

KUFRI KIRAN: A NEW HEAT TOLERANT POTATO VARIETY

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ABSTRACT: Kufri Kiran is a heat tolerant table potato variety suitable for early planting in North Indian plains and for main season planting in plateau regions. It is a clonal selection from the cross CP2372 × CP1748. Its plants are medium tall and vigorous with tolerance to mite and hopperburn. It produces attractive white-cream, ovoid tubers with shallow eyes and cream flesh, possesses 19% tuber dry matter and has excellent keeping quality. Kufri Kiran has the ability to produce up to 11% higher tuber yield than heat tolerant varieties Kufri Lima and Kufri Surya in North Indian plains in 15-20 days early planted crop.

KEYWORDS: Kufri Kiran, heat tolerance, mite and hopper burn, early planting.

INTRODUCTION

Potato (*Solanum tuberosum* L.) crop grows best in cool but frost-free areas and seasons throughout the world and does not perform well in heat due to photo and thermo-sensitivity of the crop (Minhas *et al.* 2011; Hijmans 2003). The yield and quality of potatoes are very sensitive to high temperatures (Bodlaender 1963; Ewing 1981). At high temperatures (above 17°C) tuberisation diminishes (Reynolds & Ewing, 1989). High temperatures delay, impede or even inhibit tuber initiation (Minhas *et al.*, 2006). Potato tuber initiation and development are much more sensitive to high-temperature stress than photosynthesis (Reynolds & Ewing, 1989). High night temperatures are much more deleterious to the formation of tubers than day temperatures. Minimum night temperature is very important for potato crops; whether or not potatoes will tuberise depends

largely on the minimum night temperature and not on the average daily temperature. Night temperatures above 20°C severely depress both tuber initiation and bulking and temperatures above 25°C effectively stop tuber production (Minhas *et al.*, 2001). Optimum temperatures for tuber formation are widely regarded as 10-17°C (Bodlaender 1963; Moorby and Milthorpe 1975). India has set a target to produce 125 million tonnes of potatoes to meet future requirements by 2050 (Singh *et al.*, 2014). These increased production targets can be met from the increased area (from sandwiched early crops of northern plains, the plateau and other non-traditional warmer areas including coastal areas) (Gupta *et al.*, 2020 and Gupta *et al.*, 2020a), productivity and improved mitigation strategies for various potato production agro-ecologies. In India, the effect of high temperatures not only affects the early-season crop of the north-western

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plains but it also affects the main-season crop of the central and eastern plains. Such heat stress conditions either affect the initial growth stages during the tuber formation stage or at a later stage (harvest). Transitory or constant high temperatures have a number of morpho-anatomical, physiological and biochemical changes in plants, which affect plant growth, development and potato crop may get infestation with a number of insect pests especially leaf hoppers and mites which may lead to a drastic reduction in economic yield (Wahid *et al.* 2007, Malik and Luthra 2007, Sunitha *et al.* 2020, Rao *et al.* 2018, Luthra *et al.* 2013). To overcome or reduce the impact of such abiotic stresses, potato genotypes with better sustenance may help to fulfil future production targets. ICAR-CPRI has developed the first heat-tolerant variety Kufri Surya (Minhas *et al.* 2006). A new heat-tolerant variety Kufri Kiran has been developed which would provide another alternative to extend potato cultivation in non-traditional and warmer areas besides the early crop (15-20 days earlier than the main season crop) of vast northern plains.

