Eco. Env. & Cons. 28 (1) : 2022; pp. (284-288)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i01.041

Effect of nitrogen and potassium management on performance of potato crop

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(Received 17 May, 2021; Accepted 27 June, 2021)

ABSTRACT

The present investigation was carried out at the experimental farm of Doon (P.G.) College of Agriculture and Allied Science, Rampur, Selaqui, Dehradun during *rabi* season of 2018-19. The experiment comprised of eight treatments comprising basal and foliar application of nitrogen and potassium fertilizers along with a control treatment arranged in Randomized Block Design (RBD) with three replications. The observations were recorded for various growth and yield parameters. Results of the experiment indicated significant effect of different nitrogen and potash doses application on various parameters. The treatment T_8 (50% RDK + Spray of K_2SO_4 @ 2% at 30 DAP) was found to be the best for improving growth characters, while treatment T_4 (RDF160:100:120kg NPK/ha) was found best in terms of yield parameters. Based on the results of present investigation, it could be concluded that application of RDF 160: 100: 120 kg NPK/ ha can still be adopted by the farmers but with split applications of nitrogen and potassium as recommended dose for commercial cultivation of potato under present climatic conditions to achieve higher net returns per unit area provided all other agronomic package of practices are followed.

Key words : *Growth, Nitrogen, Potassium, Potato, Quality, Yield*

Introduction

Potato is the most important vegetable crop under family Solanaceae with chromosome number, 2n= 48. In 17th century, the Portuguese presented potatoes to India which they called "Batata", when they developed their reign along the western coast. English dealers acquainted potatoes with Bengal as a root crop, 'Alu'. Before the end of the eighteenth century, it was spread across the northern slopes of India. It is utilized as a vegetable, stock feed and in enterprises for assembling starch, mixed drinks, and other handled items. Its significant good yield has been embraced well for development under subtropical conditions. It is a herbaceous dicotyledonous plant with underground stems (tuber) that are commercially utilized for human consumption. It has an exceptionally special demand in large extent as per human eating regimen is concerned. It is likewise one of the world's most eaten staple food crop and rank fourth in production after wheat, rice and maize among food crops.

Nitrogen (N) is recognized as the most limiting nutrient to potato crops (Li *et al.,* 1999). Inadequate

N fertilization leads to poorer potato growth and yield, while excessive N application leads to delayed maturity, poor tuber quality and occasionally a reduction in tuber yield (Cerny *et al*., 2010). Since nitrogen is highly mobile, its use and demand is continuously increasing as it is subjected to high loss from the soil plant system. Even under best management practices, approximately 30-50% of applied nitrogen is lost through different undergoing soil and atmospheric processes and hence, the farmer is compelled to apply more than what the crop needs to compensate for losses through leaching, volatilization and denitrification making the nutrient unavailable during the critical stages of crop growth (Hyatt *et al*., 2010).

On the other hand, potassium (K) improves the tuber yield by expanding the span of the tuber. Potassium improves early development and expands the life of the haulm and builds the measure of the upper leaves. When applied through potassium sulfate it builds up the rate of starch synthesis per unit leaf area, the impact being related with a progressively fast translocation of starch from the leaves to tubers. Potash fertilizer strengthens development to proceed longer in dry seasons; and likewise increases the number and size of tubers. Keeping these points in view the present experiment was conducted to find out the effect of nitrogen and potassium management on potato crop performance.

Materials and Methods

The present experiment was done at Experimental Farm of Doon (PG) College of Agriculture and Allied Sciences, Selaqui, Dehradun, Uttarakhand in the *rabi* season of 2018-19. The experiment consisted of eight treatments *viz.,* T_1- Control (N and K), T_2- Control (N), T_3-Control (K), T_4- RDF (160: 100: 120 kg NPK/ha), T_5- 25% RDN + 1% Urea foliar spray at 30 DAP, T_6 50% RDN + 1% Urea foliar spray at 30 DAP, T_7- 25% RDK + 2% K_2SO_4 foliar spray at 30 DAP and T_8- 50% RDK + 2% K_2SO_4 foliar spray at 30 DAP. These treatments were laid out in randomized block design with three replications. The texture of experimental soil was sandy-loam having low organic carbon and medium levels of available nitrogen, phosphorus and potassium. Well sprouted, disease free, medium sized seed tubers (2.5-4.0 cm diameter and 30-50 gram weight) of potato cultivar "Kufri Jyoti" were used as planting material. The seed tubers were properly treated with fungicides for 15 minutes prior to planting and ridge planting method was followed with net plot size 3.0 m x 2.0 m and plant spacing of 60 cm x 20 cm. The recommended dose of nitrogen and potassium fertilizers was applied as per the treatments, half as basal a day before planting of tubers and half as top-dress at 30 DAP, while phosphorus (100 kg/ ha) was applied in each plot as basal and the foliar application of fertilizers as per the treatments were also done at 30 DAP.

