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# Response of potato (*Solanum tuberosum* L.) varieties to different levels of nitrogen and potash

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**Abstract**
The experiment was conducted at Potato Research Station, S. D. Agricultural University, Deesa, Gujarat (India) in 2021-22 to show the response of potato cultivars to different levels of nitrogen and potash. Nine treatment combinations comprising of three levels of nitrogen and potassium (225 kg N and $K_2O$/ha, 275 kg N and $K_2O$/ha and 325 kg N and $K_2O$/ha,) and three different cultivars i.e. K. Ganga, K. Lima and K. Khyati were employed in this investigation. Among the three cultivars, K. Ganga variety recorded significantly higher total tuber yield as well as net realization and benefit cost ratio. Among the different levels of nitrogen and potash significantly higher plant height, maximum number of stems/hills, highest yield of A, B and C grade tuber yield (t/ha), highest total and marketable yield, highest haulm yield, higher dry matter & starch content, highest NPK content as well as uptake in tuber and haulm, highest available N and $K_2O$ after harvesting and maximum net realization of ₹ 426028/ha with the BCR of 2.62 were recorded application of 325 kg N and $K_2O$/ha.

**Keywords:** Potato, varieties, tuber yield, BCR, nitrogen fertilizer, potash fertilizer

## Introduction
Effective nutrient management combined with a robust agronomic approach is crucial throughout the growth cycle of potatoes. Potato has shallow root system and high nutrient requirements, potatoes necessitate a higher quantity of fertilizer compared to many other crops. Properly balancing and timing nutrient applications is vital to optimize growth and yield (Munoz *et al*. 2005) [23]. According to Tehran *et al*. (2008) [39], the efficiency of fertilizer use for potatoes with regard to NPK (nitrogen, phosphorus, and potassium) fertilizers is reported to be 40-50% for nitrogen, 10-15% for phosphorus, and 50-60% for potassium. This indicates varying levels of nutrient uptake efficiency by potato plants for each type of fertilizer.

Balanced fertilization has been demonstrated to be a pivotal factor in agricultural productivity across various farming conditions, contributing to nearly a 50 percent increase in overall agricultural output (Singh *et al*., 2008) [32, 33]. For optimal potato production, a well-adjusted combination of nitrogen (N), phosphorus (P), and potassium (K) is essential (Singh and Trehan, 1998) [32, 33]. In the Gujarat, there is a prevalent issue of imbalanced nutrient application, characterized by an excessive emphasis on nitrogen and insufficient potassium, which often results in suboptimal crop performance. Addressing these imbalances by applying a more balanced fertilization approach is crucial for enhancing potato yield and quality.

Nitrogen and potassium are crucial macronutrients that significantly influence the growth and development of potato crops. Excessive application of nitrogen poses a serious issue in intensive agricultural systems, as it results in substantial nitrogen losses and the enrichment of reactive nitrogen compounds in the atmosphere, soil, and water, which can harm ecosystems. Conversely, potassium application is often neglected by many farmers, leading to a continuous decline in soil potassium levels (Ladha *et al*., 2003; Lal *et al*., 2007) [19, 21].

Indian soils typically contain high total potassium; however, only a small fraction is readily available due to dynamic interactions among exchangeable, non-exchangeable, and fixed forms of potassium. With increased crop intensity and higher potassium removal rates, these soils are becoming progressively deficient in potassium. Frequent potassium deficiencies have been reported in crops (Panaullah *et al*., 2006) [25].

Regmi *et al*. (2002) [30] have indicated that inadequate potassium application could exacerbate soil potassium imbalances in agricultural ecosystems and lead to stagnating crop yields over time. Addressing these issues through balanced fertilization and adequate potassium management is essential to sustain soil fertility and optimize crop productivity.

A deeper comprehension of the interaction between nitrogen (N) and potassium (K), coupled with the use of new potato varieties, can serve as a valuable guide for optimizing nutrient management practices to achieve both high yields and efficient nutrient utilization. In light of these considerations, a field trial was undertaken to determine the most effective levels of nitrogen and potassium for three distinct potato cultivars—K. Ganga, K. Lima, and K. Khyati. The objective was to identify the optimal fertilization strategy for maximizing yield under varying nitrogen and potassium levels.