MATERIALS AND METHODS

Evaluation and testing of advanced clone: Advanced stage clone HT/07-1329 named Kufri Kiran originated from hybridization of cross CP2372 × CP1748 attempted in 2007 at Kufri (31° 1'N 77° 3'E; 2501 m above MSL) in the mid-hills of Himachal Pradesh. Seedlings and subsequent clonal generations were raised and evaluated at the ICAR-Central Potato Research Institute (CPRI), Regional Station, Modipuram, Meerut, UP (29° 4' N and 77° 46' E; 237m above msl) as per procedure described by Luthra (2020). The pedigree of Kufri Kiran has been described in Fig. 1. The female parent CP2372 (LT-9 a CIP advanced clone of low land tropic group) produces

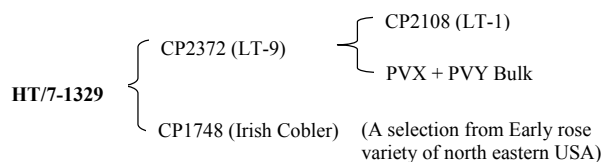


Fig. 1. Pedigree of Kufri Kiran

white-cream ovoid, shallow eyed tubers with cream flesh and possesses tolerance to heat, whereas the male parent CP1748 an exotic variety Irish Cobler produces white-cream ovoid tubers with shallow eyes and cream flesh.

The clone HT/07-1329 was in the seedling stage in 2007-08, the five-hill plot in 2008-09, 30 hill plot in 2009-10, multiple-row trial in 2010-11, in replicated yield trials at Modipuram during 2012-15, and at Pune, Maharashtra and Ladol (Gujarat) during 2014-15 and 2015-16. Based on its superior performance over control varieties in yield trials, HT/07-1329 was introduced in AICRP in the year 2016 for multi-location testing across the country. This advanced clone was evaluated during 2018-20 at 11 locations in three regions i.e., north-western (3 locations at Hisar, Jalandhar and Pantnagar), central (5 locations at Chhindwara, Deesa, Gwalior, Kanpur and Raipur) and eastern plains (3 locations at Bhubaneshwar, Faizabad and Kalyani) in multi-location replicated, initial and advanced varietal trails under AICRP.

The data were analyzed following standard statistical procedures as described by Gomez and Gomez (1984) using the software Windostat 8.5 (Ameerpet, Hyderabad, India). Based on its performance over the years/locations, the advanced clone HT/07-1329 has been recommended for release in the 38th group meeting of AICRP (Potato) held during 28-30 September 2020 through virtual mode. Subsequently, advanced clone HT/07-1329 was released and notified as variety in the name of Kufri Kiran by the Central Sub-

Committee on Crop Standards Notification and Release of Varieties for Horticultural Crops, Ministry of Agriculture, Department of Agriculture and Co-operation, Government of India, New Delhi vide Gazette Notification S.O.No. 692(E); dated 05.02.2019.

VARIETAL DESCRIPTION

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

Foliage: Grey green, leaves intermediate, leaf width medium, leaflets ovate-lanceolate, leaflet coalescence absent, rachis green, midrib green.

Flowering: Medium (Fig. 2), inflorescence small, floral stalk green, floral stalk-pedicle articulation clearly visible and located above the middle, calyx green, corolla light purple white, corolla shape pentagonal, anther yellow, anther cone normally developed, stylar length longer with stamen column and stigma bi-lobed

Tubers: Medium 7-8 tuber per plant, ovoid (Fig.2). *skin-smooth*, white-cream, *eyes-shallow*, *flesh- cream-texture mealy*.

Sprout: Red purple, shape spherical, pubescence at sprout base weak.

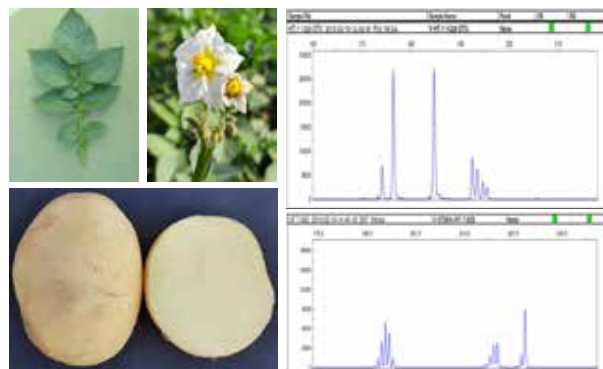


Fig. 2. Morphological features and DNA fingerprint profile of Kufri Kiran

DNA fingerprinting: The fingerprint of clone, HT/07-1329 was generated using 2 SSR markers viz., STU and STIKA using a genetic analyzer, ABI 3500. The fingerprints are clearly unique and do not match any of the existing indigenous varieties (Fig 2).

