Potato J (2023) 50 (1): 17-25

KUFRI UDAY: AN EARLY MATURING RED SKIN POTATO VARIETY

SK Luthra[1]*, VK Gupta[1], Sanjay Rawal[1], Bandana[1], Vinod Kumar[2], Vinay Bhardwaj[2], SK Chakrabarti[2] and MS Kadian[3]

ABSTRACT: Kufri Uday is an early maturing, main season, high yielding table potato variety suitable for cultivation in North Indian plains (Northern, Central, and Eastern plains). It is a clonal selection from the cross between CIP387521.3 × Aphrodite. Its plants are medium tall and vigorous with field resistance to late blight. It produces attractive red coloured ovoid tubers with shallow eyes, yellow flesh, and a mealy texture. The new variety possesses 18-19% tuber dry matter and very good keeping quality. It is fertilizer responsive and capable of yielding 36–38 t/ha under optimum agronomical practices.

KEYWORDS: Kufri Uday, variety, table potato, early maturity, red skin, high yield, late blight, keeping quality, North-Indian plains

INTRODUCTION

In India, though mostly white or yellow skinned potatoes are preferred by consumers, however, red skin potatoes are liked mainly in the eastern part of India. But, the preference for red skin potatoes is increasing in other areas also due to the liking of the migrant population and more awareness about red potatoes among people. Market supply chain dynamics are also influencing potato growers in different regions for raising red skin varieties. Efforts are continuing for developing better genotypes in this segment for potato growers and consumers to meet the ever-increasing demand. The concerted effort, in this direction, has led to the identification of an early maturing, high yielding, late blight resistant variety named Kufri Uday.

BACKGROUND

CP4409 (CIP392797.22 - C92.140) was developed at International Potato Center (CIP), Lima Peru in 1992 and was brought to India in 2012 under ICAR-CIP collaborative programme on potato crop improvement. The clone CP4409 (CIP392797.22) (LTVR-Low land tropic virus resistant) is a descendant of cross CIP387521.3 × Aphrodite. In Peru, the clone is known to be resistant to late blight, and field testing in 17 areas of Peru's coastal lowlands, confirmed it to be tolerant to heat, drought, and soil salinity (https://cipotato.org/blog/unica-a-potato-for-farmers-around-the-world/). The CIP advanced clone, CIP392797.22 has been officially released in different countries as Unica (Peru, 1998), Qingshu 9 (China, 2011), Tajikistan (Tajikistan, 2014), Yusi Maap (Bhutan, 2017), Mkanano (Africa, 2018), Unica (CIP392797.22) (Nigeria, 2023). Local experts estimated that more than 150,000 hectares in China were planted with Qingshu 9 in 2015 (https://www.rtb.cgiar.org/news/improved-potato-variety-qingshu-9-success-story/). Clone CIP392797.22, a red-skinned, high yielding and moderately resistant to late blight, was released as

[1]ICAR-Central Potato Research Institute, Regional Station, Modipuram, Meerut - 250110, Uttar Pradesh, India
[2]ICAR-Central Potato Research Institute, Shimla - 171 001, Himachal Pradesh, India
[3]International Potato Center, South West and Central Asia Region, New Delhi 110 012.
*Corresponding author; email: skluthra@hotmail.com

'Yusi Maap', and it is a micronutrient (iron and zinc) dense variety (Bajgai *et al*. 2018). This clone is presently being evaluated for possible release in Uzbekistan and Georgia. This variety is one of the most adaptable, high yielding and climate resilient potato varieties across the globe (Luthra *et al.* 2022). The pedigree of CP4409 is described in Fig. 1. The female parent CIP387521.3 belongs to International Potato Center (CIP), Lima Peru, whereas the male parent Aphrodite is from the Netherlands. Aphrodite is a very early to early maturing variety with a slight resistance to late blight and produces white/ yellow ovoid tubers with shallow eyes and light yellow flesh colour.

