



# Effect of Planting Dates and Nitrogen Levels on Tuber Quality of Potato cv. Kufri Lima

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The experiment 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<sup>th</sup> September, 10<sup>th</sup> October and 25<sup>th</sup> 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.

Potato tuber quality parameters like dry matter of tubers and haulms, reducing, non-reducing and total sugar were recorded maximum under 10<sup>th</sup> October planting, whereas, ascorbic acid and specific gravity of tubers were found non-significant. While, among the different nitrogen levels, 125% of RDN application recorded significantly maximum values for reducing, non-reducing and total sugar, while ascorbic acid, dry matter content of tuber as well haulms increased with increase

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in nitrogen levels upto 100% of RDN. Specific gravity of tubers was found maximum where no nitrogen was applied.

The highest values for nitrogen, phosphorus and potassium uptake in haulms and tubers were registered with 10<sup>th</sup> October planting, whereas, nitrogen uptake in haulms, phosphorus uptake of tubers also found at par with 25<sup>th</sup> October planting. Among the nitrogen levels, maximum NPK uptake in haulms and tubers were recorded with 125% of RDN application, whereas, phosphorus and potassium uptake by haulms was increased significantly with increasing nitrogen levels upto 100% of RDN application. The leftover NPK in soil after harvest was noted maximum with earlier planting (25<sup>th</sup> September), while among the different nitrogen levels, leftover nitrogen in soil was increased with increasing levels of nitrogen upto 100% of RDN, while, phosphorus and potassium availability was recorded in reverse trends.

**Keywords:** *Potato; tuber; nitrogen; planting dates; NPK.*

## 1. INTRODUCTION

Potato (*Solanum tuberosum* L.), is a perennial herbaceous plant that belongs to the family (Solanaceae) and species *Solanum tuberosum* L. (2n=4x=48). Protein of potato is more superior to that of cereals due to presence of “lysine” (Pandey, 2001). It can also help to fight against malnutrition and hunger due to high production potential and high nutritional value. Besides reducing malnutrition it has medicinal values like the juice of potato reduces gastrogenic problems and also provides relief and heals burned skin wounds.

Potato is a temperate region crop but can also be grown under subtropical climatic conditions. Potato is a long day plant but it is cultivated as short day plant for tuber, it is raised in India when maximum day temperature is below 35°C and the maximum night temperature is below 20°C. Temperature about 16-22°C is observed to be the best for its tuber formation which is adversely affected when the temperature rises above 30°C. Therefore, potato is grown during the *Rabi* season characterized by cooler and dry weather preferably in the winter months and quality tuber production depends on a sum of environmental and soil factors. Hence, suitable planting schedule is a factor which determine the production and productivity and quality parameters of the crop as evident in other winter crops like strawberry (Paul et al., 2017) and sweet potato (Nedunchezhiyan & Byju, 2005). Meanwhile, soil nutrition is the other most crucial factor dictating crop growth and development under such challenging subtropical climatic conditions (Howlader et al., 2019; Sultana et al., 2022). So, fertilizer nitrogen a date of planting are two most limiting entities to be addressed for quality tuber production.

Nitrogen is the most vital and responsible for the synthesis of amino acids, protein, coenzymes and nucleic acid formation, which are accountable for cell division and elongation which ultimately results in higher vegetative growth (Rahman et al., 2023). Potato is a sensitive crop to application management of nitrogen, which is one of the top management priorities for potato growing systems (Stark et al., 2004). It determines the quantity and structure of potato yield, its chemical composition and tuber quality (Kolodziejczyk, 2014). It primarily influences tuber size, dry matter and sugar contents. Excessive application of nitrogen translocates the photosynthates from tops to tubers which directly affects the yield. Specific gravity will vary within a range for a given cultivar because it is strongly influenced by climate, soil and cultural factors. Nitrogen fluctuation during the growing season influence different tuber characteristic including tuber weight, specific gravity and endogenous nitrogen concentration.