YIELD PERFORMANCE

Primary evaluation trials: At Modipuram (UP) during 2014 and 2015), HT/07-1329 produced a 6% higher total tuber (13 t/ha) yield over the best control Kufri Surya (12 t/ha) at 75 days in early crop of the winter season (Table 1). At Pune (Maharashtra), HT/07-1329 produced a 12 % higher total tuber yield (17 t/ha) over the best control Kufri Surya (15 t/ha) at 90 days in the Kharif season crop (Table 2). At Ladol (Gujarat), HT/07-1329 produced 23% higher total tuber yield (55 t/ha) over the best control Kufri Surya (45 t/ha) at 90 days early crop (Table 3).

Multi-location testing: Under AICRP, the advanced stage clone HT/07-1329 performed well as compared to control varieties in

Table.1: Performance and attributes of HT/07-1329 during 2014 and 2015 at Modipuram

Genotypes	Total Tuber Yield (t/ha)		Mean	Dry matter (%)		Mean
	2014	2015		2014	2015	
HT/07-1329	9.8	15.5	12.7	20.5	20.3	20.4
Kufri Lauvkar	7.8	12.7	10.3	-	17.1	17.1
Kufri Surya	8.3	15.6	11.9	19.2	19.1	19.1
C.D. 5%	1.33	2.18			0.68	

Table.2: Performance and attributes of HT/07-1329 during 2014 and 2015 at Pune

Genotypes	Total Tuber Yield (t/ ha)		Mean
	2014	2015	
HT/07-1329	18.33	15.67	17.0
Kufri Surya	19.16	11.24	15.2
Kufri Jyoti	-	13.80	13.8
C.D. 5%	1.39	0.96	

Table.3: Performance and attributes of HT/07-1329 during 2014-15 and 2015-16 at Ladol

Genotypes	Marketable Tuber Yield (t/ha)		Mean	Total Tuber Yield (t/ha)		Mean
	2014-15	2015-16		2014-15	2015-16	
HT/07-1329	41.4	66.6	54.0	42.3	68.1	55.2
Kufri Surya	31.5	55.9	43.7	31.9	57.9	44.7
C.D. 5%	2.39	4.32		2.76	4.29	

replicated trials during 2018-19 and 2019-20 at 11 locations of Northern, Central and Eastern plains. Pooled results of the advanced clone with superior performance are summarized as under-

Total tuber yield (75 days): HT/07-1329 produced significantly higher or at par total tuber yield than best control Kufri Lima at Hisar, Jalandhar, Pantnagar, Chhindwara, Deesa, Gwalior, Kanpur, Bhubaneswar, Faizabad and Kalyani (Table 4). However, at Raipur Kufri Surya outperformed control varieties. The mean total tuber yield of HT/07-1329 (29 t/ha) over different locations of northern, central

and eastern plains was significantly higher than the best control Kufri Lima (27 t/ha) and with a yield advantage of 10%. HT/07-1329 has acceptable tuber dry matter content (18%) and 48 % foliage maturity (Table 6, 7).

Marketable tuber yield (75 days): HT/07-1329 also produced significantly higher or at par Marketable tuber yield than best control Kufri Lima at Hisar, Jalandhar, Pantnagar, Chhindwara, Deesa, Gwalior, Kanpur, Raipur, Bhubaneswar, Faizabad and Kalyani (Table 4). The mean Marketable tuber yield of HT/07-1329 (26 t/ha) over different locations of northern plains, central plains and eastern plains was significantly higher than the best control Kufri Lima (24 t/ha) and with yield advantage of 10%.

