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# Response of potato cultivars (*Solanum tuberosum* L.) under different nitrogen levels in northern hill zone of Chhattisgarh

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**Abstract**
The present investigation noticed that the "Response of potato cultivars *(Solanum tuberosum* L.) under different nitrogen levels in northern hill zone of Chhattisgarh" was carried out at the research farm of Potato and temperate fruit research station, Mainpat, Surguja (C.G.) during *Rabi* of 2024-25, cultivars Kufri Khyati ($C_1$) recorded the maximum all growth parameters, yield attributing characters and total tuber yield *viz*. plant emergence (90.71%) plant height (39.42cm), number of shoots plant$^{-1}$ (7.25) and number of compound leaves plant$^{-1}$ (42.39) on yield parameters, number of tuber plant$^{-1}$ (8.35), fresh weight of tuber plant$^{-1}$ (335.93 g), tuberization efficiency (2.31) total tuber yield (184.76 q ha$^{-1}$) and tuber yield<50 g (14.46 q ha$^{-1}$), 50-100 g(49.42 q ha$^{-1}$), >100g (120.88 q ha$^{-1}$) as compare to Kufri Kanchan ($C_3$) and Kufri Karan ($C_2$) cultivars. On quality characters maximum dry matter content (22.72%.) in Kufri Kanchan ($C_3$) as compare to Kufri Karan ($C_2$) and Kufri Khyati ($C_1$) cultivars, maximum starch content (17.46%) in Kufri Karan ($C_2$) as compare to Kufri Khyati ($C_1$) and Kufri Kanchan ($C_3$) cultivars, maximum protein content (1.79%) in Kufri Karan ($C_2$) as compare to Kufri Kanchan ($C_3$) and Kufri Khyati ($C_1$) cultivars.
Among the nitrogen levels 225 kg ha$^{-1}$ ($N_3$) recorded maximum all growth parameters, yield attributing characters, total tuber yield and quality characters *viz*. plant emergence (78.77%), plant height (38.35 cm), number of shoots plant$^{-1}$ (5.27) and number of compound leaves plant$^{-1}$ (39.46), and on yield parameters, number of tuber plant$^{-1}$ (8.45), fresh weight of tuber plant$^{-1}$ (334.81 g), total tuber yield (168.16 q ha$^{-1}$), dry matter content (22.31 %), starch content (16.09 %) and protein content (1.54%) which was closely followed by 150 kg ha$^{-1}$ ($N_2$) and 75 kg ha$^{-1}$ ($N_1$).

**Keywords:** (*Solanum tuberosum* L.), Kufri, Chhattisgarh

## Introduction
Potato (*Solanum tuberosum* L.) is known as king of vegetable crop and poor man's food has emerged, as fourth most important food crop in India after rice, wheat and maize. It is an important food and vegetable crop of the world, produces more weight and calories per unit area as compared to all other field crops. Potato tubers are also rich source of starch, vitamins specially C and B and minerals. Potato tubers are contains carbohydrates (20.6%), protein (2.1%), fat (0.3%), crude fiber (1.1%) and ash (0.9%).
Potato is cultivated on the global basis in 16.50 million ha with a production of 375 million tonnes (FAOSTAT, 2023). India is the world's second-largest potato producer country after China. Potato is one of the most important cash crops in India. It is cultivated on an average 2.30 million ha with a production of 59.73 million tonnes with productivity of 25.53 tonnes ha$^{-1}$ (Anonymous, 2023a) [1]. Uttar Pradesh is the major potato producing state with a 31.26 % share followed by West Bengal, Bihar, Gujarat, Madhya Pradesh, Punjab, and Assam respectively. It accounts for nearly 3/4 of the area and contributes to 82% of total potato production in the country. The maximum area as well as the production of potato was recorded in Uttar Pradesh than in West Bengal. In Chhattisgarh, potato occupies about 41330 hectares with a production of 655000 tonnes and a productivity of 15.32 tonnes per hectare. The highest area (7520 ha) and production (103800 tonnes) was recorded in Surguja district followed by Balrampur and Raigarh districts of Chhattisgarh (Anonymous, 2023b) [2].