## Materials and Methods

The experiment was conducted during winter season of 2021-22 at Potato Research Station, Sardarkrushinagar Dantiwada Agricultural University, Deesa. The soil of the experimental plot was loamy sand in texture, low in organic carbon, available nitrogen and available phosphorus, while high in available potash. The soil was slightly alkaline in reaction and free from salinity-sodicity hazards. The experiment was laid in Randomized block design with factorial concept with four replications having nine treatment combinations of three levels of nitrogen and potassium, $F_1$: 225 kg N and $K_2O$/ha, $F_2$: 275 kg N and $K_2O$/ha and $F_3$: 325 kg N and $K_2O$/ha) at constant dose of P (138 kg P2O5) and three different potato varieties i.e. K. Ganga, K. Lima and K. Khyati. Full P & K and half of N were applied at the time of planting and rest half N was top dressed at the time of earthing up at 30 days after planting. The sources of N, P & K were Ammonium sulphate, Urea, Single Super Phosphate and Muriate of Potash. Well-sprouted tubers of potato Cv. K. Ganga, K. Lima and K. Khyati of seed size 50-60 g were planted during first week of November. Tubers were covered with 10-12 cm soil layer. The potato crop was dehaulmed at the time of maturity. Rest of the agronomic package of practices adopted was as per recommendation for potato cultivation of North Gujrat. The following observation were recorded during the investigation.

**Plant population at 30 days after planting:** Plant population per metre raw length was counted at 30 days after planting of crop from randomly selected five spots of each net plot area.

**Plant height (cm):** The height was measured in five-tagged plant in each treatment from ground level up to the tip of growing shoot with help of meter scale at 50 days after planting and it was measured in centimeters**.**

**Number of stems per plant:** Total numbers of stems from five randomly selected plants per replication were counted to work out average number of stems per plant at 50 DAP (days after planting).

**Number of tubers per plant:** Total numbers of tubers from five randomly selected plants were counted to workout average number of tubers per plant at the time of harvesting.

**Harvesting:** The crop was harvested when maturity sign was observed. The border lines were harvested separately. The net plot was harvested using country plough. The tubers were collected from net plot and yield per plot was recorded.

**Grading wise tuber yield (t/ha):** Tubers were graded in to four categories *viz.*, 'A' grade (Large size, > 75 g), 'B' grade (Medium size, 50-75 g), 'C' grade (Small size, 25-50 g) and 'D' grade (very small size, < 25g) in each treatment.

**Total tuber yield (t/ha):** Harvested tubers from each net plot were weighed separately and recorded as total tuber yield in kilograms per plot. Thereafter, it was converted into tones per hectare.

**Haulm yield (t/ha):** The plants after harvesting of economic yields, the haulm were left for drying in the same plot. After complete drying, the haulm was weighted and subsequently converted on hectare basis t/ha.

### Quality parameters

#### Tuber dry matter content (%)

The dry matter content of tuber was determined by oven drying method. Fresh tuber sample was weighted from each treatment and dried in oven at 80 °C till constant weight than dry weight of tuber was measured and calculated in percentage.

$$\text{Tuber dry matter content (\%)} = \frac{\text{Oven dried weight (g)}}{\text{Fresh weight (g)}} \times 100$$

#### Starch content in tuber

Starch content in tuber on fresh weight basis was determined by adopting anthrone sulphuric acid method as described by Hofreiter and Hodge (1962) [10].

### Chemical analysis

#### Plant analysis

#### Nitrogen content (%)

Representative sample of tubers and haulm were taken from each net plot and sample were prepared treatment wise for chemical analysis. Sample were oven dried at 70 °C for 24 hours and powdered by mechanical Willey grinder. Thereafter, the sample were analysed for nitrogen content. Nitrogen estimation was done micro kjeldahl digestion and distillation method (Jackson, 1973) [12].

#### Phosphorus content (%)

The dry sample of individual plots was grinded for phosphorus estimation in laboratory. Phosphorus estimation was done by Ammonium Vanado Molybdate method (Jackson, 1973) [12].