Total tuber yield (90 days): HT/07-1329 produced significantly higher or at par total tuber yield than control varieties at Hisar, Jalandhar, Pantnagar, Chhindwara, Deesa, Gwalior, Kanpur, Raipur and Faizabad (Table 5). The mean total tuber yield of HT/07-1329 (37 t/ha) over different locations of northern,

Table.4 Tuber yield of HT/07-1329 (pooled mean of 2018-19 and 2019-20) at 75 days

Regions	Locations	Total tuber yield (t/ha)			Marketable tuber yield (t/ha)		
		HT/07-1329	Kufri Lima	Kufri Surya	HT/07-1329	Kufri Lima	Kufri Surya
Northern plains	Hissar	35.2	32.2	30.8	33.6	31.3	29.0
	Jalandhar	32.8	29.5	31.6	31.8	28.5	30.3
	Pantnagar	23.4	20.2	21.5	21.9	19.3	18.9
Central plains	Chhindwara	31.8	29.3	30.9	29.8	27.5	29.0
	Deesa	43.7	38.9	34.9	41.8	35.6	32.9
	Gwalior	33.5	32.6	25.5	29.5	29.6	22.6
	Kanpur	35.4	32.6	31.6	28.0	26.6	26.5
	Raipur	21.3	21.8	24.2	13.5	13.2	10.4
Eastern plains	Bhubaneswar	11.7	9.3	13.2	10.0	7.1	11.8
	Faizabad	30.3	25.5	24.8	27.7	23.5	22.9
	Kalyani	23.3	20.4	20.7	21.7	19.8	19.2
	Mean	29.3	26.6	26.3	26.3	23.8	23.0
% Yield increase			10.2	11.3		10.3	14.2
C.D.		Var: 0.8, Var × Location: 2.7			Var : 0.7, Var × Location:1.9		

central and eastern plains was significantly higher than the controls Kufri Lima (35 t/ha), Kufri Surya (32 t/ha) and with yield advantage of 7%, 14% respectively.

Marketable tuber yield (90 days): HT/07-1329 also produced significantly higher or at par Marketable tuber yield than control varieties at Hisar, Jalandhar, Pantnagar, Chhindwara, Deesa, Gwalior, Kanpur, Raipur and Faizabad (**Table 5**). The mean Marketable tuber yield of HT/07-1329 (34 t/ha) over different locations of northern plains, central plains and eastern

plains was significantly higher than the controls Kufri Lima (31 t/ha), Kufri Surya (29 t/ha) and with yield advantage of 7%, 16% respectively. HT/07-1329 has acceptable tuber dry matter content (20%) and 79 % foliage maturity (**Table 6, 7**).

The additional trial at YSR Horticulture University: The advanced stage clone HT/07-1329 was evaluated for four years during 2016-17 to 2019-20. HT/07-1329 produced higher (24 t/ha) total tuber yield than best control Kufri Lima (19 t/ha) and Kufri Surya

Table. 5 Tuber yield of HT/07-1329 (pooled mean of 2018-19 -2019-20) at 90 days

Regions/ 90 days	Locations	Total tuber yield (t/ha)			Marketable tuber yield (t/ha)		
		HT/07-1329	Kufri Lima	Kufri Surya	HT/07-1329	Kufri Lima	Kufri Surya
Northern plains	Hissar	45.8	40.7	36.6	44.4	39.9	35.1
	Jalandhar	30.6	30.3	28.1	29.5	29.3	27.2
	Pantnagar	23.6	20.0	21.7	21.1	18.5	19.8
Central plains	Chhindwara	42.0	35.0	36.5	38.9	32.3	33.7
	Deesa	48.4	48.3	42.8	47.7	47.4	40.9
	Gwalior	39.8	37.0	29.0	36.5	34.5	25.9
	Kanpur	43.6	43.1	39.6	36.0	37.6	33.2
	Raipur	23.8	25.0	26.3	16.2	13.2	17.9
Eastern plains	Faizabad	35.9	32.2	31.3	33.7	30.3	29.4
	Mean	37.0	34.6	32.4	33.8	31.4	29.2
% Yield increase			7.0	14.3		7.4	15.6
C.D.		Var: 1.04, Var × Location:3.28			Var: 1.03, Var × Location:3.25		