## Materials and Methods

The field experiment was conducted during *Rabi*, 2024-25 at Research farm of Potato and temperate fruit research station, Mainpat, Surguja (C.G.). Geographically, Mainpat is situated in the north of Chhattisgarh and lies between $22^{0}76'$ N latitude and $83^{0}31'$ E longitude having an altitude of 1085 meter above mean sea level. The soil of experimental field was '*Inceptisols*' which is locally known as '*Chawar*'. The soil was slightly acidic (pH 6.13) in nature with medium in fertility having 0.42 % soil organic carbon, low N (204.8 kg $ha^{-1}$), medium P (13.7 kg $ha^{-1}$) and medium K (218.8 kg $ha^{-1}$). The experiment was laid out in a split plot design with three replications. The treatment consisted three cultivars *viz*. Kufri Khyati ($C_1$), Kufri Karan ($C_2$) and Kufri Kanchan ($C_3$) as main plot treatment and three nitrogen levels (Sub plot) *viz*. 75 kg $ha^{-1}$ ($N_1$), 150 kg $ha^{-1}$ ($N_2$) and 225 kg $ha^{-1}$ ($N_3$) as sub-plot treatment.

The fertilizers were applied as per the treatments. The N, P and K were applied through Urea, Single super phosphate and Muriate of potash. The whole amount of P, K and half amount of N were applied at the time of tuber planting as a basal dose. Whereas, half amout of N was applied as a top dressing 30 DAP and before earthing up.

## Results and Discussion

### Plant Emergence (%)

At 20 DAS, significant differences in plant emergence were observed among the cultivars. The highest plant emergence was recorded with Kufri Khyati ($C_1$) (90.71%), but which was statistically at par with Kufri Kanchan ($C_3$) (81.47%) and the lowest germination percentage was recorded with Kufri Karan ($C_2$) (54.80%) respectively. This might be due to varietal specific character with good quality of potato tuber. Among nitrogen levels, significant differences were also observed at 20 DAS. The highest emergence (78.77%) was recorded with 225 kg $ha^{-1}$ ($N_3$), which was statistically at par with 150 kg $ha^{-1}$ ($N_2$) (76.04%). The lowest emergence was obtained with 75 kg $ha^{-1}$($N_1$) (72.18%).

### Plant Height (cm)

Among the cultivars, Kufri Khyati ($C_1$) consistently recorded higher plant height at all growth stages, while Kufri Karan ($C_2$) showed the lowest plant height throughout the period of observation. This could be due to inherent growth habits governed by genetic traits. Similar results were reported by Kumar *et al*. (2004) [8] and Baishya *et al*. (2010) [3]. With respect to nitrogen levels, the tallest plants were recorded with 225 kg $ha^{-1}$ ($N_3$) at all stages of crop growth, whereas the shortest plants were observed under 75 kg $ha^{-1}$ ($N_1$).

### Number of Shoots $Plant^{-1}$

Across cultivars, Kufri Khyati ($C_1$) produced a significantly higher number of shoots per plant at all observation stages, while Kufri Karan ($C_2$) consistently recorded the lowest. The differences in shoot number may be attributed to varietal genetic makeup, as also reported by Kumar *et al*., (2007) [7].

With respect to nitrogen levels, the maximum number of shoots per plant was observed under 225 kg $ha^{-1}$ ($N_3$), which was statistically at par with 150 kg $ha^{-1}$ ($N_2$). The minimum number of shoots was consistently recorded under 75 kg $ha^{-1}$($N_1$).

### Number of Compound Leaves $Plant^{-1}$

Among cultivars, Kufri Khyati ($C_1$) produced significantly more compound leaves per plant compared to other varieties at all growth stages, whereas Kufri Karan ($C_2$) recorded the least. This may be attributed to genetic growth habits, as also reported by Kumar *et al*. (2007) [7].

Among nitrogen levels, the maximum number of compound leaves per plant was found under 225 kg $ha^{-1}$ ($N_3$), followed by 150 kg $ha^{-1}$ ($N_2$), while the minimum was recorded with 75 kg $ha^{-1}$ ($N_1$).

### Number of Tubers $Plant^{-1}$

Among the cultivars, Kufri Khyati ($C_1$) recorded the highest number of tubers per plant (8.35), while Kufri Karan ($C_2$) recorded the lowest. The variation may be due to varietal growth habits and better nutrient absorption, which enhanced photosynthesis and translocation of assimilates towards tuber formation. These results are in agreement with Kumar *et al*. (2004) [8].

