*Original Research Article*

# Economics of potato cv. Kufri Lima under different planting dates and nitrogen levels


## ABSTRACT

The experiment entitled "Effect of planting dates and nitrogen levels on potato cv. Kufri Lima" was conducted at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during winter season of 2020-21. The treatments comprising of three planting dates (25$^{th}$ September, 10$^{th}$ October and 25$^{th}$ October) and four levels of nitrogen (0, 75, 100 and 125% of RDN) were laid out in a randomized block design (factorial) with three replications. Results of study revealed that significantly increase in growth and yield on 10$^{th}$ October planting as compared to earlier and late planting. Total marketable yield was recorded with 10$^{th}$ October planting with 100% RDN application (408 q/ha), closely followed by 125% RDN application (407.7 q/ha) and minimum was recorded under control. It can be concluded that 10$^{th}$ October with application of 100% of RDN (150 kg N/ha) provided with highest marketable yield and benefit to cost ratio (1.82).



**KEY WORDS:** Potato tuber, nitrogen, planting date, marketable yield, economics


## 1. INTRODUCTION

Potato (*Solanum tuberosum* L.), also known as king of vegetables, belonging to the family Solanaceae. It is most important vegetable crops in the world and in terms of human consumption. Whenever there has been a scarcity of food grains, it has come to the rescue of people, as it yields higher up to 40-50 t/ha. Potato is one of the main cash crops among vegetables, which is grown and consumed all round the world. It contains high protein-calorie ratio and yields more edible energy, protein (3 kg/ha/day) and dry matter per unit area and time (47.6 kg/ha/day) compared to cereals (Ezekiel and Pandey, 2008). Potato can be grown on soil having pH in the range of 5.5-7.5 for e.g., alluvial, black, red and laterite soil (Pandey, 2007) but the best soil type for better growth of tubers is sandy loam soil. It exceptionally yields high and completely fits in multi-cropping systems which is prevalent under tropical as well as subtropical agro-climatic conditions.

India ranks 2$^{nd}$ in potato production after china, with cultivation over an area of 2.17 million hectares with the total production of 50.19 million tons and a productivity of 23.1 metric

ton per hectare during 2018-19. In Haryana it is cultivated over an area of 34.72 thousand hectares with a production of 813.80 thousand metric tons (Anonymous, 2018).

Nitrogen and planting time plays very crucial role for higher potato tuber yield. Widely fluctuating N levels result in irregular tuber growth and often end in the formation of internal (brown center and hollow heart) and external (misshapen) tuber deformities. Adequate nitrogen at tuberization produces large size tubers which increase marketable yield whereas, deficiency at this stage causes smaller tuber formation, hence reduces marketable tubers. Excessive application of nitrogen translocates the photosynthates from tops to tubers which directly affects the growth and yield. Timing of nitrogen fertilizer application had a direct impact on potato fertilizer efficiency and nitrate leaching. A higher nitrogen proportion at pre-planting tended to reduce potato tuber size; whereas a high proportion of nitrogen supplied at tuber initiation resulted in lower yield and higher residual soil mineral nitrogen at season's end.( Zotarelli, 2015)

The rate of development of seed depends on soil temperature. The optimum soil temperature for initiating tubers growth is 16-19°C, it declines as soil temperatures rise above 20°C and tuber growth practically stops at soil temperature above 30°C. The yield remains maximum when the average daytime temperature is about 21°C. The cool night is important because they affect the accumulation of carbohydrates and dry matter in the tubers. Among various factors playing important role in deciding the production, productivity and keeping quality of the potato, the date of planting is most dominant ones. Therefore, the present study was undertaken to study the economics of potato cv. Kufri lima tuber production under optimum planting date and nitrogen level for sustainable agriculture.

## 2. MATERIAL AND METHODS

The experiment was carried out at vegetable research farm of CCS Haryana Agricultural University, Hisar during 2020-21. This region is characterized by semi- arid climate with hot winds in summer and dry severe cold in winter. The soil of field was sandy loam having 10.05 % clay and EC 0.27 $dSm^{-1}$ in 0-30 cm layer. The soil pH and organic carbon content was 7.95 and 0.47% respectively. The experiment was laid in Randomized Block Design (Factorial), keeping three planting dates $S_1$- 25$^{th}$ September, $S_2$- 10$^{th}$ October, $S_3$- 25$^{th}$ October and four fertilizer levels, *i.e.*, $N_1$- 0 % of RDN, $N_2$- 112.5 kg N/ha (50% of RDN), $N_3$- 150 kg N/ha (75% of RDN) and $N_4$- 187.5 kg N/ha (100% of RDN) which were replicated thrice. The recommended dose of fertilizer for the state is 150 kg/ha nitrogen, 50 kg/ha phosphorus and 100 kg/ha potassium. The benefit-cost ratio (B:C) was calculated as (Gross return ÷ Cost of cultivation). Statistical analysis of data collected during the study was done by applying the technique of analysis of variance

(ANOVA) as suggested by Panse and Sukhatme (1987). All the statistical analysis was carried out by using OPSTAT statistical software.