Table. 6 Tuber Dry matter content of HT/07-1329 (pooled mean of 2018-19 and 2019-20)

Region	Locations	75 days			90 days		
		HT/07-1329	Kufri Lima	Kufri Surya	HT/07-1329	Kufri Lima	Kufri Surya
Northern plains	Hissar	15.9	16.2	15.9	17.5	18.4	18.4
	Jalandhar	17.7	17.7	17.4	17.6	17.5	17.3
Central plains	Chhindwara	18.2	18.2	18.3	19.3	19.3	19.3
	Deesa	17.3	18.5	18.0	20.2	22.2	19.2
	Gwalior	20.7	20.3	19.9	21.1	21.5	20.9
	Kanpur	15.3	12.0	15.1	20.5	19.3	20.2
	Raipur	19.3	19.2	19.3	21.0	19.4	20.5
Eastern plains	Faizabad	17.5	17.5	17.7	18.4	18.3	18.6
	Mean	17.7	17.4	17.7	19.5	19.5	19.3
C.D.		Var: 0.2, Var × Location: 0.56			Var: 0.16, Var × Location:0.49		

(17 t/ha) with yield advantage of 23% and 38 % respectively (Table 8).

Performance HT/07-1329 in AICRP at 75 days (pooled over locations): In northern plains, HT/07-1329 (31 t/ha and 29 t/ha) yielded 9 and 11% higher total and marketable tuber yield than the best control Kufri Surya (28 t/ha and 26 t/ha), respectively at 75 days crop duration (Table 9). HT/07-1329 has tuber dry matter content (17%). In central plains: HT/07-1329 (33 t/ha and 29 t/ha) yielded 7 and 8% higher total and marketable tuber

yields than the best control Kufri Lima (31 t/ha and 27 t/ha), respectively at 75 days crop duration. HT/07-1329 has acceptable tuber dry matter content (18%). In eastern plains: HT/07-1329 (22 t/ha and 20 t/ha) yielded 11 and 10% higher total and marketable tuber yields than the best control Kufri Surya (20 t/ha and 18 t/ha), respectively at 75 days crop duration. HT/07-1329 has acceptable tuber dry matter content (18%). The performance of over regions reflected that HT/07-1329 (29 t/ha and 26 t/ha) yielded 11% higher total and

Table. 7 Foliage senescence (%) of HT/07-1329 (pooled man of 2018-19 and 2019-20)

Region	Locations	75 days			90 days		
		HT/07-1329	Kufri Lima	Kufri Surya	HT/07-1329	Kufri Lima	Kufri Surya
Northern plains	Pantnagar	75.2	72.0	68.7	77.0	67.0	74.0
Central plains	Chhindwara	73.5	72.9	72.3	84.5	83.5	82.9
	Deesa	48.1	31.3	50.6	73.5	67.5	78.0
Eastern plains	Bhubaneswar	25.5	4.8	27.1	80.8	80.0	80.8
	Faizabad	17.5	20.3	18.3	79.0	74.5	78.9
	Mean	48.0	40.2	47.4	79.0	74.5	78.9
C.D.		Var: 1.2, Var × Location: 2.6			Var 1.67, Var × Location: 3.3		

Table. 8 Trials of HT/07-1329 at YSR Horticultural University, Andhra Pradesh

Genotypes	Total tuber yield (t/ha)				Mean	% Advantage
	2016-17	2017-18	2018-19	2019-20		
HT/07-1329	15.3	26.4	27.3	25.03	23.5	
Kufri Surya	6.4	18.1	23.12	20.36	17.0	38
Kufri Jyoti/ Kufri Lima	8.6	25.2	23.52	19.11	19.1	23