#### Potassium content (%)

The dry sample of individual plots was grinded for potassium estimation in laboratory. Potassium estimation was done by Flame photometer method (Jackson, 1973) [12].

#### Nutrient uptake (kg/ha)

The concentration of the nutrients determined in plant samples (tuber and haulm of potato crop) was expressed in

percent for major nutrients (N, P and K) on dry weight basis. The uptake of these elements was calculated by using the following formula.

$$\text{Nutrient uptake kg/ha} = \frac{\text{Nutrient content (\%)} \times \text{Dry yield (kg/ha)}}{100}$$

The cost of cultivation was calculated by taking into account the prevailing market price of inputs and the produce. Benefit: cost ratio (B: C ratio) was expressed as gross return per rupee spent.

Data recorded for various parameters during the course of investigation were statistically analyzed by a procedure as described by Panse and Sukhatme (1967) [27]. The variance of different sources in ANOVA were tested by "F" test and compare with value of Table F at 5% level of significance. Standard error of mean (S.Em.±), critical difference (CD) value, coefficient of variation (C.V.%) and other related statistically calculation was also worked out.

## Result and Discussion

### Growth parameters

Plant population was not influenced by different cultivars as well as different level of nitrogen and potassium. The mean data on plant height (cm) recorded at 50 DAP as significantly influenced by different cultivars and fertilizer levels. The tallest plants (44.52 cm) were recorded by K. Khyati. The next cultivar in sequence was K. Ganga which recorded 41.75 cm. at 50 DAP while K. Lima recorded the lowest plant height of 38.60 cm while in case of fertilizer levels the significantly taller plants 43.25 cm were recorded under $F_3$ (325 kg N and $K_2O$/ha) and it was at par with $F_2$ (275 kg N and $K_2O$/ha) which recorded 42.07 cm height. Significantly the lowest plant height (39.55 cm.) was recorded under $F_1$ (225 kg N and $K_2O$/ha) (Table:1). The linear increase in the plant height was noticed with increase in each nitrogen and potash level from $F_1$. Higher plant height is attributed to increase in uptake of nitrogen and potassium a constituent of protein and component of protoplasm, has cell elongation and reflected in higher plant growth. Similar results were reported by Banjare (2014) [2], Solangi *et al.* (2015) [37], Kumar *et al.* (2017) [17], Sriom *et al.* (2017) [38], Mechao and Bhandari (2018) [22], Singh *et al.* (2018) [35], Kundu *et al.* (2019) [18], Kumar *et al.* (2021) [16] and Parginiha *et al.* (2022) [29].

The data of stem per hill (Table:1) revealed that the highest stems per hill (5.15) was recorded in K. Ganga followed by K. Khyati which recorded 4.20 stems per hill. Significantly the least numbers of stem per hill (3.54) was recorded in K. Lima measured at 50 DAP while $F_3$ level (325 kg N and $K_2O$/ha) recorded highest number of stem per hill (4.93) which was followed by F2 and F1. The results are strongly supported by Banjare (2014) [2], Kumar *et al.* (2017) [17], Singh *et al.* (2018) [35] and Kumar *et al.* (2021) [16].

The highest number of tubers per plant (8.62) was recorded in K. Ganga followed by K. Khyati cultivar which recorded 7.29 number of tubers per plant. This finding is in conformity with the report of Haile (2009) [9]. Significantly the highest number tubers per plant (7.74) were recorded under $F_3$ level (325 kg N and $K_2O$/ha) and it was at par with $F_2$ level (275 kg N and $K_2O$/ha). The least number of tubers per plant (6.73) was recorded under $F_1$ level (225 kg N and $K_2O$/ha). Increase rate of nitrogen and potash fertilizer in potato to increase the number of tubers per plant and the mean weight of tuber per plant. This could be due to the significant role of nitrogen and potash on photosynthesis, favors high energy status which helps the crop for timely and appropriate nutrients translocation and water absorption by roots. This results in availability of more photosynthates to produce more number of tubers per plant. The results were confirmed by Chopra *et al.* (2010) [7], Kavadias *et al.* (2012) [14], Solangi *et al.* (2015) [37], Kumar *et al.* (2017) [17], Singh *et al.* (2018) [35] and Panthi *et al.* (2019) [28].