The observations recorded at 30 days interval starting from 30 DAP for various growth parameters *viz.* plant height, number of haulms/ hill and haulm girth; yield parameters *viz.* grade-wise number and yield of tubers, total number and total yield of tubers per plot were recorded at the time of harvest. The data thus obtained was subjected to analysis of variance (ANOVA) using statistical methods as suggested by Sukhatme and Panse (1995).

Results

Growth parameters

The maximum plant height and number of haulms per hill (Table 1) were recorded under treatment T_8 (50% RDK + Spray of K_2SO_4 @ 2% at 30 DAP) and the minimum under treatment T_1 (No application of nitrogen and potash) at all stages of crop growth observed, while the maximum haulm girth was recorded under in treatment T_6 (50% RDN + 1% Urea as foliar spray at 30 DAP) and the minimum under treatment T_1 (No application of nitrogen and potash).

Yield parameters

In data on grade-wise number of tubers (Table 2) obtained, the number of grade A tubers per plot was recorded maximum (29.0) in treatment T_5 (25% RDN+1% Urea as foliar spray at 30 DAP) followed by T_7 (25% RDK + Spray of K_2SO_4 @ 2% at 30 DAP). Minimum number of grade A tubers per plot (0.0) was recorded under treatment T_1 (No application of nitrogen and potash). The maximum number of grade B tubers per plot (39.0) was recorded under treatment T_4 (RDF160:100:120kg NPK/ha) followed by T_7 (25% RDK + Spray of K_2SO_4 @ 2% at 30 DAP), while the minimum number of grade B tubers per plot (2.0) was recorded both under treatment T_1 (No application of nitrogen and potash) and T_2 (No application of nitrogen).

With regard to grade C tubers, the maximum number of tubers per plot (68.7) was recorded in treatment T_5 (25% RDN+1% Urea as foliar spray at 30 DAP) which was however not significant over other treatments, while the minimum number of tubers per plot (19.0) was recorded under treatment T_1 (No application of nitrogen and potash). The maximum number of grade D tubers per plot (663.3) was recorded under treatment T_8 (50% RDK + Spray of K_2SO_4 @ 2% at 30 DAP), whereas the minimum number of tubers per plot (265.7) was recorded under treatment T_1 (No application of nitrogen and potash). As per the total number of tubers per plot is concerned, it was recorded maximum (724.3) under treatment T_8 (50% RDK + Spray of K_2SO_4 @ 2% at 30 DAP) followed by T_4 (RDF 160:100:120 kg NPK/ha), while treatment T_1 (No application of nitrogen and potash) recorded minimum total number of tubers (286.7).

In grade-wise yield of tubers, the maximum per plot yield of grade A tubers (3.5 kg) was recorded under treatment T_5 (25% RDN + 1% Urea as foliar spray at 30 DAP), while it was recorded minimum (0.0 kg) under treatment T_1 (No application of nitrogen and potash). The maximum per plot yield of grade B tubers (2.1 kg) was recorded in treatment T_4 (RDF 160:100:120 kg NPK/ha) which was statistically higher over all the treatments, while the minimum grade B tuber yield per plot (0.1 kg) was recorded under treatments T_1 (No application of nitrogen and potash) and T_2 (No application of nitrogen).

Yield of grade C and grade D tubers per plot was recorded maximum (3.4 kg and 6.8 kg, respectively) under treatment T_4 (RDF 160: 100: 120 kg NPK/ ha) which was statistically higher than all other treatments, whereas their minimum yield (0.7 kg and 2.3 kg, respectively) was recorded under treatment T_1 (No application of nitrogen and potash). In total yield of tubers, the maximum total yield (12.6 kg) was obtained under treatment T_4 (RDF 160: 100: 120 kg NPK/ ha) while, it was minimum (3.1 kg) under treatment T_1 (No application of nitrogen and potash).