Table 9. Performance in AICRP trials at 75 days (pooled over location)

Regions	HT/07-1329			Kufri Lima			Kufri Surya		
	TTY*	MTY**	DM%**	TTY*	MTY**	DM%**	TTY*	MTY**	DM%**
Northern plains	30.5	29.1	16.8	27.3	26.4	16.9	28	26.1	16.6
	Yield advantage (%)			11.5	10.4		8.8	11.5	
Central plains	33.1	28.5	18.1	31.1	26.5	17.6	29.4	24.3	18.1
	Yield advantage (%)			7	7.5		12.6	17.4	
Eastern plains	21.8	19.8	17.5	18.4	16.8	17.5	19.5	17.9	17.7
	Yield advantage (%)			18.2	17.7		11.3	10.3	
G Mean	28.5	25.8	17.5	25.6	23.2	17.3	25.6	22.8	17.5
	Yield advantage (%)			11.2	11.0		11.1	13.3	

*TTY-Total tuber yield (t/ha); **MTY-Marketable tuber yield (t/ha); ***DM-Dry matter

marketable tuber yield than Kufri Lima (26 t/ha and 23 t/ha) and 11% and 13% higher total and marketable tuber yield than Kufri Surya respectively at 75 days crop duration (Table 9). HT/07-1329 has tuber dry matter content (18%).

Performance HT/07-1329 in AICRP at 90 days (pooled over locations): In Northern plains, HT/07-1329 (33 t/ha and 32 t/ha) yielded 10 and 8% higher total and marketable tuber yield than the best control Kufri Lima (30 t/ha and 29 t/ha), respectively at 90 days crop duration (Table 12). HT/07-1329 has tuber dry matter content (18%). In central plains, HT/07-1329 (40 t/ha and 35 t/ha) yielded 5 and 6% higher total and marketable tuber yields than the best control Kufri Lima (38 t/ha and 33 t/ha), respectively at 90 days crop duration. HT/07-1329 has acceptable tuber dry matter content (20%). In eastern plains, HT/07-1329 (36 t/ha and 34 t/ha) yielded 11% higher total and marketable tuber yields than the best control Kufri Lima (32 t/ha and 30 t/ha), respectively at 90 days crop duration. HT/07-1329 has acceptable tuber dry matter content (18.4%). The performance of over regions reflected that HT/07-1329 (36 t/ha and 34 t/ha) yielded 9% higher total and marketable tuber yield than control

Kufri Lima (33 t/ha and 31 t/ha) and 15% and 16% higher total and marketable tuber yield than Kufri Surya (32 t/ha and 29 t/ha) respectively at 90 days crop duration (Table 10). HT/07-1329 has tuber dry matter content (19%).

Keeping quality: The advanced clone HT/07-1329 possesses a long tuber dormancy period (10 weeks), comparatively less weight loss, rottage, and weight loss due to sprouts after 75 days of on-farm storage (Table 11), therefore adjudged to be an excellent keeper. HT/07-1329 clearly showed excellent keeping quality it has lesser physiological and total weight loss (9%) as compared to heat tolerant variety Kufri Surya (11%) and local check Kufri Bahar (16%) at Modipuram.

Tolerance to temperature stress and disease resistance: The new variety Kufri Kiran (HT/07-1329) possess tolerance to high temperature stress, therefore is able to tuberize and produce a sustainable yield in a crop planted 15-20 days early than normal season, thereby fetching the remunerative price due to preference of consumers for fresh potatoes during the early season (Table 12, 13). HT/07-1329 is tolerant to hopper and mite burn (Table 14), which causes serious yield losses under heat stress conditions.