In India, the advanced clone CP4409 was evaluated during the main season at Modipuram (2014-15, 2015-16, and 2016-17) following the breeding procedure of Luthra *et al*. 2022 and based on its superior performance; it was introduced in All India Co-ordinated Research Project (AICRP) - Potato and tested during 2018-19, 2019-20 and 2020-21 at 8 locations in North Indian plains comprising northern, central and eastern plains. It showed wider adaptability and higher yield than the controls. The data was analyzed following standard statistical procedures using the online statistical software OPSTAT, CCS HAU, Hisar, Haryana (Sheoran *et al*, 1998).

The advanced clone CIP392797.22 (CP4409) under AICRP trials in India was however got released in Bhutan as Yusi Maap (2017) and subsequently, it was notified in India (2019) under the Regional Seed Agreement for plains of India. However, in the Foreign Aided Project Meeting of the Horticultural Sciences Division, ICAR, New Delhi on 22nd June 2022, the name of Yusi Maap was changed to Kufri Uday as per the tradition of ICAR-CPRI.

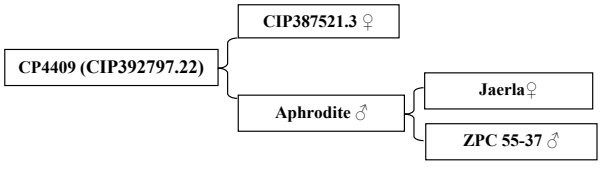


Fig.1. Pedigree of Kufri Uday

VARIETAL DESCRIPTION

Morphological characteristics of the variety Kufri Uday (leaf, flower, sprout, and tuber) have been depicted in Fig. 2.

Plant: Medium, canopy semi-compact, stem medium thick, predominantly green, secondary stem colour red brown throughout lightly scattered, wings poorly developed and straight.

Foliage: Grey green, leaves open, leaf width medium, leaflets ovate lanceolate, leaflet coalescence absent, rachis coloured, midrib coloured at the base.

Inflorescence

Flowering: Flowering medium, inflorescence small, floral stalk medium coloured, floral



Fig. 2. Morphological characteristics of Kufri Uday: Leaf, flowers, tuber and sprout

stalk-pedicle articulation clearly visible and located above the middle, calyx light red brown, corolla red violet, corolla shape pentagonal, anther yellow, anther cone normally developed, stylar length longer than stamen column and stigma round uni-lobed.

Tubers

Size: Medium to large, 8-9 tubers per plant; *Shape:* Ovoid; *Skin:* Smooth and red; *Eyes:* Shallow, predominantly apical; *Eyebrows:* Normal; *Flesh:* Yellow with a mealy texture.

Sprout

Red purple, spherical, pubescence at sprout base is weak, sprout tip closed, length of apical sprout is medium (2-5 cm).

YIELD PERFORMANCE

Station trials: CP4409 (43.02 t/ha) yielded 11 and 21 % higher total tuber yield over Kufri Lalit (38.75 t/ha) and Kufri Lalima (35.65 t/ha), respectively at 90 days (**Table 1**). It produced nearly 95% marketable tuber yield as compared to Kufri Lalit (95%) and Kufri Lalima (94%). The variety with 40.91 t/ha marketable tuber yield showed benefits of 11 and 23% respectively over control varieties Kufri Lalit (36.83 t/ha) and Kufri Lalima (33.39 t/ha).

Multi-location testing: Replicated yield trials with controls were conducted at 8 locations during 2018-19 and 2019-20 (**Table 2**) and 2020-21 (**Table 3**) in North Indian plains comprising Northern (Jalandhar, Hissar, Modipuram), Central (Kanpur) and Eastern plains (Bhubaneshwar, Faizabad, Kalyani, Patna).

Replicated yield trials (2018-19 & 2019-20)

Crop duration (75 days): Based on the pooled performance of eight locations, advanced clone CP4409 (30.01 t/ha) yielded 7 and 16 % higher total tuber yield over Kufri Lalit (27.97 t/ha) and Kufri Lalima (25.91 t/ha), respectively (**Table 2**). CP4409 produced nearly 93% marketable tuber yield as compared to Kufri Lalit (91%) and Kufri Lalima (87%).