Proper fertilization with inorganic sources plays an important role in increasing quantity and quality of produce (Seghatoleslami et al., 2013). But excessive and indiscriminate use of inorganic fertilizers can lead to environmental degradation, soil nutrient imbalances, and increased production costs (Kayesh et al., 2023; Gomasta et al., 2024). Furthermore, the overuse of chemical nutrients contributes to the emission of greenhouse gases, water pollution through runoff, and long-term soil fertility decline due to nutrient leaching and altered microbial communities (Apu et al., 2022; Hassan et al., 2024). So, judicious soil amendments with fertilizers particularly nitrogen is essential for maintaining or enhancing crop productivity and soil health. Selection of high yielding variety is also too important as different varieties respond differently to various soil nutrients levels. Excess

soil nitrogen levels during tuberization can delay growth of tuber, yield and also lessen the specific gravity. This delay in tuber maturation can adversely affect the storage and quality of the potatoes.

Potato is a weather sensitive crop. Planting dates is considered very important to take the full advantage of the short growing period. Earlier planting is not possible due to unfavourable weather conditions. Tuberization rate in potato declines above a temperature of 17°C, increasing temperature may lead to reduced yields in potato. Early planted potatoes are high in starch content (White & Sanderson, 1983) and low in glucose and fructose (Nelson & Shaw, 1976) whereas, delayed planting results in reduced dry matter and starch content and increased reducing sugar (Lisinska & Leszczynski, 1987) of the tubers. Kufri Lima (CP4054) is an early season high yielding variety suitable for planting in North-Indian plains, having tolerance to hopper and mite burn, good keeping and culinary quality.

## 2. MATERIALS AND METHODS

### 2.1 Description of the Study Area and Climatic Conditions

The present study entitled was conducted at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during *Rabi* season of 2020-21. Hisar is situated at latitude of 29° 10' N, longitude of 75° 46'E and height of 215.2 meters above mean sea level and falls in semi-arid and sub-tropical region with dry and hot summer and severe cold in winter. The total rainfall (approx. 400 mm) and its distribution in this region are subjected to large variation. About 80 to 90% of the total rainfall is received through southwest monsoon during July to September with few showers

during winter and spring seasons. The average minimum and maximum temperature as well as relative humidity during the crop period was between 8 to 25°C and 54 to 94.1 %, respectively. Before conducting the investigation, the composite sample (500 g) of soil were taken from the experimental field up to a depth of 15 cm and subjected to mechanical analysis to know the chemical composition of the experimental field.

### 2.2 Treatment and Experimental Details

The experiment was laid out in a randomized block design (factorial) with three replications, keeping three planting dates, viz., 25<sup>th</sup> September, 10<sup>th</sup> October and 25<sup>th</sup> October and four nitrogen levels, viz., nitrogen 0 kg/ha, i.e. control, 75% RDN, 100% RDN and 125% RDN. The seed material (tubers) of potato varieties Kufri Lima used for the present investigation was procured from the Department of Vegetable Science, CCS Haryana Agricultural University. The recommended dose of phosphorus (50 kg/ha) and potassium (100 kg/ha) for the crop and nitrogen was applied in two split doses as per treatments. The remaining half of the nitrogen was applied at the time of earthing up (35 DAP). Recommended dose of nitrogen by university is 150kg/ha for this crop. Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and muriate of potash, respectively. The statistical method described by Panse and Sukhatme (1967) was followed for the analysis of variance and interpretation of experimental results. For this, OPSTAT statistical software was used, developed by Chaudhry Charan Singh Haryana Agricultural University, Hisar, Haryana, India. All the tests of significance were made at 5% level of the significance. Critical difference was computed to test the significance of difference between means of two treatments.

**Table 1. Physico-chemical characteristics of soil of experimental field before experimentation**

Component	Values	Method
Clay (%)	10.05	International pipette method (Piper, 1966)
Silt (%)	16.50	
Sand (%)	79.85	
pH (1:2)	7.95	pH meter having glass electrode (Walkley and Black, 1934)
EC (dSm <sup>-1</sup> at 25° C)	0.27	Walkley and Black (1934)
Organic carbon (%)	0.47	Walkley and Black (1934)
Available nitrogen (kg ha <sup>-1</sup> )	122.4	Alkaline Permanganate method (Subbaih & Asija, 1956)
Available phosphorus (kg ha <sup>-1</sup> )	22.1	Sodium bicarbonate soluble P method (Olsen <i>et al.</i> , 1954)
Available potassium (kg ha <sup>-1</sup> )	210	Ammonium acetate method (Jackson,1973)