Table 10. Performance in AICRP trials at 90 days (pooled over location)

Regions	HT/07-1329			Kufri Lima			Kufri Surya		
	TTY*	MTY**	DM%**	TTY*	MTY**	DM%**	TTY*	MTY**	DM%**
Northern plains	33.3	31.7	17.6	30.3	29.2	17.9	28.8	27.3	17.8
	Yield advantage (%)			9.9	8.3		15.8	15.9	
Central plains	39.5	35.1	20.2	37.7	33.0	21	34.8	30.3	19.9
	Yield advantage (%)			5	6.3		13.4	15.7	
Eastern plains	35.9	33.7	18.4	32.2	30.3	18.3	31.3	29.4	18.6
	Yield advantage (%)			11.4	11.3		14.7	14.6	
G Mean	36.2	33.5	18.7	33.4	30.8	19.1	31.6	29.0	18.8
	Yield advantage (%)			8.5	8.6		14.5	15.5	

*TTY-Total tuber yield (t/ha); **MTY-Marketable tuber yield (t/ha); ***DM-Dry matter

Table. 11 Storage behaviour of HT/07-1329 at ambient temperature (2013-14 to 2014-15)

Genotypes	Year	Dormancy	% sprouting at 45 days	% sprouting at 75 days	% loss due to sprouting	% Rottage	Physiological wt loss	Total wt loss %
HT/07-1329	2014-15	>10 weeks	6.2	11.2	0.0	0.0	9.8	9.8
	2013-14	<10 weeks	0.0	100.0	0.1	1.1	6.1	7.4
	Mean	> 10 weeks	3.1	55.6	0.05	0.6	8.0	8.6
Kufri Surya	2014-15	>10 weeks	25	55.9	0.04	0.0	11.2	11.3
	2013-14	<10 weeks	21.4	100.0	0.1	0.0	10	10.1
	Mean	10 weeks	23.2	78.0	0.07	0.0	10.6	10.7
Kufri Bahar	2014-15	<6 weeks	100.0	100.0	0.5	7.4	11.8	19.2
	2013-14	<6 weeks	89.5	100.0	0.7	1.6	9.2	12.1
	Mean	<6 weeks	94.8	100.0	0.6	4.5	10.5	15.6

Table 12. The temperature profile of AICRP locations during crop growth (2019-20)

Location	Date of planting	Temperature °C		Mean Temperature °C	Growing degree days
		Max	Min		
Northern plains					
Hisar	18-Oct	22.8 (33.0)*	9.7 (16.0)	16.2	1056
Jalandhar	12-Oct	20.3 (30.0)	10.9 (20.0)	15.6	1000
Modipuram	25-Sep	27.0 (31.0)	14.2 (23.0)	20.6	1448
Central plains					
Chindwara	16-Nov	24.3 (27.0)	11.7 (14.0)	18	1216
Deesa	25-Oct	28.5 (34.0)	14.7 (23.0)	21.6	1539
Raipur	13-Nov	27.1 (30.0)	13.9 (15.0)	20.5	1440
Eastern plains					
Bhubaneswar	05-Dec	28.3 (29.0)	16.2 (17.0)	22.2	1597
Faizabad	07-Nov	20.6 (28.0)	9.6 (13.0)	15.1	957

*Figures in parenthesis are weekly mean temperatures during planting

Table.13: Tuberization at elevated temperatures under controlled conditions

Genotypes	24°C/22°C (Day and Night Temp)			24°C/24°C (Day and Night Temp)		
	No. of sessile Tubers	No. of stolons	Diameter of tubers (mm)	No. of sessile Tubers	No. of stolons	Diameter of tubers (mm)
HT/07-1329	4	5	5.7	3	1	3.9
Kufri Surya	6	Nil	5.4	3	Nil	4.4

Table.14: Mite and hopper tolerance in HT/07-1329 during 2014 and 2015 at Modipuram

Insects	Damage %			
	HT/07-1329	Kufri Surya	Kufri Bahar	Kufri Lauvkar
Miteburn	10.4	15.6	18.2	51.8
Hopperburn	0.0	0.85	5.0	10.0

