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NITROGEN AND POTASSIUM FERTILIZATION LEVEL RESPONSES IN POTATO

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ABSTRACT

A potato field trial was carried out during winter season of 2018-19 at experimental farm of Doon (PG) College of Agriculture and Allied Sciences, Rampur, Selaqui, Dehradun. This work aimed to determine the response of nitrogen and potassium fertilizer on potato (*Solanum tuberosum* L.). The experiment was organized as per Randomized Block Design having three replicates of eight treatments. Observations were recorded on growth and yield contributing parameters at 60 days after planting and at harvest, respectively. The results indicated superiority of application of 50% RDK + Spray of K_2SO_4 @ 2% at 30 DAP over other treatments in terms of growth and per hectare number of tubers. Application of 50% RDN + 1% Urea foliar spray at 30 days statistically affected per hectare number of tubers of grade A and C. In terms of yield, application of RDF 160: 100: 120 kg NPK/ha was found best. Based on the results of this study, it can be concluded that nitrogen and potassium interaction not only increase the growth parameters but also the yield of potato.

Keywords **:** Nitrogen, potassium, potato, growth, yield

Introduction

India is the second largest producer of potatoes, behind China. In terms of human consumption, it ranks as the third most significant crop globally, behind wheat and rice. It has a high concentration of proteins, vitamins, calcium, and a well-balanced combination of amino acids. The exceptional qualities of potatoes include their high nutritional content, capacity to thrive in marginal environments, ease of cultivation, cheap cost, and high production, making them an excellent source of money and food. Additionally, it may provide supplementary sustenance to underprivileged populations in emerging nations worldwide.

According to Olfs *et al.* (2005), a larger quantity of nitrogen is essential for maximizing crop output and absorption by most plants. According to Errebhi *et al.* (1998), it is the primary nutrient crucial for crop development. Farmers often use increased quantities of nitrogen (N) to enhance the development and production of their crops (Lemaire and Gastal, 1997). Reduced N application will primarily affect tuber growth due to reduced leaf area and early defoliation, which will result in less photosynthesis (Kumar *et al.*, 2007).

According to Imas and Bansal (1999), the application of potassium (K) boosts crop vigor and plant height, while also providing resistance to numerous diseases such as late blight, black scurf, and hollow heart. Potassium is essential for enhancing the production of potato tubers due to its crucial involvement in photosynthesis, regulation of stomata,

and promotion of high energy levels that facilitate the efficient transport of nutrients and water absorption in plants (Bergmann, 1992).

Both nitrogen and potassium fertilizers may affect tuber production. The contact takes place both inside the plant cell and at the interface between the soil and the root. Potatoes need a higher amount of potassium fertilizer compared to other crops that are grown with irrigation to get maximum yield. To improve N absorption efficiency and minimize N losses while preserving high yield and quality, optimal N and irrigation management is crucial (Alva, 2004). Applying potassium and nitrogen increases the growth of tubers by lowering tiny and very small-sized tubers and boosting big and medium-sized tubers (Singh and Lal, 2012).

Materials and Methods

A field experiment was undertaken at Doon (PG) College of Agriculture and Allied Sciences, Rampur, Selaqui, Dehradun, during the winter season of 2018-19. The experiment consisted eight treatments *viz.*: T1- Control (N and K), T2- Control (N), T3- Control (K), T4- RDF (160: 100: 120 kg NPK/ha), T5- 25% RDN + 1% Urea foliar spray at 30 days, T6- 50% RDN + 1% Urea foliar spray at 30 days, T7- 25% RDK + 2% K_2SO_4 foliar spray at 30 days, and T8- 50% RDK + 2% K_2SO_4 foliar spray at 30 days after planting (DAP). The experiment used sandy loam soil with a pH of 6.8, and the ridge planting technique was used. Agronomic operations as per package of practices for potato in Uttarakhand region were carried out a few days before planting. The experimental treatments were replicated thrice under a Randomized Block Design. Disease free seed tubers of potato cultivar 'Kufri Jyoti' with well-developed sprouts, medium size with a diameter of 2.5-4.0 cm and a weight of around 30-50 grams were used. Before sowing, the tubers were immersed in the fungicide. The treatments involved the application of half doses of nitrogen and potassium fertilizers as basal before planting the tubers, with the remaining half applied as top dressing 30 days after planting (DAP). Additionally, phosphorus was applied at a rate of 100 kg/ha as basal in each plot. The foliar application of fertilizers, according to the treatments, was also carried out at 30 DAP.

Results

Growth Parameters

At observational stage of crop growth (Table 1), treatment T8 (50% RDK + 2% K_2SO_4 foliar spray at 30 DAP) followed by treatment T7 (25% RDK + 2% K_2SO_4 foliar spray at 30 DAP) and T6 (50% RDN + 1% Urea foliar spray at 30 DAP) recorded significantly highest plant height, number of haulms and haulm girth, while these were recorded minimum under treatment T1 (No application of nitrogen and potash).