Crop duration (90 days): The results pooled over eight locations, showed superior performance of advanced clone CP4409 (37.40 t/ha) by 7 and 17 % for higher total tuber yield as compared to Kufri Lalit (35.07 t/ha) and Kufri Lalima (32.03 t/ha), respectively (**Table 2**). CP4409 produced nearly 93% marketable tuber yield as compared to Kufri Lalit (93%) and Kufri Lalima (91%).

Replicated yield trials (2020-21)

Crop duration (75 days): Based on the pooled performance of eight locations, advanced clone CP4409 (32.59 t/ha) yielded 16, 17 and 24% higher total tuber yield over Kufri Manik (28.12 t/ha), Kufri Lalit (27.93 t/ha) and Kufri Lalima (26.30 t/ha), respectively (**Table 3**). CP4409 produced nearly 88% marketable tuber yield as compared to Kufri

Table 1. Mean performance of CP4409 at Modipuram during 2014-2017

Genotypes	Tuber yield (t/ha) at 90 days								% Yield ± over controls	
	2014-15		2015-16		2016-17		Mean			
	MTY	TTY	MTY	TTY	MTY	TTY	MTY	TTY	MTY	TTY
CP4409	33.37	35.10	46.55	48.85	42.80	45.12	40.91	43.02	-	-
Kufri Lalit	30.83	32.79	41.62	43.73	38.04	39.73	36.83	38.75	11.08	11.02
Kufri Lalima	27.86	29.99	37.65	40.15	34.65	36.80	33.39	35.65	22.52	20.67
CD (0.05)	2.25	1.93	1.60	1.54	2.16	2.11	2.75	2.67		

MTY: Marketable tuber yield; TTY: Total tuber yield

Table 2. Mean performance of CP4409 in AICRP trials (2018-19 & 2019-20) at 75 and 90 days

Regions	Locations	Total tuber yield (t/ha) at 75 days			Total tuber yield (t/ha) at 90 days)		
		CP4409	Kufri Lalit	Kufri Lalima	CP4409	Kufri Lalit	Kufri Lalima
Northern plains	Hissar	39.14	35.29	32.42	43.00	42.08	38.76
	Jalandhar	33.25	33.61	28.78	42.72	40.14	35.50
	Modipuram	37.41	31.97	33.23	46.22	48.30	45.83
Central plains	Kanpur	34.73	32.68	28.80	42.21	35.75	31.41
Eastern plains	Bhubaneshwar	20.01	15.18	15.42	24.85	18.93	16.91
	Faizabad	26.77	28.46	23.11	36.24	35.71	32.03
	Kalyani	25.80	20.71	23.01	32.63	32.59	31.01
	Patna	23.00	25.85	22.54	31.36	27.07	24.80
Mean		30.01	27.97	25.91	37.40	35.07	32.03
% Yield ±			7.31	15.82		6.65	16.77
CD (0.05)		Genotypes: 0.73, Genotype x location: 2.72)			Genotypes: 0.70, Genotype x location: 2.52		

Table 3. Mean performance of CP4409 in AICRP trials (2020-21) at 75 and 90 days

Regions	Locations	Total tuber yield (t/ha) at 75 days				Total tuber yield (t/ha) at 90 days)			
		CP4409	Kufri Manik	Kufri Lalit	Kufri Lalima	CP4409	Kufri Manik	Kufri Lalit	Kufri Lalima
Northern plains	Hissar	41.53	32.99	34.06	32.88	55.07	43.64	46.42	39.71
	Jalandhar	42.71	37.76	43.4	41.49	49.48	45.83	51.04	50.87
	Modipuram	29.69	30.79	27.92	29.19	43.26	38.32	43.94	38.12
Central plains	Kanpur	29.31	28.58	23.96	23.65	44.90	27.50	27.47	34.31
Eastern plains	Bhubaneshwar	13.38	8.45	10.38	10.82	20.46	13.72	12.25	16.71
	Faizabad	35.01	33.48	33.08	25.97	38.62	37.52	36.05	35.02
	Kalyani	36.62		26.77	27.47	38.39		27.36	30.24
	Patna	32.45	24.78	23.9	18.92	34.91	27.79	27.43	21.84
Mean		32.59	28.12	27.93	26.30	40.64	33.47	34.00	33.35
% Yield ±			15.89	16.66	23.91		21.40	19.54	21.84
CD (0.05)		Genotypes: 1.13, Genotype x location: 4.50				Genotypes: 0.92, Genotype x location: 3.57			

Manik (88%), Kufri Lalit (88%), and Kufri Lalima (93%).