Usage: Kufri Kiran is a table potato variety suitable for planting 15-20 days early than normal planting in sub-tropical North Indian plains. It produces white-cream, ovoid tubers with shallow eyes and cream flesh which leads to less peeling losses. The tubers of Kufri Kiran seldom exhibit external/internal defects and

are not susceptible to skin damage at harvest. It is easy to cook (15-20 minutes) and cooked/boiled potatoes are free from discolouration. It possesses a pleasant flavour, mealy texture and very good organoleptic taste. The desirable tuber characteristics, excellent keeping and culinary quality of Kufri Kiran will favour its acceptance.

AGRONOMIC MANAGEMENT

Planting time: 15-20 days early than the main season planting of the region. For seed potatoes, plant the crop in the main season.

Planting: *Seed rate:* 35-40 q/ha. *Seed size:* 40-60 g. *Spacing:* Plant spaced at 20 cm in 60 cm (planting depth: 10-12 cm) rows provides optimum tuber size distribution for the production of desirable tuber size for seed or table potatoes.

Manure and fertilizer: Apply 10-15 t/ha FYM at the time of planting. For seed crop, the dose of 180, 80, and 100 kg/ha of nitrogen, phosphorous and potassium, respectively is recommended, where half of N and full P_2O_5 and K_2O is applied at planting and the remaining half N is given at earthing-up. Apply 180 kg N, 40 kg P_2O_5 and 100 kg K_2O / ha respectively for 75 days ware crop under moderate fertility level at Modipuram. Nitrogen is best applied in split doses, 90 kg at the time of planting and 90 kg at the time of earthing up. Nutrient management should be done as per soil test data and regional recommendations for optimum productivity of this variety.

Irrigations: Pre-sowing irrigation is recommended for uniform emergence otherwise first irrigation should be given 4-6 days after planting. Post planting irrigations is recommended at 7-10 days interval in sandy loam soil and 10-12 days in heavy soil. Germination, stolon formation and tuber bulking are critical stages for moisture. Local

recommended irrigation schedules may be followed.

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 hopper and aphids. For seed crops to manage white flies and aphid vectors, place yellow sticky traps (15x30 cm² size) just above the canopy height @ 60 traps/ha at equidistance from each other for mass trapping of white flies/aphids. Seed treatment with imidacloprid (200SL) @ 0.04% (4 ml/10 lit) for 10 minutes before planting. First spray with imidacloprid (200SL) @ 0.03% (3 ml/10 lit of water) at 85% crop emergence. Second spray with thiamethoxam (25 WG) @ 0.05% (5 gm/10 lit of water) after 10-15 days of the first spray. For control of late blight, prophylactic spray with mancozeb or propineb or chlorothalonil @ 0.2% (20 gm/10 l of water) followed by need based application of cymoxanil + mancozeb or dimethomorph + mancozeb or fenamidone + mancozeb @ 0.3% (30 gm/10 l of water is required).

ADAPTABILITY

Kufri Kiran (HT/07-1329) has performed well in primary evaluation trials at Modipuram (UP), Ladol (Gujarat), Pune (Maharashtra) and multi-location trials conducted under AICRP in all major regions and has been recommended for cultivation in Indian plains (north, central, eastern), plateau region including West Godavari District of Andhra Pradesh (Rao *et al*, 2018 and Rao *et al*, 2018a). Kufri Kiran produced up to 9% higher tuber yield as compared to Kufri Lima and 16% higher as compared to heat tolerant variety Kufri Surya. It produces attractive white-cream ovoid tubers with shallow eyes and possesses excellent keeping quality. The cultivation of Kufri Kiran in early season planting, warmer and non-traditional areas

would help in expanding potato areas and meeting the consumer demand for fresh potatoes. It would also help farmers to get remunerative prices for the produce, thereby improving the farmer's economic conditions.

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

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