The significantly highest A grade tuber yield (31.55 t/ha) was recorded in Kufri Lima cultivar (Table:1) while significantly highest B grade tuber yield (14.90) was recorded in Kufri Khyati cultivar. The significantly highest C and D grade tuber yield was recorded in Kufri Ganga Cultivar. In case of the fertility level the significantly highest A, B and C grade tuber was recorded in under $F_3$ level (325 kg N and $K_2O$/ha).

The K. Ganga cultivar though produced the highest total tuber yield (48.65 t/ha) which remained at par with K. Khyati (47.78 t/ha). K. Lima recorded significantly lower total tuber yield (45.56 t/ha). Haile (2009) [9] reported that potato varieties showed significant difference yield of potato tuber in response to K application. Similar response was also reported by Adhikari (2009) [1], Zelelew *et al.* (2016) [41], and Yakimenko and Naumova (2018) [40]. In case of the fertility level highest total tuber yield 49.99 t/ha were recorded under the level $F_3$ (325 kg N and $K_2O$/ha) and it remained at par with level $F_2$ (275 kg N and $K_2O$/ha) which recorded 47.85 t/ha total tuber yield (Table:1). Higher rate of nitrogen and potassium provides better growth, development and translocation of photosynthesis from source to sink (tuber) which resulted in to higher yield of potato tubers. Naz *et al.* (2011) [24] also reported that potato yield and yield component varied with variety, soil characteristics and geographical escarpment. Similar results were also reported by Javed and Singh (2012) [13], Singh and Lal (2012) [36], Chongtham *et al.* (2015) [6], Chongtham *et al.* (2016) [5], Haddad *et al.* (2016) [8], Sriom *et al.* (2017) [38], Singh *et al.* (2018) [35], Kumar *et al.* (2021) [16] and Parginiha *et al.* (2022) [29].

The effect of cultivars did not show their significant influence on marketable tuber yield. K. Ganga, K. Khyati and K. Lima cultivars produced 46.81, 46.19 and 44.62 t/ha marketable tuber yield respectively. The significantly the highest marketable tuber yield 49.05 t/ha were recorded under level $F_3$ (325 kg N and $K_2O$/ha) and it remained at par with potash level $F_2$ (275 kg N and $K_2O$/ha) which recorded 46.69 t/ha marketable tuber yield (Table:1). The results were in conformity with those of Singh and Lal (2012) [36] and Solangi *et al.* (2015) [37].

Significantly the highest haulm yield 2.18 t/ha was recorded by K. Lima cultivar followed by K. Khyati and K. Ganaga which recorded 1.54 and 1.44 t/ha haulm yield respectively. Among the fertility level the significantly higher haulm yield 1.89 t/ha were recorded under the level $F_3$ (325 kg N and $K_2O$/ha) and it was remained at par with level $F_2$ (275 kg N and $K_2O$/ha) which noted 1.77 t/ha haulm yield. Nitrogen and potash level F1 (225 kg N and $K_2O$/ha) recorded significantly the lowest haulm yield 1.49 t/ha (Table:1). This might be due to increased uptake of nitrogen and potassium a constituent of protein and component of protoplasm, has helped to increase the synthesis of carbohydrates, which ultimately enhance cell elongation and resulted in higher vegetative growth of plant hence increased haulm yield. Similar results were also reported by

Banjare (2014) [2], Kumar *et al.* (2017) [17], Sriom *et al.* (2017) [38] and Singh *et al.* (2018) [35].