Table 1: Effect of nitrogen and potash on potato plant height, number and girth of haulms

Treatments	Plant height (cm)	Number of haulms per hill	Haulm girth (mm)
T1	18.3	3.9	6.0
T2	22.9	4.2	6.8
T3	28.3	4.5	7.0
T4	34.3	5.0	7.5
T5	32.7	4.8	7.5
T6	34.1	4.9	7.9
T7	36.5	5.0	7.6
T8	37.4	5.2	8.1
SEm±	1.6	0.2	0.3
C.D. (0.05)	4.8	0.7	1.0

Yield Parameters

The treatment T5, which consisted of 25% RDN and 1% Urea as a foliar spray at 30 DAP, recorded the highest number of tubers per hectare under grade A (48.3) and grade C (114.4 q/ha) in Table 2. This treatment showed statistically significant superiority over all other treatments. Under treatment T1 (no nitrogen and potash application), the lowest number of tubers per hectare (0.0, 31.7) was noted. Treatment T4 (RDF 160: 100: 120 kg NPK/ha) had the highest observed tuber density per hectare (65.0) in grade B, surpassing all other treatments in a statistically significant manner. Treatment T1 (no nitrogen and potash application) resulted in a minimum tuber count of 3.3 thousand per hectare. Treatment T8, which consisted of 50% recommended dose of potassium fertilizer (RDK) and a spray of potassium sulphate (K_2SO_4) at a concentration of 2% at 30 days after

planting (DAP), resulted in the highest number of tubers per hectare (1105.6) among all the treatments. This difference was statistically significant. The treatment, T1 (no application of nitrogen and potash) resulted in a minimal number of tubers per hectare (442.8).

Treatment T8 (50% recommended dose of potassium + spray of potassium sulphate at 2% at 30 days after planting) resulted in the highest total number of tubers per hectare (1207.2), which was much better than the other treatments, while treatment T4 (Recommended dose of 160: 100: 120 kg NPK per hectare) was *at par*. Treatment T1, which included no application of nitrogen and potash, resulted in the lowest total number of tubers (477.8) (Table 2).

Table 2: Effect of different nitrogen and potash treatments on number and yield of potato tubers

Treatments	Grade-wise number of tubers (per ha)				Total number of tubers (thousand/ ha)	Grade-wise yield of tubers (q/ha)				Total yield of tubers (q/ha)
	A (>75g)	B (50-75g)	C (25-50g)	D (<25g)		A (>75g)	B (50-75g)	C (25-50g)	D (<25g)	
T1	0.0	3.3	31.7	442.8	477.8	0.0	1.8	11.2	38.9	51.9
T2	3.3	3.3	66.7	644.4	717.8	2.1	1.4	25.9	65.2	94.6
T3	9.4	31.7	81.7	800.0	922.8	7.0	17.6	29.7	100.8	155.2
T4	7.8	65.0	98.3	953.3	1124.4	5.1	34.2	56.4	113.9	209.6
T5	48.3	31.1	114.4	748.3	942.2	58.2	31.1	38.9	35.2	163.3
T6	7.8	11.1	76.1	561.7	656.7	4.8	6.6	47.2	48.3	107.0
T7	22.2	38.9	42.8	820.6	924.4	23.6	25.0	19.4	97.2	165.3
T8	15.0	33.3	53.3	1105.6	1207.2	13.9	18.1	16.7	125.0	173.6
SEm±	7.8	8.0	18.2	73.5	72.4	10.0	3.3	9.2	12.5	19.0
C.D. (0.05)	23.6	24.3	NS	223.0	219.7	30.3	10.1	27.8	37.9	57.7

Among all the treatments, treatment T5 (25% RDN + 1% Urea as a foliar spray at 30 DAP) produced the highest weight of grade A tubers per hectare (58.2 q/ha), which was statistically greater. Under treatment T1 (no application of nitrogen and potash), the minimum tuber weight per plot (0.0 q/ha) was measured. The treatment T4 (RDF 160: 100: 120 kg NPK/ha) had the highest reported maximum weight of grade B tubers per plot, which was 34.2 q/ha. This weight was statistically superior to all other treatments. The lowest tuber weight (1.4 q/ha) per plot was noted for treatment T2 (no nitrogen application) (Table 2).

