 2017 who recorded maximum tuber yield with the variety KufriPukhraj when supplied with 180 kg N/ha. The interaction effect between nitrogen levels and varieties for tuber yield was found to be non-significant.

CONCLUSION

From this study, it can be concluded that potato variety KufriPukhraj supplied with the nitrogen dose of 160 kg/ha performed better in terms of growth and yield (335.22 q/ha) as compared to other nitrogen doses and potato varieties. Hence, potato variety KufriPukhraj is recommended with the application of 160 kg nitrogen per hectare for cultivation in the northern plains of India.

Table 1. Effect of different nitrogen levels and potato varieties on plant emergence (%), number of leaves per hill, leaf weight (g) per hill and stem weight (g) per hill at harvest of potato crop-

Treatment	Plant Emergence (%)			Mean	No. of leaves/hill			Mean	Leaf weight (g)/hill			Mean	Stem weight (g/hill)			Mean
	V1	V2	V3		V1	V2	V3		V1	V2	V3		V1	V2	V3	
N1	93.33	95.00	96.11	94.81	36.9	32.7	34.2	34.6	192.6	175.6	187.8	185.3	105.21	96.28	99.4	100.30
N2	93.89	96.67	95.56	95.37	42.3	40.9	41.9	41.7	232.6	211.6	222.5	222.2	129.29	118.59	121.39	123.09
N3	94.44	93.33	95.56	94.44	56.7	55.8	56.4	56.3	259.2	240.3	245.1	248.2	146.39	135.51	140.28	140.73
N4	94.45	95.00	93.89	94.45	59.6	55.3	56.5	57.1	262.5	245.0	248.0	251.8	153.19	138.50	143.80	145.16
Mean	94.03	95.00	95.28		48.9	46.2	47.3		236.7	218.1	225.8		133.52	122.22	126.22	
CD at 5%																
Nitrogen (N)	NS				1.5				4.6				5.1			
Variety (V)	NS				1.3				3.7				4.2			
N x V	NS				NS				NS				NS			

(N1= control; N2= 80 kg/ha; N3= 160 kg/ha; N4= 240 kg/ha; V1= kufripukhraj; V2= kufrigaurav; V3= AICRP-P-39 and NS= Non significant)

Table 2. Effect of different nitrogen levels and potato varieties on plant height at 60, 75 and 90 DAP and total tuber yield (q/ha) of potato crop-

Treatment	Plant height (cm) at 60 DAP			Mean	Plant height (cm) at 75 DAP			Mean	Plant height (cm) at 90 DAP			Mean	Total tuber yield (q/ha)			Mean
	V1	V2	V3		V1	V2	V3		V1	V2	V3		V1	V2	V3	
N1	50.7	42.2	47.9	46.9	53.7	45.4	50.7	49.9	59.8	54.7	54.4	56.3	264.4	239.9	248.1	250.8
N2	55.3	51.5	52.7	53.2	56.9	55.6	55.2	55.9	62.5	62.5	62.9	62.6	301.4	277.1	284.8	287.8
N3	57.8	54.2	56.4	56.1	62.4	58.0	61.6	60.7	67.1	66.4	64.9	66.1	357.4	312.1	336.0	335.2
N4	62.8	60.3	61.1	61.4	68.4	64.9	66.3	66.5	70.7	69.7	68.1	69.5	361.4	313.9	339.2	338.2
Mean	56.7	52.1	54.5		60.4	56.0	58.5		65.0	63.3	62.6		321.1	285.7	302.0	
CD at 5%																
Nitrogen (N)	0.92				1.42				1.26				7.72			
Variety (V)	0.79				1.23				1.09				6.69			
N x V	1.59				2.46				2.18				NS			

(N1= control; N2= 80 kg/ha; N3= 160 kg/ha; N4= 240 kg/ha; V1= KufriPukhraj; V2= KufriGaurav; V3= AICRP-P-39 and NS= Non significant)

Table 3. Effect of different nitrogen levels and potato varieties on yield of different grades of potato tuber-