**Quality parameters**

The effect of different cultivars on tuber dry matter content was significant. Significantly the highest tuber dry matter content (Table:2) was noted in K. Ganga 21.28 % and significantly the lowest tuber dry matter content was noted in K. Lima (16.78 %). Singh and Fzekiel (2008) [34] reported that difference in dry matter content of tuber among the cultivars could be due to variation in hereditary factors and agro climatic condition. The fertility level also affects the tuber dry matter significantly. The significantly the highest tuber dry matter content 19.47 % was recorded under level $F_3$ (325 kg N and $K_2O$/ha) and it was followed by level $F_2$ (275 kg N and $K_2O$/ha) which noted 19.15% tuber dry matter content. The increase in dry matter percentage of tuber with nitrogen and potassium application might be due to the fact that higher doses of nitrogen and potassium might have helped in the production of photosynthesis, resulting in the accumulation of dry matter content of tuber. These results were in accordance with finding of Sharma and Sood (2002) [31] and Ismail and Zinada (2009) [11] and Banjare (2014) [2].

Significantly the highest starch content (15%) was recorded in K. Ganga (Table:2). Significantly the lowest starch content was recorded under K. Lima (11.87 %). Singh and Fzekiel (2008) [34] reported that difference in starch content of tuber among the cultivars could be to variation in hereditary factors and agro-climatic condition. Among the different fertility level the significantly higher starch content 13.76 % was recorded under level $F_3$ (325 kg N and $K_2O$/ha) and it was at par with level $F_2$ (275 kg N and $K_2O$/ha) which recorded 13.44 % starch content. These results are in accordance with findings of Zhang *et al.* (2018) [42].

**N, P, and K content (%) and uptake (kg/ha)**

The different potato cultivars imparted significant influence on nitrogen content (%) in tuber. Significantly higher N content in tuber (1.92 %) was recorded in K. Khyati cultivar and it was at par with K. Ganga. K. Lima recorded the lowest N content in tuber (1.84 %). The N content in haulm was not significantly influenced. The nitrogen content in tuber and haulm was significantly influenced by nitrogen and potash levels. Significantly the highest N content in tuber (1.94 %) and haulm (2.22%) were recorded under $F_3$ followed by $F_2$ (275 kg N and $K_2O$/ha) which recorded N content in tuber (1.90%) and haulm (2.19 %). Significantly the lowest N content in tuber (1.83 %) and haulm (2.15 %) were recorded under $F_1$ (225 kg N and $K_2O$/ha) (Table:2). An increase in N content in tuber and haulm due to increase levels of N might be due to fact that N had favourable effect on availability of N in soil as well as applied N which ultimately increased the uptake of nitrogen by the plant and there by which in turn increased the concentration of N in tuber and haulm. The results were in conformity with the findings of Sharma and Sood (2002) [31] and Kumar *et al.* (2021) [16].

The different potato cultivars imparted significant influence on nitrogen uptake (kg/ha) by tuber and haulm. Significantly higher N uptake by tuber (197.77 kg/ha) was recorded under K. Ganga followed by K. Khyati and K. Lima which recorded N uptake by tuber 173.95 and 141.26 kg/ha respectively. Significantly higher N uptake by haulm (47.20 kg/ha) was recorded by K. Lima followed by K. Khyati and K. Ganga which recorded N uptake of 34.00 and 31.55 kg/ha respectively. The nitrogen uptake was significantly influenced due to different nitrogen and potash level. Significantly the highest N uptake by tuber (189.05 kg/ha) and haulm (41.88 kg/ha) were recorded under $F_3$ (325 kg N and $K_2O$/ha) followed by $F_2$ (275 kg N and $K_2O$/ha) and $F_1$ (225 kg N and $K_2O$/ha) which recorded N uptake by tuber (175.20 and 148.73 kg/ha) and haulm (38.88 and 32.00 kg/ha) respectively (Table:2). Increase in N levels due to increase N uptake due to effect of nitrogen fertilizer could be attributed to enhanced vigour of crop growth with increased utilization and translocation of N into plant resulting enhancement of yield and thereby uptake of nitrogen by tuber and haulm. Similar results were reported by Khalak and Kumarswami (1996) [15], Sharma and Sood (2002) [31], Brar and Kaur (2006) [3], Javed and Singh (2012) [13], Shingh and Lal (2012) [36] and Pandit *et al.* (2020) [26].