## 3. RESULTS AND DISCUSSION

### Yield parameters

The data demonstrated that different planting dates and nitrogen levels significantly affected the total marketable tuber yield (q/ha) was recorded maximum with 10th October planting as compared to early and late planting dates. As the temperature is one of the most dominating factors in yield contribution in potato crop temperatures during vegetative as well as reproductive growth phase might have suitable towards getting better vegetative growth and higher yield in this planting date. The present results are similar to the finding of Thongam *et al*. (2017), recorded the highest tubers yield with 10th October planting as compared to delayed planting. Early planting from October 20 to October 30 can be used for maximum marketable yield (Kumar *et al*., 2009).

Among the different nitrogen levels, weight of marketable tuber yield were recorded in the range 187.3 to 285.1 q/ha, which were observed significantly highest for the 125% of RDN application, it was at par with 100% of RDN. Total marketable tuber yield increased with increase in nitrogen levels upto 100% of RDN, higher than this level of nitrogen application has no significant effect on tuber yield.

**Table 1.1: Effect of planting dates and nitrogen levels on total marketable yield (q/ha)**

| **Planting dates** | **Nitrogen levels (% of RDN)** | | | | **Mean** |
|---|---|---|---|---|---|
| | **$N_0$** | **$N_{75}$** | **$N_{100}$** | **$N_{125}$** | |
| 25th September | 71.4 | 102.3 | 119.1 | 124.5 | **104.3** |
| 10th October | 273.7 | 311.1 | 408.0 | 407.7 | **350.1** |
| 25th October | 217.0 | 282.5 | 322.4 | 323.0 | **286.2** |
| **Mean** | **187.3** | **232.0** | **283.2** | **285.1** | |
| **CD at 5%** | Planting dates: 29.8 | | Nitrogen levels: 34.4 | | Interaction: N.S. |
| **SE(D)** | Planting dates: 10.1 | | Nitrogen levels: 11.6 | | Interaction: 20.2 |

Inadequate supply of nitrogen fertilizer to potato crop leads to poor growth and yield, while excessive application of nitrogen, especially as mineral fertilizer, leads to luxury consumption for plant growth, occasionally a reduction in yield and quality of tubers, delayed maturity and leaching of excessive nitrate in soil (Arriaga *et al*., 2009; Cerny *et al*., 2010). Yield of any crop is a function of intergraded metabolic plant processes, which depend on adequate and balanced supply of nutrients. Nitrogen improves leaf chlorophyll content and plant growth, *i.e.*,

plant height, number of stems, leaf number and leaf area, which thereby might have encouraged much more metabolites to produce higher total yield. The result of present investigation are in line with the findings of Sahu *et al*. (2016) and Banjare *et al*. (2014), they noticed the maximum marketable as well as total tuber yield with nitrogen dose of 225 kg/ha.

## Economics

The data on economics of different treatments of planting dates and nitrogen levels have been presented in table 1.2. Among different treatments, the maximum net income (Rs. 1,62,342/ha) was obtained from combination of 10$^{th}$ October planting with application of 100% of RDN (150 kg/ha), followed by application of 125% of RDN on same date of planting (Rs. 1,62,111), and in these treatments, the cost of cultivation was Rs. 89432 and Rs. 89917/ha, respectively.

**Table 1.2: Effect of planting dates and nitrogen levels on economics of different treatments**

| Treatments | Common cost (Rs./ha) | Treatment cost (Rs./ha) | Total cost (Rs./ha) | Yield (q/ha) | Gross return (Rs./ha) | Net return (Rs./ha) | B:C ratio |
|---|---|---|---|---|---|---|---|
| **25$^{th}$ September** | | | | | | | |
| **0** | 87505 | 0 | 87505 | 75.8 | 45474 | -42031 | -0.48 |
| **75 % of RDN** | 87505 | 1442 | 88947 | 104.1 | 62484 | -26463 | -0.30 |
| **100 % of RDN** | 87505 | 1927 | 89432 | 121.2 | 72713 | -16719 | -0.19 |
| **125% of RDN** | 87505 | 2412 | 89917 | 126.3 | 75806 | -14111 | -0.16 |
| **10$^{th}$ October** | | | | | | | |
| **0** | 87505 | 0 | 87505 | 288.7 | 173202 | 85697 | 0.98 |
| **75 % of RDN** | 87505 | 1442 | 88947 | 326.3 | 195758 | 106811 | 1.20 |
| **100 % of RDN** | 87505 | 1927 | 89432 | 419.6 | 251774 | 162342 | 1.82 |
| **125% of RDN** | 87505 | 2412 | 89917 | 420.0 | 252028 | 162111 | 1.80 |
| **25$^{th}$ October** | | | | | | | |
| **0** | 87505 | 0 | 87505 | 228.1 | 136834 | 49329 | 0.56 |
| **75 % of RDN** | 87505 | 1442 | 88947 | 294.5 | 176717 | 87770 | 0.99 |
| **100 % of RDN** | 87505 | 1927 | 89432 | 335.1 | 201088 | 111656 | 1.25 |
| **125% of RDN** | 87505 | 2412 | 89917 | 335.7 | 201412 | 111495 | 1.24 |