Crop duration (90 days): The results pooled over eight locations, showed superior performance of advanced clone CP4409 (40.64 t/ha) by 21, 20, and 22% higher total tuber yield over Kufri Manik (33.47 t/ha), Kufri Lalit (34.00 t/ha) and Kufri Lalima (33.35 t/ha), respectively (**Table 3**). CP4409 produced nearly 89% marketable tuber yield as compared to Kufri Manik (91%), Kufri Lalit (89%), and Kufri Lalima (95%).

Overall performance of advanced clone CP4409 in AICRP on Potato

Crop duration (75 days): In Northern plains, CP4409 (37.17 t/ha) produced 10, 9, and 14% higher total tuber yield over controls Kufri Manik (33.85 t/ha), Kufri Lalit (34.13 t/ha) and Kufri Lalima (32.49 t/ha), respectively. In Central plains, CP4409 (32.92 t/ha) produced 15, 11 and 22% higher total tuber yield over controls Kufri Manik (28.58 t/ha), Kufri Lalit (29.77 t/ha) and Kufri Lalima (27.09 t/

ha), respectively. In Eastern plains, CP4409 (26.83 t/ha) produced 21, 20 and 26% higher total tuber yield over controls Kufri Manik (22.24 t/ha), Kufri Lalit (22.44 t/ha) and Kufri Lalima (21.31 t/ha), respectively. Based on mean performance over 8 locations and years, advanced clone CP4409 (31.47 t/ha) yielded 12, 13 and 20% higher total tuber yield over Kufri Manik (28.12 t/ha), Kufri Lalit (27.74 t/ha) and Kufri Lalima (26.23 t/ha), respectively (**Table 4**). CP4409 produced nearly 92% marketable tuber yield than Kufri Manik (88%), Kufri Lalit (90%), and Kufri Lalima (90%).

Crop duration (90 days): In Northern plains (locations representing Punjab, Haryana, and western Uttar Pradesh), CP4409 (45.74 t/ha) produced 7, 2, and 12% higher total tuber yield over controls Kufri Manik (42.60 t/ha), Kufri Lalit (44.72 t/ha) and Kufri Lalima (40.99 t/ha), respectively. In Central plains (Kanpur representing central Uttar Pradesh), CP4409 (43.09 t/ha) produced 57, 31 and 33% higher total tuber yield over controls Kufri Manik (27.50 t/ha), Kufri Lalit (32.99 t/ha) and Kufri Lalima (32.38 t/ha), respectively. In Eastern plains (locations representing Orissa, Eastern Uttar Pradesh, West Bengal, and Bihar), CP4409 (31.94 t/ha) produced 21, 18 and 22% higher total tuber yield over controls Kufri Manik (26.34 t/ha), Kufri Lalit (27.14 t/ha) and Kufri Lalima (26.12 t/ha), respectively. The results pooled over eight locations and years, showed the superiority of advanced clone CP4409 (38.51 t/ha) by 15, 12 and 19% for higher total tuber yield over Kufri Manik (33.47 t/ha), Kufri Lalit (34.46 t/ha) and Kufri Lalima (32.48 t/ha), respectively (**Table 4**). CP4409 produced nearly 92% marketable tuber yield than Kufri Manik (91%), Kufri Lalit (92%), and Kufri Lalima (93%).