### List 1. List of method used for the study

Nutrient	Method used	Reference
N	Nessler's reagent method	Lindner (1944)
P	Ammonium Vanademolybdo- Phosphoric acid yellow colour method	Koening and Johnson (1942)
K	Flame photometric method	Jackson (1973)

## 2.3 Crop Raising and Data Recording

The experimental field was prepared by four harrowings each followed by planking to prepare a suitable planting bed. The potato tuber was planted according to treatment in the net plot of 3.0 m × 3.0 m with plant spacing of 60 cm × 20 cm. The recommended package of practices was followed for raising the crop successfully. Haulm cutting of potato crop was done at 90 days after planting of crop as per treatments, harvested after 10-15 days of haulm cutting. The thin slices of tuber and haulms (washed) weight of 200 g from each plot was taken and then dried separately first in polyhouse for 5-7 days and then in hot air oven at 60°C temperature until a constant weight was achieved. The dry matter content of haulms and tuber was worked out by using the following formula:

Dry matter (%) =

$$\frac{\text{Oven dried haulms/tuber weight (g)}}{\text{Fresh haulms/tuber weight (g)}} \times 100$$

The weight of sample unit in air divided by weight of sample unit in water is one of the commonly used methods to determine the specific gravity. Specific sample units were first weighed in air and then the same units were re-weighed after suspending in water.

For NPK estimation in potato tuber and haulm, samples were collected just after harvesting washed and dried in hot air oven at 65°C for three days. The dried samples were ground in stainless steel Wiley mill, passed through sieve of 40-mesh size and thus analyzed as per standard procedures for NPK content.

To analyze N, P and K content of tubers and haulm, the prepared samples were digested in diacid mixture of H<sub>2</sub>SO<sub>4</sub> and HClO<sub>4</sub> (4:1). The final volume of the digested samples was made 50 ml by using distilled water, followed by filtration and storage for further assessment. The

NPK contents were analyzed by the methods mentioned above.

Sugars are estimated by the method of Hulme and Narain (1931) and the ascorbic acid content was determined by the standard method (A.O.A.C., 1980).

## 3. RESULTS AND DISCUSSION

### 3.1 Total Yield

The data demonstrated that different planting dates and nitrogen levels significantly affected the total (kg/m<sup>2</sup>) was recorded maximum with 10<sup>th</sup> 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 10<sup>th</sup> October planting as compared to delayed planting. Similarly in strawberry, a temperature sensitive crop like potato, yielded the best when planted during early November rather December or late planting (Paul *et al.*, 2017).

Among the different nitrogen levels, weight of tubers (kg/m<sup>2</sup>) were recorded in the range 1.98 to 2.94 kg/m<sup>2</sup>, which were observed significantly highest for the 125% of RDN application, it was at par with 100% of RDN. 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). Such non-significant statistical variations with higher nitrogen levels corresponds to the crops nitrogen uptake limits upto a certain levels as noticed by Gomasta *et al.* (2024) and Hassan *et al.* (2024) in tomato.

**Table 2. Effect of planting dates and nitrogen levels on quality parameters of potato tubers**

Treatments	Dry matters %		Specific gravity	Sugar (mg/100g)			Ascorbic acid (mg/100g)
	Leaves	Tubers		Reducing	Non reducing	Total	
	<b>Planting dates</b>						
25 <sup>th</sup> sept.	8.7	17.1	1.06	214.9	152.3	375.2	20.5
10 <sup>th</sup> oct.	10.9	17.9	1.06	224.8	160.6	393.9	20.8
25 <sup>th</sup> oct	9.9	17.0	1.07	219.4	157.1	384.8	20.7
SE(M)	0.2	0.2	0.002	1.3	1.0	1.2	0.5
CD	0.7	0.7	N.S.	3.8	3.0	3.5	N.S.
	<b>Nitrogen levels</b>						
N <sub>0</sub>	8.6	15.9	1.078	189.7	140.9	338.1	19.3
N <sub>75</sub>	9.5	16.8	1.068	209.4	151.5	368.8	19.8
N <sub>100</sub>	10.3	18.0	1.054	230.5	162.7	401.8	21.4
N <sub>125</sub>	10.9	18.6	1.047	249.2	171.6	429.8	22.0
SE(M)	0.3	0.3	0.002	1.5	1.2	1.4	0.5
CD	0.8	0.9	0.007	4.4	3.4	4.1	1.6