Treatment	< 25g tuber			Mean	>25-50g tuber			Mean	>50-75g tuber			Mean	Yield of >75g tuber			Mean
	V1	V2	V3		V1	V2	V3		V1	V2	V3		V1	V2	V3	
N1	0.20	0.16	0.18	0.18	0.76	0.67	0.69	0.70	0.99	0.76	0.80	0.85	1.59	1.37	1.44	1.47
N2	0.29	0.24	0.27	0.27	0.93	0.86	0.92	0.90	1.18	0.91	1.15	1.08	1.94	1.56	1.91	1.80
N3	0.38	0.32	0.35	0.35	1.17	1.02	1.02	1.07	1.25	1.10	1.12	1.16	2.18	1.94	2.02	2.05
N4	0.42	0.35	0.39	0.39	1.26	1.09	1.13	1.16	1.27	1.12	1.17	1.19	2.30	2.01	2.07	2.13
Mean	0.32	0.27	0.30		1.03	0.91	0.94		1.18	0.97	1.06		2.00	1.72	1.86	
CD at 5%																
Nitrogen (N)	0.03				0.17				0.10				0.14			
Variety (V)	NS				NS				0.09				0.12			
N x V	NS				NS				NS				NS			

(N1= control; N2= 80 kg/ha; N3= 160 kg/ha; N4= 240 kg/ha; V1= KufriPukhraj; V2= KufriGaurav; V3= AICRP-P-39 and NS= Non significant)

REFERENCES

Adhikari, R.C. (2009). Effect of NPK on vegetative growth and yield of Desiree and KufriSindhuri potato. *Nepal Agriculture Research Journal*, **9**: 67-75.

Google Scholar

Banjare, S., Sharma, G. and Verma S.K. (2014). Potato crop growth and yield response to different levels of nitrogen under Chhattisgarh plains agro-climatic zone. *Indian Journal of Science and Technology*, **7**: 1504-1508.

Google Scholar

Chongtham, S.K., Patel, C.K., Patel, R.N., Patel, D.H., Patel, C.R., Zapadiya, D.M. and Patel, J.K. (2015). Yields, nutrient and water use efficiency and economics of potato variety Kufri Surya as influenced by different nitrogen levels. *International Journal of Agricultural Science*, **7**: 785-787.

Google Scholar

Guler S. (2009). Effects of nitrogen on yield and chlorophyll of potato (*Solanumtuberosum* L.) cultivars.*Bangladesh Journal of Botany*, **38**: 163-169.

Google Scholar

Hopkins, B.G., Rosen, C.J., Shiffler, A.K. and Taysom, T.W. (2008). Enhanced efficiency fertilizers for improved nutrient management: potato (*Solanumtuberosum*). *CropManagement*,**7**: 1-16.

Google Scholar

Malik, G.C. and Ghosh, D.C. (2002). Effect of fertility level, plant density and variety on growth and productivity of potato. In: *Potato global research and development proceedings of global conference on potato*, **2**: 866-871.

Google Scholar

Millard, P. and Marshall, B. (1986). Growth, nitrogen uptake and partitioning within the potato crop (*Solanumtuberosum*L.) in relation to nitrogen application. *Journal of Agricultural Science*, **107**: 421–429.

Google Scholar

Sahu, E., Sarnaik, D.A., Sharma, P.K., Barik, S.B. and Yadav, V. (2016). Influence of different levels of nitrogen on potato cultivars under Chhattisgarh plains in dorsa soil. *Progressive Horticulture*, **48**: 87-91.

Google Scholar

Singh, H.P. (2008). Policies and strategies conducive to Potato development in Asia and the Pacific region. In: *Proceedings of the Workshop to Commemorate the International Year of Potato*, 18-29.

Google Scholar

Singh, S.K. and Lal, S.S. (2012). Effect of potassium nutrition on potato yield, quality and nutrient use efficiency under varied levels of nitrogen application.*Potato Journal*, **39**(2): 155-1654.

Google Scholar

Sriom, M.D., Mishra, D.P., Rajbhar, P., Singh, D., Singh, R.K. and Mishra, S.K. (2017). Effect of different levels of nitrogen on growth and yield in potato (*Solanumtuberosum* L.) cv. KufriKhyati.*International Journal of Current Microbiology and Applied Sciences*, **6**: 1456-1460.

Google Scholar

Yadav, S.K., Singh, G.K., Jain, V.K. and Tiwari, A. (2017). Response of potato (*Solanumtuberosum* L.) cultivars to different levels of nitrogen.*International Journal of Current Microbiology and Applied Sciences*, **6**: 2734-2739.

Google Scholar