The different potato cultivars and different fertility level imparted non-significant influence on phosphorus content (%) in tuber and haulm (Table: 2). The different potato cultivars imparted significant influence on phosphorus uptake (kg/ha) by tuber and haulm. Significantly higher phosphorus uptake by tuber (22.98 kg/ha) was recorded by K. Ganga followed by K. Khyati (20.10 kg/ha) and K. Lima (17.26 kg/ha) and significantly higher phosphorus uptake by haulm (4.63 kg/ha) was recorded by K. Lima followed by K. Khyati (3.27 kg/ha) and K. Ganga (3.05 kg/ha). Among the different fertility level the significantly the highest phosphorus uptake by tuber (21.83 kg/ha) and haulm (4.04 kg/ha) were noted under $F_3$ (325 kg N and $K_2O$/ha) followed by $F_2$ (275 kg N and $K_2O$/ha) and $F_1$ (225 kg N and $K_2O$/ha). Significant increase in uptake of phosphorus by tuber and haulm in present study under application of $F_3$ (325 kg N and $K_2O$/ha) might be due to increase in the yield of tuber and haulm which ultimately increase the uptake of phosphorus by tuber and haulm. The results were in conformity with the finding of Lakshmi *et al.* (2010) [20] and Pandit *et al.* (2020) [26].

The different potato cultivars imparted significant influence on potassium content (%) in tuber (Table:2). Significantly higher K content in tuber (1.86 %) was noted by K. Khyati followed by K. Ganga (1.82 %). The potassium content in haulm found non-significant. The significantly the highest potassium content in tuber (1.86 %) and haulm (2.46 %) recorded under $F_3$ (325 kg N and $K_2O$/ha) and it was followed by $F_2$ (275 kg N and $K_2O$/ha) which recorded potassium content in tuber (1.82 %) and haulm (2.40 %). The results were in conformity with the findings of Sharma and Sood (2002) [31] and Kumar *et al.* (2021) [16].

The different potato cultivars imparted significant influence on potassium uptake (kg/ha) by tuber and haulm (Table:2). Significantly higher potassium uptake by tuber (188.84 kg/ha) was recorded by K. Ganga followed by K. Khyati and K. Lima which were recorded potassium uptake by tuber 168.07 and 135.60 kg/ha respectively. Significantly higher potassium uptake by haulm (51.85 kg/ha) was recorded by K. Lima followed by K. Khyati and K. Ganga which recorded potassium uptake by tuber 37.14 and 34.40 kg/ha respectively. Among the different level of fertility the significantly the highest potassium uptake by tuber (181.67 kg/ha) and haulm (46.44 kg/ha) was noted under $F_3$ (325 kg N and $K_2O$/ha) followed by $F_2$ (275 kg N and $K_2O$/ha). Similar results were reported by Khalak and Kumarswami

(1996) [15], Sharma and Sood (2002) [31], Brar and Kaur (2006) [3], Javed and Singh (2012) [13], Shingh and Lal (2012) [36] and Pandit *et al.* (2020) [26].

## Economics

Data presented in Table 3 revealed that K. Ganga recorded maximum net realization of 404719 (₹/ha) with BCR of 2.57 followed by K. Khyati which recorded net realization of 397298 (₹/ha) and BCR of 2.52. The increase in gross margin from the crops for every addition of nitrogen and potassium levels could be due to the positive yield responses of the used potato cultivar. The results are in agreement with those reported by Chongtham *et al.* (2016) [5] and Chaudhari *et al.* (2018) [4].

The data of nitrogen and potash levels indicated that application of different levels of nitrogen and potash increased the net realization. The level $F_3$ (325 kg N and $K_2O$/ha) recorded the maximum net realization of 426028 (₹/ha) with BCR of 2.62 followed by level $F_2$ (275 kg N and $K_2O$/ha) which recorded net realization of 403334 (₹/ha) with BCR (2.57). The results are in agreement with those reported by Chongtham *et al.* (2016) [5] and Chaudhari *et al.* (2018) [4].