**Table 3. Effect of planting dates and nitrogen levels on nutrient uptake and post-harvest soil status**

Treatments	Uptake by Haulm (%)			Uptake by Tubers (%)			Soil status after harvest (%)		
	N	P	K	N	P	K	N	P	K
	<b>Planting Dates</b>								
25 <sup>th</sup> sept.	29.4	6.4	89.4	52.0	10.0	119.0	160.8	22.5	237.0
10 <sup>th</sup> oct.	35.9	9.5	99.7	62.3	14.9	135.3	149.2	18.2	230.2
25 <sup>th</sup> oct	34.3	8.5	96.4	59.0	12.9	130.2	153.1	20.6	233.4
SE(M)	0.6	0.2	0.8	0.8	0.6	1.2	2.0	0.5	1.0
CD	1.7	0.6	2.3	2.3	1.8	3.5	5.8	1.6	3.0
	<b>Nitrogen Levels</b>								
N <sub>0</sub>	23.9	4.4	60.4	43.7	8.7	95.9	117.3	22.3	243.0
N <sub>75</sub>	32.4	7.1	94.5	56.7	9.9	115.6	143.4	20.8	239.4
N <sub>100</sub>	37.1	10.3	111.8	63.7	15.1	147.6	175.6	20.0	230.2
N <sub>125</sub>	39.2	10.8	114.0	67.0	16.7	153.6	181.4	18.7	221.6
SE(M)	0.6	0.2	0.9	0.9	0.7	1.4	2.3	0.6	1.2
CD	1.9	0.7	2.7	2.7	2.1	4.0	6.7	1.9	3.5

**Table 4. Interaction effect of planting dates and nitrogen levels on different parameters**

Interaction	Total yield (kg/m <sup>2</sup> )	Total sugar in tuber (mg/100g)	K uptake by tuber
D <sub>1</sub> N <sub>0</sub>	0.76	334.0	84.8
D <sub>1</sub> N <sub>75</sub>	1.04	361.1	114.6
D <sub>1</sub> N <sub>100</sub>	1.21	387.7	135.0
D <sub>1</sub> N <sub>125</sub>	1.26	418.1	141.6
D <sub>2</sub> N <sub>0</sub>	2.89	344.9	99.2
D <sub>2</sub> N <sub>75</sub>	3.27	377.1	131.5
D <sub>2</sub> N <sub>100</sub>	4.20	413.0	152.3
D <sub>2</sub> N <sub>125</sub>	4.20	440.4	158.0
D <sub>3</sub> N <sub>0</sub>	2.28	335.3	103.8
D <sub>3</sub> N <sub>75</sub>	2.95	368.2	100.5
D <sub>3</sub> N <sub>100</sub>	3.35	404.6	155.3
D <sub>3</sub> N <sub>125</sub>	3.35	431.1	161.1
SE (m)	0.14	2.4	2.4
CD	0.42	7.0	7.1

### 3.2 Quality Parameters

Dry matter of tubers and haulm influenced significantly with different planting dates and maximum was recorded with 10<sup>th</sup> October planting. It may be due to that 10<sup>th</sup> October planting is the optimum date of planting of potato var. Kufri Lima. Begum *et al.*, (2015) also reported that optimum date of planting showed highest dry matter content as compared to delayed plating. The dry matter content of tubers and haulms (%) for different nitrogen levels was recorded in the range of 15.9 to 18.6% and 8.6 to 10.9%, respectively and noted significantly highest dry matter content of tubers (18.6%) and haulms (10.9%) with 125% of RDN application closely followed with 100% of RDN. Zinada *et al.* (2009) observed that nitrogen increment significantly increased tuber dry matter percentage, probably due to an increase in new leaf formation and extended activity of older leaves. The stimulatory effect of nitrogen application in increasing dry matter of potato tubers might be explained that nitrogen is an indispensable elementary constituent of numerous organic compounds of general importance, *i.e.*, cytoplasm, chlorophyll, amino acids, proteins, nucleic acids and many other important compounds, which might have improved the dry matter content of tubers. As the nitrogen level increased, fresh and dry weight of plant were also increased and found significantly maximum with the application of nitrogen 200 kg /ha (Sriom *et al.*, 2017) and with 187.5 kg/ha (Chopra *et al.*, 2006). Dry matter enhancement after soil nitrogen amendments also addressed by Rahman *et al.* (2023) in off-season okra under semi-arid conditions.