Tuber dry matter content

At station trials, CP4409 contained nearly 18% tuber dry matter as compared to 18%

Table 4. Mean performance of CP4409 in AICRP trials (2018-19, 2019-20 & 2020-21) at 75 and 90 days

Regions	Locations	Total tuber yield (t/ha) at 75 days				Total tuber yield (t/ha) at 90 days)			
		CP4409	Kufri Manik	Kufri Lalit	Kufri Lalima	CP4409	Kufri Manik	Kufri Lalit	Kufri Lalima
Northern plains	Hissar	40.27	32.99	34.88	32.57	47.03	43.64	43.53	39.08
	Jalandhar	36.40	37.76	36.88	33.02	44.97	45.83	43.77	40.62
	Modipuram	34.84	30.79	30.62	31.88	45.23	38.32	46.85	43.26
	Mean	37.17	33.85	34.13	32.49	45.74	42.60	44.72	40.99
	% Yield ±		9.82	8.92	14.40		7.39	2.30	11.61
Central plains	Kanpur	32.92	28.58	29.77	27.09	43.09	27.50	32.99	32.38
	% Yield ±		15.19	10.58	21.52		56.69	30.62	33.08
Eastern plains	Bhubaneshwar	17.88	8.45	13.19	12.45	22.66	13.72	15.59	16.81
	Faizabad	31.22	33.48	30.31	25.88	37.03	37.52	35.82	33.02
	Kalyani	30.98		21.17	25.31	35.51		29.98	30.63
	Patna	27.24	24.78	25.07	21.61	32.55	27.79	27.19	24.01
	Mean	26.83	22.24	22.44	21.31	31.94	26.34	27.14	26.12
	% Yield ±		20.66	19.59	25.89		21.23	17.66	22.28
Grand mean		31.47	28.12	27.74	26.23	38.51	33.47	34.46	32.48
% Yield ±			11.91	13.46	19.99		15.04	11.73	18.58

in Kufri Lalit and 19% in Kufri Lalima at 90 days (**Table 5**). Advanced clone CP4409 possessed comparable mean tuber dry matter content (%) of 17 and 19% at 75 and 90 days, respectively in comparison to controls Kufri Lalit (18 and 19%) and Kufri Lalima (19 and 20%) in multi-location AICRP on Potato trials during 2018-19 and 2019-20 (**Table 6**). During 2020-21 (**Table 7)**, this clone maintained 17 and 19% tuber dry matter content across the locations at 75 and 90 days as compared to Kufri Manik (16 and 18%), Kufri Lalit (17 and 18%) and Kufri Lalima (17 and 19%).

Keeping quality

Advanced clone CP4409 was adjudged to be a very good keeper as it exhibited medium tuber dormancy (6-8 weeks), comparatively less total weight loss, rottage, sprout weight, and firm tuber appearance after 75 days of on-farm storage in station trials (**Table 8**). It clearly showed an advantage of very good keeping quality by having nil rottage and total weight loss (8.65%) as compared to the new red skin variety Kufri Lalit (2.60 and 9.34%). It had lower rottage and at par total weight loss when compared to the prevalent red skin variety Kufri Lalima (0.99 and 7.64%). Very good keeping quality of CP4409 will benefit small and marginal farmers, who are unable to store potatoes in cold stores. Normally, they store potatoes in traditional stores at their farm for a short period of about 75 days and sell their produce afterward in the market.

Table 5. Tuber dry matter content of CP4409 at Modipuram, Meerut

Genotypes	Tuber dry matter (%			
	2014-15	2015-16	2016-17	Mean
CP4409	17.52	17.40	17.53	17.48
Kufri Lalit	17.93	18.15	18.38	18.16
Kufri Lalima	18.86	19.27	18.87	19.00
CD (0.05)	2.52	1.79	0.93	1.32

Usage

The new early maturing variety Kufri Uday is suitable for table potatoes with attractive red ovoid tubers having shallow eyes, which leads to less peeling losses in comparison to Kufri Lalima and Kufri Sindhuri as both have round shaped tubers with deep eyes and their peeling losses are high (Luthra *et al.*, 2020 and Kumar *et al.*, 2014). Tubers of this variety seldom exhibit external/internal defects and are not susceptible to skin damage at harvest. Its tubers are easy to cook (15-20 minutes)

Table 6. Tuber dry matter (%) content in AICRP trials (pooled over 2018-19 & 2019-20).