**Table 1:** Growth and yield attribute of potato cultivars as influenced by nitrogen and potassium levels.

| Treatment | Growth attribute | | | Yield attribute | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plant population at 30 DAP | Plant height (cm) at 50 DAP | Number of stems per hill (plant) | Number of tubers per plant at harvest | A- grade tubers (>75 g) yield (t/ha) | B- grade tubers (50-75 g) yield (t/ha) | C- grade tubers (25-50 g) yield (t/ha)s | D- grade tubers (<25 g) yield (t/ha) | Total tuber yield (t/ha) | Marketable tuber yield (t/ha) | Haulm yield (t/ha) |
| **Name of Cultivars** | | | | | | | | | | | |
| $C_1$: Kufri Ganga | 4.54 | 41.75 | 5.15 | 8.62 | 29.07 | 14.85 | 2.89 | 1.84 | 48.65 | 46.81 | 1.44 |
| $C_2$: Kufri Lima | 4.57 | 38.60 | 3.54 | 5.83 | 31.55 | 11.18 | 1.89 | 0.94 | 45.56 | 44.62 | 2.18 |
| $C_3$: Kufri Khyati | 4.43 | 44.52 | 4.20 | 7.29 | 29.06 | 14.90 | 2.23 | 1.59 | 47.78 | 46.19 | 1.54 |
| S. Em. ± | 0.04 | 0.50 | 0.10 | 0.26 | 0.70 | 0.44 | 0.12 | 0.06 | 0.84 | 0.83 | 0.05 |
| C.D. at 5% | NS | 1.45 | 0.28 | 0.76 | 2.04 | 1.30 | 0.34 | 0.17 | 2.46 | NS | 0.14 |
| | | | | | | | | | | | |
| **Nitrogen and potash each level (kg/ha)** | | | | | | | | | | | |
| $F_1$: 225 kg N and $K_2O$/ha | 4.49 | 39.55 | 3.62 | 6.73 | 27.80 | 11.99 | 2.09 | 2.27 | 44.15 | 41.88 | 1.49 |
| $F_2$: 275 kg N and $K_2O$/ha | 4.56 | 42.07 | 4.35 | 7.26 | 30.40 | 14.00 | 2.29 | 1.16 | 47.85 | 46.69 | 1.77 |
| $F_3$: 325 kg N and $K_2O$/ha | 4.48 | 43.25 | 4.93 | 7.74 | 31.47 | 14.95 | 2.63 | 0.94 | 49.99 | 49.05 | 1.89 |
| S. Em. ± | 0.04 | 0.50 | 0.10 | 0.26 | 0.70 | 0.44 | 0.12 | 0.06 | 0.84 | 0.83 | 0.05 |
| C.D. at 5% | NS | 1.45 | 0.28 | 0.76 | 2.04 | 1.30 | 0.34 | 0.17 | 2.46 | 2.44 | 0.14 |
| **Interaction** | | | | | | | | | | | |
| C×F | NS | NS | NS | NS | NS | NS | NS | 0.29 | NS | NS | NS |
| C.V. % | 3.24 | 4.12 | 7.81 | 12.40 | 8.10 | 11.29 | 17.28 | 13.50 | 6.16 | 6.30 | 9.85 |
| | | | | | | | | | | | |