The data on specific gravity of potato tubers revealed that different planting date had non-significant and nitrogen levels had significant influence on specific gravity of tuber. Specific gravity for different nitrogen levels was fluctuated in the range of 1.047 to 1.078 and significantly maximum (1.078) was noticed in control plots (without nitrogen application) and lowest specific gravity (1.047) was recorded with 125% of RDN. It is clear from the results that specific gravity of tubers decreased with increasing nitrogen levels. Nitrogen fertilization increased the tuber nitrogen and NO<sub>3</sub>-N concentrations, and decreased specific gravity in Atlantic Canada variety of potato (Belanger *et al.*, 2002). Yassen *et al.* (2011) observed the highest specific gravity (1.071) was recorded with 200 kg N/ha and lowest at 250 kg N/ha.

The reducing, non-reducing and total sugar content (mg/100 g) in tubers was observed significantly maximum with 10<sup>th</sup> October planting. Among the different nitrogen levels, reducing, non reducing and total sugar content in tubers was increased with increase in nitrogen levels and it was significantly highest (249.2, 171.6, 429.8 mg/100) for the 125% of RDN application. Reducing sugar of potato tubers increased with increasing rates of nitrogen up to 187.7 kg/ha and decreased thereafter (Chopra *et al.*, 2006). Banu *et al.* (2007) noted that reducing sugars and crude protein content were increased with increase in nitrogen levels and maximum (190 mg/100g) was recorded at 240 kg N/ha application, while Sandhu *et al.* (2010) found maximum up to 200 kg N/ha. The interaction effect of planting dates and nitrogen levels was significant for total sugar content of tubers and recorded in the range of 334.0 to 440.4 mg/100g.

The maximum total sugar content (440.4 mg/100 g) was recorded with 10<sup>th</sup> October planting along with application of 125% of RDN which was considerably higher than all other interactions, whereas the minimum was recorded in the plot with planting on 25<sup>th</sup> September without application of nitrogen fertilizer.

The data on ascorbic acid (mg/100g) content in tubers revealed that different nitrogen levels significantly influenced the ascorbic acid (mg/100g) content of tubers but planting dates was found statistically non-significant. In context of different nitrogen treatments, ascorbic acid fluctuated in the range of 19.3 to 22.0 mg/100 g and significantly maximum was noticed with 125% of RDN, it was at par with 100% of RDN (21.4 mg/100 g) application. Mondy *et al.* (1979) concluded that there was significant relation between ascorbic acid content and nitrogen levels, as nitrogen level increased there was significant increase in ascorbic acid of tuber.

Nitrogen, phosphorus and potassium uptake (kg/ha) in haulms was found significantly affected with different planting dates and nitrogen levels. Among the planting dates, significantly maximum nitrogen, phosphorus and potassium in haulms (35.9, 9.5, 99.7 kg/ha, respectively) was found with 10<sup>th</sup> October planting. This may be due to that plant got favourable environmental condition planting on this date, which resulted vigorous plant growth and maximum uptake of nutrients from the soil. Among the different nitrogen levels, nitrogen, phosphorus and potassium uptake by the haulms was observed in the scale of 23.9-39.2, 4.4-10.8, 60.4-114 kg/ha, respectively and significantly maximum was observed with 125% of RDN closely followed with 100% of RDN. The increased accumulation of nitrogen, phosphorus and potash in haulms might be due to more absorption of these elements from the soil caused by better growth and development of root and aerial portion with successive increase in fertility levels. Kumar and Trehan (2012) reported that increase in nitrogen levels from 0 to 240 kg/ha significantly increased the uptake of nitrogen by haulm from 10.73 to 29.07 kg N/ha.