The treatment T4 (RDF160:100:120 kg NPK/ha) yielded the highest weight of grade C tubers per hectare (56.4 q/ha), which was significantly greater than the weight of tubers in any other treatment. The treatment T1 (no nitrogen and potash application) had the lowest tuber weight per hectare (11.2 q/ha). The highest weight per hectare of grade D (125.0 q/ha) tubers were seen in treatment T8 (50% recommended dose of potassium fertilizer + spray of potassium sulphate at 2% concentration at 30 days after planting). However, this difference was not statistically significant. The treatment T5 (25% RDN + 1% Urea as a foliar spray at 30 DAP) resulted in the lowest tuber weight per hectare, with 35.2 q/ha (Table 2).

The maximum total yield of tubers (209.6 q/ha) was obtained under treatment T4 (RDF 160: 100: 120 kg NPK/ha) which was statistically similar with rest of the treatments except treatment T3 (No application of potassium), T5 (25% RDN + 1% Urea as foliar spray at 30 DAP), T7 (25% RDK + Spray of K_2SO_4 @ 2% at 30 DAP) and T8 (50% RDK + Spray of K_2SO_4 @ 2% at 30 DAP). The minimum total yield of tubers (51.9 q/ha) was obtained under treatment T1 (No application of nitrogen and potash) (Table 2).

Discussion

Growth Parameters

The findings from Table 1 demonstrate that the management of K in split doses led to an increase in plant height. This rise may be attributed to the fact that the soil in the experimental plot was deficient in potash, and the application of K helped improve the nutritional status of the soil. This result is consistent with the findings published by Dkhil *et al.* (2011). In the study conducted on the haulm per hill, it was shown that the dosage of potassium (K) had little effectiveness, which closely aligned with the findings of Singh and Lal (2012). Furthermore, Sati *et al.* (2017) and Vidushi *et al.* (2022) showed that potash supplementation increased haulm girth. This is because potassium is crucial for achieving optimal leaf expansion and stem elongation. These results are consistent with the findings of YinGang (2003), who observed that the application of K fertilizer led to a considerable increase in stem diameter as the K rates rose. The application of K_2SO_4 resulted in the greatest

reading of plant height. This finding is consistent with the results reported by Moshileh and Errebi (2004) as well as Ati and Nafaou (2012), who also observed an increase in vegetative growth, length, and plant leaf index of potato plants.

Yield Parameters

The findings from Table 2 demonstrate that treatment T5 (50% recommended dose of nitrogen + 1% Urea applied as a foliar spray at 30 days after planting) resulted in a significant increase in number of tubers of grade A and C. The study demonstrated that nitrogen has a positive impact on the yield of tubers, resulting in an increased number of tubers per acre. These findings are supported by the results as reported by Chowdhury *et al*. (2002). An increase in the grade B tubers was seen in treatment T4 (RDF 160: 100: 120 kg NPK/ ha), indicating that the balanced application of NPK had a positive influence on potato growth. This result is consistent with the findings of the YinGang (2003) experiment. In grade D, the treatment T8 (25% RDK + Spray of K_2SO_4 @ 2% at 30 DAP) had the highest number of tubers. This indicates that at 60 DAP, the application of split and foliar spray of potash mainly affected the small sized tubers, leading to an increase in the total number of tubers per hectare. This finding is in conformity with the results as reported by Gunadi (2009) and Abd El-Hady *et al*. (2021).

The yield of grade A potatoes in treatment T5 (50% RDN + 1% Urea as foliar spray at 30 DAP) increased because of the split dosage of nitrogen, which included both basal and foliar spray applications. Dividing the dosages of nitrogen (N) had a positive impact on the tuber production, which was also seen by Kumar and Trehan (2012). The highest tuber production for grades B and C was seen in treatment T4 (RDF 160: 100: 120 kg NPK/ ha), indicating that the prescribed dosage had a direct favourable impact on tuber growth, as it facilitated optimal nutrient absorption. Grade D saw favourable outcomes from treatment T8, which included the application of 25% RDK and a 2% spray of K_2SO_4 at 30 days after planting. This treatment effectively enhanced the growth of small-sized tubers, thus leading to an increase in overall yield. The total crop yield was enhanced in treatment T4 (RDF 160: 100: 120 kg NPK/ ha) due to the inclusion of grade B and C tubers, resulting in an overall rise in the total yield. The results demonstrated that the use of NPK significantly enhanced the crop production, which aligns with the findings of Kumar *et al.* (2004), Irungbam *et al.* (2018), and Singh and Lal (2012).

Conclusion

The results of this experiment indicate that treatment T8 (25% RDK + Spray of K_2SO_4 @ 2% at 30 DAP) showed superior vegetative growth in terms of plant height, number of haulms and girth of haulms as compared to rest of the treatments. However, treatment T4 (RDF 160: 100: 120 kg NPK/ ha) demonstrated superior yield compared to all other treatments. Therefore, the combination of NPK showed beneficial effects on potato yield.

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