Regions	Locations	75 days			90 days		
		CP4409	Kufri Lalit	Kufri Lalima	CP4409	Kufri Lalit	Kufri Lalima
Northern plains	Hissar	14.64	15.87	16.99	16.75	16.09	20.20
	Jalandhar	15.82	15.71	18.12	16.50	16.83	18.73
	Modipuram	14.04	15.51	18.17	15.80	15.73	19.74
Central plains	Kanpur	20.73	21.21	21.28	23.52	24.32	24.25
Eastern plains	Bhuwabneshwar	18.38	19.36	19.24	18.11	18.72	19.10
	Faizabad	17.37	17.43	17.32	18.43	18.68	18.38
	Kalyani	20.18	18.50	21.44	23.46	21.55	22.46
	Patna	16.67	17.05	15.47	17.60	17.65	17.88
Mean		17.23	17.58	18.50	18.77	18.70	20.09
CD (0.05)		Genotypes: 0.16, Genotype x location: 0.52			Genotypes: 0.26, Genotype x location: 0.61		

Table 7. Tuber dry matter (%) content in AICRP trials during 2020-21

Regions	Locations	75 days				90 days			
		CP4409	Kufri Manik	Kufri Lalit	Kufri Lalima	CP4409	Kufri Manik	Kufri Lalit	Kufri Lalima
Northern plains	Hissar	14.70	14.63	15.60	16.75	16.15	15.78	16.30	17.60
	Jalandhar	16.25	15.75	16.75	17.00	18.50	17.73	18.00	19.00
Central plains	Kanpur	17.08	16.98	17.73	17.08	19.78	18.85	20.60	20.03
Eastern plains	Bhubaneshwar	16.53	15.92	16.35	18.40	18.21	17.08	17.78	18.95
	Faizabad	17.30	17.71	16.30	17.50	18.10	18.89	17.09	18.40
	Kalyani	18.57	-	18.46	18.83	22.28	-	21.58	20.29
	Patna	15.40	14.63	15.90	16.30	16.93	16.87	16.90	16.67
Mean		16.55	15.94	16.73	17.41	18.56	17.53	18.32	18.71

Table 8. Keeping quality (mean of 4 years) at Modipuram, Meerut

Genotypes	Dormancy	Sprouting (%)		Loss due to sprouting (%)	Loss due to rottage (weight basis) (%)	Physiological weight loss (%)	Total weight loss (%)
	(<or> than 6 weeks	At 6 weeks	At 75 days				
CP4409	6-8 weeks	63.06	95.00	0.65	0.00	8.00	8.65
Kufri Lalit	>10 weeks	33.80	60.88	0.10	2.60	6.64	9.34
Kufri Lalima	>10 weeks	2.25	30.06	0.06	0.99	6.60	7.64

and cooked/boiled tubers are free from any kind of discolouration. The variety possesses a pleasant flavour, mealy texture, and good organoleptic taste. Thus, the desirable tuber characters, good keeping, and culinary quality of this variety will favour its acceptance.

Disease resistance

CP4409 has field resistance to late blight (AUDPC: 398; lesion area: 4.49 cm^2) as compared to the red skinned varieties like Kufri Lalit (AUDPC: 550; lesion area: 6.68 cm^2) and Kufri Lalima (AUDPC: 570; lesion area: 4.70 cm^2), when investigated under field conditions and through standard detached leaf method (Lal *et al.* 2020), respectively (**Table 9**).

Table 9. Late blight at Modipuram, Meerut

Genotypes	Field screening		Detached leaf	
	AUDPC	rAUDPC	Lesion area (cm^2)	Grading
CP4409 (3*)	398	0.20	4.49	MR
Kufri Lalit (3*)	550	0.28	6.68	S
Kufri Lalima (2*)	570	0.29	4.70	MR

*Number of years screened; Grading: Lesion area (cm^2): Up to 1.0- Highly resistant (HR); 1.1 to 2.5- Resistant (R); 2.51-5.0- Moderately resistant (MR), > 5.0 –Susceptible (S)
AUDPC (< 250):HR; AUDPC (251-350):R; AUDPC (351-650):MR; AUDPC (651-1200):S; AUDPC (>1200):HS

Crop management

Kufri Uday is capable of producing 36-38 t/ha total tuber yield following the normal agronomical schedule of potato crops.