Nitrogen, phosphorus and potassium uptake by the tuber was significantly differed with different planting date and nitrogen levels. Among the planting dates, nitrogen, phosphorus and potassium uptake were recorded significantly maximum (62.3, 14.9, 135.3 kg/ha, respectively) with 10<sup>th</sup> October planting, whereas, phosphorus was at par with 20<sup>th</sup> October planting. As the

temperature is one of the most dominating factors for potato crop, the required temperatures during vegetative as well as reproductive growth phase might have suitable towards getting better vegetative growth and higher nutrient uptake by tubers in this planting date. Sandhu *et al.* (2014) also found the maximum uptake of NPK in potato tuber with optimum planting time.

Among the different nitrogen levels, nitrogen, phosphorus and potassium uptake by the tubers was observed in the range of 43.7-67.0, 8.7-16.7, 95.9-153.6 kg/ha, respectively and significantly maximum nitrogen, phosphorus and potassium uptake by the tubers was recorded with application of 125% of RDN, while, phosphorus uptake by tuber was at par with 100% of RDN application. The increased content of nitrogen, phosphorus and potash in tubers might be due to more uptakes of these elements from the soil with successive increase in fertility levels and their slow utilization under low temperature conditions in the field. Kumar and Trehan (2012) also noticed significantly increase in nitrogen uptake by tubers with increasing nitrogen levels from 0 to 240 kg/ha. Similarly, with increasing levels of nitrogen, tuber nitrogen content (Kumar *et al.*, 2008) and potassium content (Mahmoodi and Hakimian, 2005) also increased significantly.

For potassium uptake in tubers, the effect of interaction between planting dates and nitrogen levels was found significant; moreover considerably maximum (161.1 kg/ha) uptake of potassium in tubers was observed when crop was planted on 25<sup>th</sup> October with 125% of RDN application, it was at par with 100% of RDN on same date of planting and 125% of RDN application with 10<sup>th</sup> October planting.

Available nitrogen, phosphorus and potassium in soil after harvesting of potato crop was observed significantly difference among the different planting dates and nitrogen levels and 25<sup>th</sup> September planted crop recorded maximum leftover NPK (160.8, 22.5, 237 kg/ha, respectively) in soil after crop harvest. The higher leftover values for nitrogen, phosphorus and potassium in soil on early planting date (25<sup>th</sup> September) might be due to less utilization of these elements because of poor plant growth and tuber yield.

Among the different nitrogen levels, available nitrogen in soil after harvesting crop was increased with increase in nitrogen levels, whereas, phosphorus and potassium was

recorded in reverse trends. The significantly highest leftover nitrogen in soil after harvesting of crop was recorded with 125% of RDN application, which was at par with 100% of RDN, while phosphorus was recorded with the treatment where no nitrogen was applied, closely followed with 75 % of RDN application and for potassium availability, significantly highest was recorded with treatment where no nitrogen was applied.

The maximum leftover value for nitrogen in soil where its highest dose was applied might be due to its excessive application than the crop requirement, while the higher leftover values for phosphorus and potassium in soil where no nitrogen was given might be due to less utilization of these elements because of poor plant growth and tuber yield. The respective increase in total nitrogen, phosphorus and potassium uptake was recorded when they were applied at the rate of 150, 150 and 100 kg/ha in the presence of farmyard manure 15 t/ha (Datt et al., 2002). The highest nitrogen and potassium was available in soil at all stages of potato growth when nitrogen and potassium each was applied 180 kg/ha (Lakshmi et al., 2012).

#### 4. CONCLUSION

Based on one-year study, 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 10<sup>th</sup> October with application of 100% of RDN provided with high quality potato tuber.

#### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

- A.O.A.C. (1980). *Official methods of analysis* (11th ed.). Association of Official Analytical Chemists. Washington, D.C. USA.
- Apu, S. C., Biswas, M. S., Bhuiyan, M. A. B., Gomasta, J., Easmin, S., & Kayesh, E. (2022). Effect of organic amendments and arbuscular mycorrhizal fungi on plant growth, yield and quality of strawberry. *Annals of Bangladesh Agriculture*, 26(2), 71–82.
- Arriaga, F. J., Lowery, B., & Kelling, K. A. (2009). Surfactant impact on nitrogen utilization and leaching in potatoes. *American Journal of Potato Research*, 86, 383–390.
- Banu, S. S., Thiyagarajan, T. M., & Malavizhi, P. (2007). Effect of graded levels of fertilizers on quality aspects of potato. *Potato Journal*, 34(3–4), 242–244.
- Begum, F., Kundu, B., & Hossain, M. (2015). Physiological analysis of growth and yield of potato in relation to planting date. *Journal of Bangladesh Academy of Sciences*, 39(1), 45–51.
- Belanger, G., Walsh, J. R., Richards, J. E., Milburn, R. H., & Ziadi, L. N. (2002). Nitrogen fertilization and irrigation affects tuber characteristics of two potato cultivars. *American Journal of Potato Research*, 79, 269–279.
- Cerny, J., Balik, J., Kulhanek, M., Casova, K., & Nedved, V. (2010). Mineral and organic fertilization efficiency in long-term stationary experiments. *Plant Soil Environment*, 56, 28–36.
- Chopra, S., Kanwar, J. S., & Samnotra, R. K. (2006). Effect of different levels of nitrogen and potassium on growth, yield and biochemical composition of potatoes variety Kufri Jawahar. *Environment and Ecology*, 24(2), 268–271.
- Datt, N., Sharma, R. P., & Rana, M. C. (2002). Balanced fertilization and manuring of sprinkler irrigated potatoes in Lahaul valley of Himachal Pradesh. *Journal of Indian Potato Association*, 29(1–2), 47–50.
- Gomasta, J., Hassan, J., Sultana, H., & Kayesh, E. (2024). Interactive plant growth regulator and fertilizer application dataset on growth and yield attributes of tomato (*Solanum lycopersicum* L.). *Data in Brief*, 57, 111136.
- Hassan, J., Sultana, H., Gomasta, J., & Kayesh, E. (2024). Substitution of chemical fertilization using PGRs evident in growth and yield of tomato. *Journal of Science and Technology Research*, 6(1), 53–64.
- Howlader, M. I. A., Gomasta, J., & Rahman, M. M. (2019). Integrated nutrient management for tomato in the southern region of Bangladesh. *International Journal of Innovative Research*, 4(3), 55–58.