Cost of seed @ Rs. 1000/q; Potato sold@ Rs. 600/q; Cost of fertilizer: Urea @ Rs. 5.91/kg; SSP @ Rs. 7/kg; MOP @ Rs. 15/kg

In terms of benefit to cost ratio, again the treatment 10th October planting with application of 100% of RDN nitrogen gave the maximum benefit cost ratio (1.82) and it was closely followed with 125% of RDN application on 10th october planting (1.80).

The highest net income (Rs. 1,62,342 $ha^{-1}$) and benefit to cost ratio (1.82) was obtained from the variety Kufri Lima planting on 10th October with application of 100% of RDN. This may be due to higher marketable and total tuber yield under these treatments The results of present investigation are similar with the results of Banjare *et al*. (2014) and Mozumder *et al*. (2014), they obtained maximum gross as well as net returns and benefit to cost ratio with the treatment where tuber yield was recorded maximum. Sahu *et al*. (2016) also reported the maximum gross as well as net returns and benefit to cost ratio from the variety Kufri Pukhraj supplied with nitrogen at the rate of 225 kg/ha.

## 4. CONCLUSION

Based on research carried out during winter season of 2020-21 at research farm of Department of Vegetable Science, CCS HAU, Hisar, it is concluded that the potato variety Kufri Lima planting on 10th October with application of 100% of RDN (150 kg N/ha) provided with highest marketable yield (408 q/ha), net return (Rs. 1,62,342/ha) and benefit to cost ratio (1.82).

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**APPENDIX-I**

| Sr. No. | Operations/Particulars | No. of units | Rate (Rs.)/unit | Value in Rs. |
|---|---|---|---|---|
| **COMMON COST** | | | | |
| 1 | Preparatory tillage | 4 | 1000 $ha^{-1}$ | 4000 |
| 2 | Planting | 1 | 2500 $ha^{-1}$ | 2500 |
| 3 | Seed | 25 q | 1000 $q^{-1}$ | 25000 |
| 4 | Fertilizer application (Labour) | 2 | 350 $labour^{-1}$ | 700 |
| 5 | SSP | 312 kg | 7.00 $kg^{-1}$ | 2184 |
| 6 | MOP | 166 kg | 15.00 kg-$^{1}$ | 2656 |
| 7 | Labour for irrigation | 7 | 350 $labour^{-1}$ | 2450 |
| 8 | Hoeing and weeding/ herbicide | 1 | 3000 | 3000 |
| 9 | Plant protection | 1 | 2000 $ha^{-1}$ | 2000 |
| 10 | Harvesting | 30 (labour) | 350 $labour^{-1}$ | 10500 |
| 11 | Miscellaneous | - | - | 800 |
| 12 | Working capital (1 to 11) | | | **55785** |
| 13 | Interest on working capital @ 12% per annum | 4 month | - | 2231 |
| 14 | Transportation | - | 10000 $ha^{-1}$ | 10000 |
| 15 | Management charge (10% of 15) | | | 5578 |
| 16 | Risk charges (10%) | | | 5578 |
| 17 | Rental value of land | 4 months | 25000/ha/year | 8333 |
| **Total** | | | | **87505** |
| **TREATMENT COST** | | | | |
| **Sr. No.** | **Operations/Particulars** | **Amount of Urea (kg)** | **Rate** | **Value in Rs.** |

| | | | | |
|---|---|---|---|---|
| 1 | Nitrogen 0 kg/ha | 0 | Rs. 5.91/kg | 0 |
| 2 | Nitrogen 112.5 kg/ha | 244 | Rs. 5.91/kg | 1442 |
| 3 | Nitrogen 150 kg/ha | 326 | Rs. 5. 91/kg | 1927 |
| 4 | Nitrogen 187.5 kg/ha | 408 | Rs. 5.91/kg | 2411 |
| **OUTPUTS** | | | | |
| **Particulars** | | **Price Rs./unit** | | |
| Tuber yield | | 600/q | | |