With respect to nitrogen levels, the highest number of tubers per plant (8.45)was recorded under 225 kg $ha^{-1}$($N_3$), followed by 150 kg $ha^{-1}$($N_2$), while the lowest was observed under 75 kg $ha^{-1}$($N_1$).Increasing doses of nitrogen resulted in a gradual increase in the number of tubers in all the cultivars. Among the nutrient treatments 225 kg $ha^{-1}$ ($N_3$) recorded significantly better performance with maximum number of tubers $plant^{-1}$ than other treatments. This might be due to sufficient supply of nutrients which promoted larger, thick, dark green and succulent leaves production, due to meristematic activities in plant cell. This also improves the efficient utilization of sunlight and other growth factors, which ultimately resulted the maximum production of photosynthates and translocation from leaf to tubers (Baishya *et al*., 2010) [3].

### Fresh Weight of Tubers $Plant^{-1}$(g)

Kufri Khyati ($C_1$) recorded the maximum fresh weight of tubers per plant (335.93 g), while Kufri Karan ($C_2$) recorded the lowest. Among nitrogen levels, significantly higher fresh tuber weight per plant (334.81g) was observed with 225 kg $ha^{-1}$($N_3$), followed by 150 kg $ha^{-1}$($N_2$), whereas the lowest weight was observed with 75 kg $ha^{-1}$($N_1$).

### Tuberization Efficiency (Tuber: Haulm)

Significant differences were recorded among cultivars, with Kufri Khyati ($C_1$) exhibiting the highest tuberization efficiency (2.31), while Kufri Karan ($C_2$) recorded the lowest (2.06). Among nitrogen levels, the highest tuberization efficiency (2.20) was recorded with 225 kg $ha^{-1}$ ($N_3$), followed by 150 $kgha^{-1}$ ($N_2$). The minimum efficiency (2.12) was observed under 75 $kgha^{-1}$ ($N_1$).

### Grade-wise and Total Tuber Yield (q $ha^{-1}$)

Among cultivars, Kufri Khyati ($C_1$) recorded significantly higher yields in all grades: <50 g (14.46 q $ha^{-1}$), 50-100 g (49.42 q $ha^{-1}$), >100 g (120.88 q $ha^{-1}$), with the maximum total yield (184.76 q $ha^{-1}$). Kufri Karan ($C_2$) consistently recorded the lowest yields across grades. These variation in different grades wise tuber yield of cultivars might be due to genetic variation or adoptability of the cultivars to the climatic conditions of the experimental site Similar findings were also reported by Sahu *et al*., (2016), Joshi *et al*., (2014), Jatav *et al*., (2018) [9, 6, 5].

With respect to nitrogen levels, 225 kg ha$^{-1}$($N_3$) gave the highest yields of <50 g (12.17 q ha$^{-1}$, at par with 150 kg ha$^{-1}$ ($N_2$), 50-100 g (47.32 q ha$^{-1}$), >100 g (108.67 q ha$^{-1}$), and total tuber yield (168.16 q ha$^{-1}$). The minimum yield across all categories was observed with 75 kg ha$^{-1}$ ($N_1$).

**Economics (Gross Returns, Net Returns, and B:C Ratio)**

Among cultivars, the cost of cultivation remained similar; however, Kufri Khyati ($C_1$) registered the highest gross return (₹369,517 ha$^{-1}$), net return (₹270,221 ha$^{-1}$), and benefit-cost ratio (2.72). In contrast, Kufri Karan ($C_2$) recorded the lowest gross return (₹211,053 ha$^{-1}$), net return (₹111,757 ha$^{-1}$), and B:C ratio (1.12).

Among nitrogen levels, the maximum gross return (₹336,326 ha$^{-1}$) and net return (₹235,725 ha$^{-1}$) and B:C ratio (2.34) were recorded with 225 kg ha$^{-1}$($N_3$). The lowest gross return (₹268,460 ha$^{-1}$), net return (₹170,468 ha$^{-1}$), and B:C ratio (1.74) were recorded with 75 kg ha$^{-1}$($N_1$).Related finding was reported by Sahu *et al*., (2016) [9].