Discussion

Growth parameters

The results (Table 1) indicated that the split application of potash increase plant height than no application or single application, *i.e.* basal only. An increase in plant height due to split application of potash might be due to the fact that the soil of experimental plot was low in potash and the split application of potash improved the soil nutrient status which resulted in better growth of potato plant in comparison to control treatment T_1 (No application of nitrogen and potash) and T_3 (No application of potash). The number of haulms per hill however was not affected by application of potash. Our results were in close conformity with Singh and Lal (2012) who reported that stems per plant are a factor of variety, seed size and its physiological status. The results also indicated that nitrogen applied in split doses improves the haulm girth and this was also reported by Al-Moshileh *et al.* (2017) that splitting N rates improved plant growth characters like stem thickness. A similar finding was also reported by Rizk *et al.* (2013).

Yield parameters

The results on yield parameters (Table 2) indicated

Table 1. Effect of different nitrogen and potash treatments on plant height, number of haulms per hill and haulm girth of potato

Treatments	Plant height (cm)		Number of haulms/ hill		Haulm girth (mm)	
	30 DAP	45 DAP	30 DAP	45 DAP	30 DAP	45 DAP
T1	8.0	13.3	3.0	3.5	5.0	5.5
T2	11.5	17.5	3.3	3.7	5.8	6.3
T3	16.1	22.5	3.7	4.0	6.1	6.5
T4	23.2	29.7	4.0	4.5	6.3	6.9
T5	20.8	27.3	3.9	4.4	6.6	7.0
T6	23.3	28.9	3.9	4.3	7.2	7.7
T7	24.3	30.4	4.0	4.5	6.3	6.9
T8	24.5	31.3	4.0	4.6	6.9	7.3
SEm±	1.5	1.6	0.2	0.2	0.3	0.3
C.D. (0.05)	4.6	4.7	0.6	0.7	0.8	0.9

Table 2. Effect of different nitrogen and potash treatments on grade-wise and total number and yield of tubers of potato per plot

Treatments	Grade-wise number of tubers (per plot)				Total number of tubers (per plot)	Grade-wise yield of tubers (kg/plot)				Total yield of tubers (kg/ plot)
	A (>75g)	B (50-75g)	C (25-50g)	D (<25g)		A (>75g)	B (50-75g)	C (25-50g)	D (<25g)	
T1	0.0	2.0	19.0	265.7	286.7	0.0	0.1	0.7	2.3	3.1
T2	2.0	2.0	40.0	386.7	430.7	0.1	0.1	1.6	3.9	5.7
T3	5.7	19.0	49.0	480.0	553.7	0.4	1.1	1.8	6.1	9.3
T4	4.7	39.0	59.0	572.0	674.7	0.3	2.1	3.4	6.8	12.6
T5	29.0	18.7	68.7	449.0	565.3	3.5	1.9	2.3	2.1	9.8
T6	4.7	6.7	45.7	337.0	394.0	0.3	0.4	2.8	2.9	6.4
T7	13.3	23.3	25.7	492.3	554.7	1.4	1.5	1.2	5.8	9.9
T8	9.0	20.0	32.0	663.3	724.3	0.8	1.1	1.0	7.5	10.4
SEm±	4.7	4.8	10.9	44.1	43.5	0.6	0.2	0.6	0.8	1.1
C.D. (0.05)	14.2	14.6	NS	133.8	131.8	1.8	0.6	1.7	2.3	3.5

that there was an increase in the number of tubers in grade A and C in treatment T_5 (50% RDN + 1% Urea as foliar spray at 30 DAP) that have shown effect of nitrogen on the tubers which may be due to better nitrogen uptake by plant roots facilitated by split applications (Kumar and Trehan, 2012). In grade B tubers, the maximum number and yield were found in treatment T_4 (RDF 160: 100: 120 kg NPK/ ha) which indicated that all the applied macronutrients showed their effect on the plants thereby increasing the number and yield of tubers. The plots receiving increased split doses of potash as basal and foliar applications had higher number of grade D tubers which resulted in less yield in comparison to the plot receiving recommended dose of NPK where there were higher number of grade B and C tubers. Similar results were reported by Irungbam *et al.* (2018). These results indicated that increasing potash application rate and split application of nitrogen and potash, *i.e*. basal + top dress or basal + foliar, gave better response than that of control and single applications (basal only).