- Jackson, M. L. (1973). *Soil chemical analysis*. Prentice Hall of India Private Limited.
- Kayesh, E., Gomasta, J., Bilkish, N., Koly, K. A., & Mallick, S. R. (2023). A holistic approach of organic farming in improving the productivity and quality of horticultural crops. In *Organic Fertilizers—New Advances and Applications*. IntechOpen.
- Koenig, R. A., & Johnson, C. R. (1942). Colorimetric determination of phosphorus in biological materials. *Industrial and Engineering Chemistry Analytical Edition*, 14(2), 155–156.
- Kołodziejczyk, M. (2014). Effect of nitrogen fertilization and microbial preparations on potato yielding. *Plant, Soil and Environment*, 60(8), 379–386.
- Kumar, M., & Trehan, 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, M., Jadav, M. K., & Trehan, S. P. (2008). Contributing organic sources to potato nutrition at varying nitrogen levels. *Global Potato Conference*, New Delhi, 9–12 December, 2008.
- Lakshmi, D. V., Padmaja, G., & Rao, P. C. (2012). Effect of levels of nitrogen and potassium on soil available nutrient status and yield of potato (*Solanum tuberosum* L.). *Indian Journal of Agricultural Research*, 46(1), 36–41.
- Lindner, R. C. (1944). Rapid analysis method for some of the more common inorganic constituents of plant tissues. *Plant Physiology*, 19, 76–86.
- Lisinska, G., & Leszczynski, W. (1987). *9th Kartoffel-Tagung*, Detmold, Germany, 3–4.
- Mahmoodi, S. H., & Hakimian, M. (2005). *Principle of soil science* (Translation). Tehran University Press.
- Mondy, N. I., Koch, R. L., & Chandra, S. (1979). Influence of nitrogen fertilization on potato discoloration in relation to chemical composition. 2. Phenols and ascorbic acid. *Journal of Agricultural and Food Chemistry*, 27, 418–420.
- Nedunchezhiyan, M., & Byju, G. (2005). Effect of planting season on growth and yield of sweet potato (*Ipomoea batatas* L.) varieties. *Journal of Root Crops*, 31(2), 111–114.
- Nelson, D. C., & Shaw, R. (1976). Effect of planting and harvest dates, location in the hill and tuber size on sugar content of Kennebec potatoes. *American Potato Journal*, 53, 15–21.
- Olsen, S. R., Cole, C. V., Watenabe, F. S., & Dean, L. A. (1954). *Estimation of available phosphorous in soil by extraction with sodium bicarbonate*. United States Department of Agriculture Center.
- Pandey, R. P. (2001). Introduction. In *The potato*. Pusa Agril Book Service.
- Panase, V. G., & Sukhatme, P. V. (1987). *Statistical methods for agricultural research workers*. ICAR Publications.
- Paul, C., Gomasta, J., & Hossain, M. M. (2017). Effects of planting dates and variety on growth and yield of strawberry. *International Journal of Horticulture, Agriculture and Food Science*, 1(4), 1–12.
- Piper, C. S. (1966). *Soil and plant analysis*. Hans Publisher.
- Rahman, S. A., Khan, S. A., Iqbal, S., Rehman, M. M., & Kim, W. Y. (2023). Eco-Friendly, High-Performance Humidity Sensor Using Purple Sweet-Potato Peel for Multipurpose Applications. *Chemosensors*, 11(8), 457.
- Sandhu, A. S., Sharma, S. P., Bhutani, R. D., & Khurana, S. C. (2014). Effects of planting dates and fertilizer dose on plant growth attributes and nutrient uptake of potato (*Solanum tuberosum* L.). *International Journal of Agricultural Science*, 4(5), 196–202.
- Sandhu, K. S., Chinna, G. S., Marwaha, R. S., Kumar, P., & Pandey, S. K. (2010). Effect of nitrogen fertilization on yield and chipping quality of processing varieties grown in cooler North Indian Plains. *Potato Journal*, 37(3–4), 43–150.
- Seghatoleslami, M., Mousavi, G., Mahdavi, R., & Zabihi, H. (2013). Response of yield and yield component of fenugreek to irrigation intervals, potassium and zinc. *Annual Review and Research in Biology*, 3(4), 466–474.
- Sriom, M. D., Rajbhar, P., Singh, D., Singh, R. K., & Mishra, S. K. (2017). Effect of different levels of nitrogen on growth and yield in potato (*Solanum tuberosum* L.) cv. Kufri Khyati. *International Journal of Current Microbiology and Applied Sciences*, 6(6), 1456–1460.
- Stark, J. C., Westermann, D. T., & Hopkins, B. G. (2004). Nutrient management guidelines for russet burbank potatoes. *University of Idaho College of Agricultural and Life Sciences Bulletin*, 840, 5–7.
- Subbiah, B. V., & Asija, G. L. (1956). A rapid produce for determination of estimation of available nitrogen in soil. *Current Science*, 25, 259–260.

- Sultana, N., Mannan, M. A., Khan, S. A. K. U., Gomasta, J., & Roy, T. (2022). Effect of different manures on growth, yield and profitability of small scale brinjal (egg-plant) cultivation in gunny bag. *Asian Journal of Agricultural and Horticultural Research*, 9(1), 52–60.
- Thongam, B., Kadam, A. S., Singh, A. A., & Singh, Y. H. (2017). Influence of planting dates on growth and yield of potato (*Solanum tuberosum* L.). *Journal of Pharmacognosy and Phytochemistry*, 6(6), 1243–1246.
- Walkley, A. J., & Black, L. A. (1934). Estimation of soil organic carbon by the chromic acid titration method. *Soil Science*, 37, 29–38.
- White, R. P., & Sanderson, J. B. (1983). Effect of planting date, nitrogen rate and plant spacing on potatoes grown for processing in Prince Edward Island. *American Potato Journal*, 60(2), 115–126.
- Yassen, A. A., Safia, M. A., & Sahar, M. Z. (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(11), 1296–1303.
- Zinada, I. A. I. A. (2009). Potato response to potassium and nitrogen fertilization under Gaza strip conditions. *Journal of Al Azhar University-Gaza (Natural Sciences)*, 11, 15–30.

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