Planting time: Optimum planting time in North-Indian plains remains between the second fortnights of October to the first fortnight of November when the daily maximum day temperature comes down to around 32°C.

Seed rate: 35-40 q/ha. *Seed size*: 40-60 g. Seed tubers are to be taken out from the cold store at least 10 days before planting. Exposure of seed bags in direct sunlight is to be avoided as it may result in rottage due to sudden

exposure to high temperatures. Spreading of tubers in thin layers under shade in diffused light leads to proper sprouting and allows sprouts to become 0.5-1.0 cm long, thick, and green. Sprouted tubers are to be taken in seed trays or baskets for planting to avoid sprout damage.

Spacing: Plant spacing at 20 cm in 60 cm rows provides optimum tuber size distribution for seed or table potatoes.

Fertilizer: Fertilizer doses have been worked out after field experimentation at Modipuram. CP4409 responded up to 240 N, 30 P_2O_5, and 120 K_2O kg/ha, respectively for 90 days of crop duration of ware potatoes. For seed crops, 150 kg N, 30 kg P_2O_5, and 120 kg K_2O per hectare can be applied. Green manuring before the potato crop is beneficial for crops in several ways including crop nutrition. At, planting 10-15 t/ha well rotten FYM may also be applied to provide seed bed a better tilth and nutrition to the potato crop. These crop management practices shall reduce the approximately one-third dose of nitrogen and half doses of phosphorus and potassium. Thus, half-adjusted doses of N and full-adjusted doses of P_2O_5 and K_2O should be applied at planting. The remaining half-adjusted dose of N should be applied 20-25 days after planting i.e. at the time of inter-cultivation and earthing up. Nutrient management in different agroecologies may differ, so, the regional recommendation may be fine-tuned and adopted for obtaining optimum productivity of this clone.

Irrigations: Pre-sowing irrigation is done to ensure uniform emergence. If this is not given then the first irrigation should be done 4-6 days after planting. Post planting irrigations are kept light and applied subsequently at 7-10 days intervals in sandy loam soil and 10-12 days in heavy soil. Potato ridges must not be submerged under water in any case and arrangements for drainage should also be developed keeping unseasonal rains in view during the crop season.

Plant Protection Measures: For management of cutworms, white grubs, beetles, and leaf eating caterpillars, apply cartap hydrochloride 4G @20 kg/ha during earthing-up. It will also take care of sucking pests like leaf hoppers and aphids. For seed crops, place yellow sticky traps (15x30 cm^2 size) just above the canopy height @ 60 traps/ha at equidistance from each other for mass trapping of white flies/aphids. Seed treatment is done with imidacloprid (200SL) @ 0.04% (4 ml/10 l water) for 10 minutes before planting. The first spray of imidacloprid (200SL) @ 0.03% (3 ml/10 l water) is completed at 85% crop emergence followed by a second spray with thiamethoxam (25 WG) @ 0.05% (5 gm/10 l water) 10-15 days after the first spray. Although the variety is moderately resistant to late blight, prophylactic spray just at the time of canopy closure with mancozeb or propineb or chlorothalonil @ 0.2% (2 gm/l water) followed by need based application of cymoxanil + mancozeb or dimethomorph + mancozeb or fenamidone + mancozeb @ 0.3% (3 gm/l water) is required for effective management of late blight. Insecticide sprays are not required in the case of table crops and integrated pest and disease management recommended by the institute should be followed (Rawal *et al*., 2021).

Harvesting: Irrigation should be stopped 10-12 days before haulm killing and harvesting may be done 10-15 days after haulm cutting at proper soil moisture. After harvest, produce should be kept under shade in heaps covered with 30 cm thick available straw or crop residue for 10-15 days. Both of these measures shall help in curing tuber skin. All damaged and rotten tubers are removed and graded for fetching better prices in the market. Potatoes are packed in 45-50 kg capacity gunny or

leno bags and labeled either for selling in the market or storing in cold storage (Rawal *et al*., 2021).