**Table 1:** Effect of different cultivars on plant emergence (%), plant height (cm), number of shoots plant$^{-1}$, number of compound leaves plant$^{-1}$of different nitrogen levels

| Treatment | Plant emergence (%) | Plant height (cm) 90 DAS | Number of shoots plant$^{-1}$90DAS | Number of compound leaves plant$^{-1}$90 DAS |
|---|---|---|---|---|
| **Cultivars** | | | | |
| $C_1$-Kufri Khyati | 90.71 | 39.42 | 7.25 | 42.39 |
| $C_2$- Kufri Karan | 54.80 | 35.47 | 3.67 | 36.29 |
| $C_3$- Kufri Kanchan | 81.47 | 37.73 | 4.00 | 38.92 |
| SEm± | 0.33 | 0.79 | 0.14 | 0.29 |
| CD (P= 0.05%) | 1.29 | 3.09 | 0.54 | 1.13 |
| **Nitrogen Levels (Kgha$^{-1}$)** | | | | |
| $N_1$- 75 | 72.18 | 36.53 | 4.67 | 38.86 |
| $N_2$- 150 | 76.04 | 37.74 | 4.98 | 39.29 |
| $N_3$- 225 | 78.77 | 38.35 | 5.27 | 39.46 |
| SEm± | 0.58 | 0.30 | 0.17 | 0.33 |
| CD (P= 0.05%) | 1.78 | 0.94 | 0.51 | 1.02 |

**Table 2:** Effect of different cultivars on number of tuber plant$^{-1}$ at harvest, fresh weight of tuber plant$^{-1}$ (g) at harvest, tuberization efficiency, grade wise and total tuber yield (q ha$^{-1}$) of different nitrogen levels

| Treatment | Number of tuber plant$^{-1}$at harvest | Fresh weight of tuber plant$^{-1}$(g) at harvest | Tuberization efficiency | Grade wise and total tuber yield (qha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|
| **Cultivars** | | | | **<50 (g)** | **50-100(g)** | **>100(g)** | **Total yield** |
| $C_1$-Kufri Khyati | 8.35 | 335.93 | 2.31 | 14.46 | 49.42 | 120.88 | 184.76 |
| $C_2$- Kufri Karan | 6.07 | 266.67 | 2.06 | 8.29 | 36.00 | 61.24 | 105.53 |
| $C_3$- Kufri Kanchan | 8.00 | 309.63 | 2.14 | 11.82 | 44.45 | 107.46 | 163.73 |
| SEm± | 0.04 | 2.27 | 0.02 | 0.28 | 0.21 | 0.45 | 0.72 |
| CD (P= 0.05%) | 0.18 | 8.92 | 0.06 | 1.11 | 0.84 | 1.78 | 2.83 |
| **Nitrogen Levels (Kgha$^{-1}$)** | | | | | | | |
| $N_1$- 75 | 6.49 | 274.26 | 2.12 | 10.93 | 38.03 | 85.26 | 134.23 |
| $N_2$- 150 | 7.48 | 303.15 | 2.19 | 11.47 | 44.51 | 95.64 | 151.62 |
| $N_3$- 225 | 8.45 | 334.81 | 2.20 | 12.17 | 47.32 | 108.67 | 168.16 |
| SEm± | 0.03 | 4.59 | 0.03 | 0.31 | 0.26 | 0.31 | 0.64 |
| CD (P= 0.05%) | 0.10 | 14.13 | 0.09 | 0.97 | 0.81 | 0.97 | 1.99 |

**Table 3:** Effect of different cultivars on gross return (₹ ha$^{-1}$), net return (₹ha$^{-1}$), B: C ratio, grade wise and total tuber yield (q ha$^{-1}$) of different nitrogen levels

| Treatment | Gross return(₹ ha$^{-1}$) | Net return (₹ha$^{-1}$) | B: C ratio |
|---|---|---|---|
| **Cultivars** | | | |
| $C_1$-Kufri Khyati | 369517 | 270221 | 2.72 |
| $C_2$- Kufri Karan | 211053 | 111757 | 1.12 |
| $C_3$- Kufri Kanchan | 327451 | 228154 | 2.29 |
| SEm± | 1439 | 1439 | 0.01 |
| CD (P= 0.05%) | 5651 | 5651 | 0.06 |
| **Nitrogen Levels (Kg ha$^{-1}$)** | | | |
| $N_1$- 75 | 268460 | 170468 | 1.74 |
| $N_2$- 150 | 303235 | 203939 | 2.05 |
| $N_3$- 225 | 336326 | 235725 | 2.34 |
| SEm± | 1290 | 1290 | 0.01 |
| CD (P= 0.05%) | 3974 | 3974 | 0.04 |

**Conclusion**

On the basis of experimentation on cultivars with nitrogen levels applied in potato crop under *Inceptisol* it can be concluded that:-Variety Kufri Khyati ($C_1$) recorded maximum growth parameters, yield attributes, all grade wise yield, total tuber yield, net income and B:C ratio under higher nitrogen level with 225 kg ha$^{-1}$ ($N_3$).

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