There was an increase in total number of tubers per plot with the increased levels of split applications of nitrogen and potash which may be due to the fact that total number of tubers mainly depends on number of stolons per plant, therefore, the potato plants receiving the higher and split applications of these nutrients may had more number of stolons and ultimately this resulted into higher number of tubers. These results are also in agreement with findings of Kumar *et al.* (2004) and Singh and Lal (2012). Results on total yield indicated that as there was more yield of B and C grade tubers as compared to all other treatments, this contributed to maximum total tuber yield. The similar results were also reported by Sati *et al.* (2016); Yassen *et al.* (2011) and Abd El-Samad *et al.* (2011).

Conclusion

Many researchers have shown results of improvement in potato yields with split applications of nutrients and recommended to apply balanced dose of nutrients in splits. This is however not much emphasized by the growers and this causes reduction in yields obtained and also the nutrient use efficiency, as much of the nutrients applied are either lost through leaching or through fixation in soil. Therefore, on the basis of the results of present investigation it could be concluded that the higher responses to nitrogen and potassium nutrients can be obtained in potato crop with the split applications of nitrogenous and potassic fertilizers if applied as either as soil applications (basal + top dress) or by foliar applications (basal + foliar spray).

References

Cerny, J., Balk, J., Kulhanek, M., Casova, K. and Nedved, V. 2010. Mineral and organic fertilization efficiency in long-term stationary experiments. *Plant, Soil and Environment.* 56 : 28–36.

Hyatt, C.R., Venterea, R.T., Rosen, C.J., McNearney, M., Wilson, M.L. and Dolan, M.S. 2010. Polymer coated Urea maintains potato yields and reduces nitrous oxides emissions in a Minnesota loamy sand. *Soil Science Society of America Journal.* 74 : 419–428.

Irungbam, P., Pramanick, M. and Devi, T.S. 2017. Growth

and productivity of potato (cv. Kufri Jyoti) and soil nutrient status as influenced by different nutrient management in new alluvial zone of West Bengal. *Journal of Envionmental Biology.* 39: 17–22.

Kumar, M. and Tehran, S.P. 2012. Influence of potato cultivars and N levels on contribution of organic amendments to N nutrition. *Potato Journal*. 39(2): 133–144.

Kumar, P., Pandey, S.K., Singh, B.P., Rawal, S., Singh, S.V. and Kumar, D. 2004. Fertilizer requirements of chipping potato (*Solanum tuberosum* L.) cultivars in West Bengal plains. *Potato Journal.* 31(3–4): 177–181.

Li, H. Parent, L.E. and Tremblay, C. 1999. Potato response to crop sequence and nitrogen fertilization following sod breakup in a Gleyed Humo-Ferric Podzol. *Canadian Journal of Plant Science.* 79: 439–446.

Abd El-Samad, E.H., Khalifa, R.Kh.M., Lashine, Z.A. and Shafeek, M.R. 2011. Influence of urea fertilization and foliar application of some micronutrients on growth, yield and bulb quality of onion. *Australian Journal of Basic and Applied Sciences.* 5(5): 96–103.

Al-Moshileh, A., Errebhi, M. and Motawei, M. 2017. Effect of various potassium and nitrogen rates and splitting methods on potato under sandy soil and arid environmental conditions. *Emirates Journal of Food and Agriculture.* 17(1): 1–9.

Rizk, F.A., Shaheen, A.M., Singer, S.M. and Sawan, O.A. 2013. The produtivity of potato plants affected by urea fertilizer as foliar spraying and humic acid added with irrigation water. *Middle East Journal of Agriculture Research.* 2(2): 76–83.

Sati, U. C., Raghav, M., and Singh, N. 2016. Effect of dose and method of potash application on production behaviour of Potato. *Ecology, Environment and Conservation*. *22*(3): 1375–1378.

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): 155–165.

Sukhatme, P.V. and Panse, V.G. 1995. *Statistical Methods for Agricultural Workers*. ICAR, New Delhi, 359 p.

Yassen, A.A., Adam, S.M. and Zaghloul, S.M. 2011. Impact of nitrogen fertilizer and foliar spray of selenium on growth, yield and chemical constituents of potato plants. *Australian Journal of Basic and Applied Sciences.* 5: 1296–1303.