ADAPTABILITY

Kufri Uday has performed well in multi-location trials conducted under AICRP on Potato and has been recommended for cultivation in North-Indian plains. Thus, the variety Kufri Uday can easily be grown in Punjab, Haryana & Uttar Pradesh (Northern plains); Central Uttar Pradesh (Central plains) and Bihar, Orissa, West Bengal, and Eastern Uttar Pradesh (Eastern plains).

CONCLUSION

Due to early maturity, high yield, and very good keeping quality, Kufri Uday can serve as a better choice for farmers and consumers, where red skinned potatoes are preferred. Kufri Uday export potential can also be explored in Bangladesh, Bhutan, Nepal, Pakistan and Philippines, where red skinned tubers are traditionally preferred (Pandey *et al.* 2000 and Luthra *et al.* 2004).

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

ETHICAL STATEMENT

This article does not contain any studies with human participants or animals performed by any of the authors

LITERATURE CITED

Bajgai Y, Dochen T, Wangchuk P, Haan S de, Kadian MS, Felde TZ, Bonierbale M, Lefebvre M, Zang L, Arya S, Sangay S, Gyeltshen T and Wangdi N (2018) Participatory varietal selection of potato and agronomic performance with farmers' feedback on new variety. *Bhutanese Journal of Agriculture* **1(1)**: 1-12.

Kumar V, Luthra SK, Bhardwaj V and Singh BP (2014) Indian potato varieties and their salient features. *Technical Bulletin* No. **78** (Revised), ICAR-CPRI, Shimla, HP, 64p

Lal M, Luthra SK, Gupta VK and Kumar M (2020) Screening of potato genotypes against Phytophthora infestans causing late blight of potato under subtropical plains of India. *Indian Journal of Horticulture* **77(2)**:322-327

Luthra SK, Pande PC and Singh BP (2004) Perspective planning for developing potatoes for export. In: Processing & Export Potentials of Indian Potatoes (Eds. SM Paul Khurana, BP Singh, SK Luthra, NR Kumar, Devendra Kumar and Dinesh Kumar). *Proceedings of International Potato Conference & Fest-2004*, ICAR-CPRI Campus, Modipurarm, Meerut, UP, India, Indian Potato Association, Shimla, pp18-27

Luthra SK, Gupta VK, Tiwari JK, Kumar V, Bhardwaj V, Sood S, Dalamu, Kaur RP, Kumar R, Vanishree G, Kumar D, Mhatre P and Chakrabarti SK (2020) *Potato Breeding in India*. CPRI Technical Bulletin No 74 (revised), ICAR-Central Potato Research Institute, Shimla, Himachal Pradesh, India, 214p.

Luthra SK, Gupta VK, Rawal S, Bandana, Kumar V, Sood S, Pandey NK, Bhardwaj VB, Rathore A, Kadian MS, Baruah S and Mohanty S (2022) Unica or Yusi map: a unique potato variety with agro-ecological resilience across countries. World Potato Congress.30 May-2 June, 2022, Ireland. Abstract book, p214.

Pandey SK, Shekhawat GS and Sarkar D (2000) Quality attributes of Indian potatoes for export: priorities and possibilities. *Potato Journal* (*Formerly J Indian Potato Assoc*.) **27**:103-11

Sheoran OP, Tonk DS, Kaushik LS, Hasija RC and Pannu, RS (1998). Statistical Software Package for Agricultural Research Workers. In: Recent Advances in information theory, Statistics & Computer Applications (Eds. DS Hooda and RC Hasija), Department of Mathematics Statistics, CCS HAU, Hisar, pp139-143

Rawal S, Mankar P, Dua VK, Kumar D, Malik K, Luthra SK, Lal M, Singh S, Lekshmanan DK, Das B and Chakrabarti SK (2021) Good agricultural practices for the production of potato crop. E-book, ICAR-CPRI, Shimla, HP Website, 219p

MS Received: May 08, 2023; Accepted: July 27, 2023