**Table 2:** Quality parameters and chemical analysis of haulm and tuber influenced by treatment combinations.

| Treatment | Quality parameters | | chemical analysis of haulm and tuber | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dry matter content of tuber (%) | Starch content (%) | N content in tuber (%) | N content in haulm (%) | N uptake by tuber (kg/ha) | N uptake by haulm (kg/ha) | Phosphorus content in tuber (%) | Phosphorus content in haulm (%) | Phosphorus uptake by tuber (kg/ha) | Phosphorus uptake by haulm (kg/ha) | Potassium content in tuber (%) | Potassium content in haulm (%) | Potassium uptake by tuber (kg/ha) | Potassium uptake By haulm (kg/ha) |
| **Name of Cultivars** | | | | | | | | | | | | | | |
| $C_1$: Kufri Ganga | 21.28 | 15.00 | 1.90 | 2.19 | 197.77 | 31.55 | 0.222 | 0.212 | 22.98 | 3.05 | 1.82 | 2.39 | 188.84 | 34.40 |
| $C_2$: Kufri Lima | 16.78 | 11.87 | 1.84 | 2.17 | 141.26 | 47.20 | 0.225 | 0.213 | 17.26 | 4.63 | 1.77 | 2.38 | 135.60 | 51.85 |
| $C_3$: Kufri Khyati | 18.85 | 13.42 | 1.92 | 2.20 | 173.95 | 34.00 | 0.222 | 0.212 | 20.10 | 3.27 | 1.86 | 2.40 | 168.07 | 37.14 |
| S. Em. ± | 0.07 | 0.11 | 0.01 | 0.01 | 3.28 | 1.11 | 0.001 | 0.001 | 0.41 | 0.11 | 0.02 | 0.01 | 3.51 | 1.28 |
| C.D. at 5% | 0.20 | 0.32 | 0.04 | NS | 9.57 | 3.23 | NS | NS | 1.19 | 0.31 | 0.05 | NS | 10.25 | 3.73 |
| | | | | | | | | | | | | | | |
| **Nitrogen and potash each level (kg/ha)** | | | | | | | | | | | | | | |
| $F_1$: 225 kg N and $K_2O$/ha | 18.30 | 13.09 | 1.83 | 2.15 | 148.73 | 32.00 | 0.221 | 0.211 | 17.95 | 3.13 | 1.76 | 2.30 | 142.60 | 34.28 |
| $F_2$: 275 kg N and $K_2O$/ha | 19.15 | 13.44 | 1.90 | 2.19 | 175.20 | 38.88 | 0.223 | 0.213 | 20.57 | 3.78 | 1.82 | 2.40 | 168.24 | 42.67 |
| $F_3$: 325 kg N and $K_2O$/ha | 19.47 | 13.76 | 1.94 | 2.22 | 189.05 | 41.88 | 0.224 | 0.213 | 21.83 | 4.04 | 1.86 | 2.46 | 181.67 | 46.44 |
| S. Em. ± | 0.07 | 0.11 | 0.01 | 0.01 | 3.28 | 1.11 | 0.001 | 0.001 | 0.41 | 0.11 | 0.02 | 0.01 | 3.51 | 1.28 |
| C.D. at 5% | 0.20 | 0.32 | 0.04 | 0.04 | 9.57 | 3.23 | NS | NS | 1.19 | 0.31 | 0.05 | 0.04 | 10.25 | 3.73 |
| **Interaction** | | | | | | | | | | | | | | |
| C×F | 0.34 | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| C.V. % | 1.23 | 2.84 | 2.68 | 2.19 | 6.64 | 10.20 | 1.90 | 1.54 | 7.04 | 10.04 | 3.03 | 2.12 | 7.41 | 10.76 |

**Table 3:** Economics of potato as influenced by different potato cultivars and fertilizer levels

| Treatment | Tuber yield (t/ha) | Gross realization (₹/ha) | Cost of cultivation (₹/ha) | Net realization (₹/ha) | BCR |
|---|---|---|---|---|---|
| **Name of cultivars** | | | | | |
| $C_1$: Kufri Ganga | 46.81 | 561706 | 156988 | 404718 | 2.57 |
| $C_2$: Kufri Lima | 44.62 | 535476 | 156988 | 378488 | 2.41 |
| $C_3$: Kufri Khyati | 46.19 | 554285 | 156988 | 397297 | 2.52 |
| **Nitrogen and potash each level (kg/ha)** | | | | | |
| $F_1$: 225 kg N and $K_2O$/ha | 41.88 | 502595 | 151451 | 351144 | 2.32 |
| $F_2$: 275 kg N and $K_2O$/ha | 46.69 | 560321 | 156988 | 403333 | 2.57 |
| $F_3$: 325 kg N and $K_2O$/ha | 49.05 | 588552 | 162524 | 426028 | 2.62 |

## Conclusion

Based on the results of one year experimentation, it is concluded that for securing better quality higher tubers yield and net return of potato cv. Kufri Ganga should be grown under North Gujarat Agro climatic Zone on loamy sand soil and fertilized with 325 kg each of N and K2O/ha along with RDP (138 kg/ha). Half dose of N and full dose of phosphorus and potash should be applied as basal and remaining half dose of N (50 % RDN) should be applied at 35 DAP.

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## Authors Contribution

All authors contributed equally

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