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KUFRI LOHIT: A NEW RED SKIN POTATO VARIETY

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ABSTRACT: Kufri Lohit is a red skin, medium maturing, main season, high yielding table potato variety recommended for cultivation in North-Indian plains (Eastern & Central plains). It can also successfully be grown in northern plains to meet the seed potato demands of regions that prefer red skin tubers. It is a clonal selection of a cross between Kufri Kanchan and Kufri Khyati. Its plants are medium tall and vigorous having field resistance to late blight. It produces attractive red coloured, ovoid tubers with shallow eyes, cream flesh, and mealy texture. This variety possesses approximately 18% tuber dry matter content and has very good keeping quality. It is responsive to crop nutrition and yields 36–38 t/ha total tuber yield under optimum crop management.

KEYWORDS: Kufri Lohit, variety, table potato, red skin, high yield, late blight, keeping quality, North-Indian plains.

INTRODUCTION

Red skinned potatoes are preferred by consumers especially in the eastern part of India (eastern Uttar Pradesh, Bihar, Jharkhand, West Bengal, and Orissa) and in Jammu & Kashmir. Though white/yellow skinned or flesh potatoes are the common preference in other parts of the country, however, preference for red skin potatoes is increasing due to the migrant population from eastern states who has a liking for red skin tubers. Market supply chain dynamics also influence potato growers in different regions for raising red skin varieties. As in district Kannauj (UP), farmers are cultivating red skin potatoes to cater to the demand of locals and markets of the neighbouring country Nepal. Similarly, in district Bareilly (UP), the local cultivar Bareilly Red is highly preferred among the zone's consumers because its dark red tubers have variegated flesh colour and waxy texture (Luthra *et al.*, 2015a). Some local potato varieties having purple black or purple skin, although having low yield potential, are grown and consumed in several pockets of North-Western hills and the North-Eastern region. These locally adapted varieties remain popular due to the slow rate of degeneration and unique taste liked by the local populace (Luthra *et al.,* 2015b). As consumers are also becoming aware of their health and the better nutritive value of food, so coloured potatoes shall also be preferred by them due to their higher antioxidant potential (Luthra *et al.*, 2018). CPRI has developed eight indigenous varieties with red skin and white or white-cream flesh colour and one purple skinned variety Kufri Neelkanth with yellow flesh colour (Luthra *et al.*, 2020b). Efforts are continuing to develop better genotypes in this segment for potato growers and consumers to meet the ever-increasing demand. Work in this direction has led to the development of a new high-yielding, late blight resistant potato variety named Kufri Lohit. Its tubers are red skinned and its flesh colour is cream. This variety possesses very good keeping quality and taste. This will provide an opportunity for farmers to get higher farm profits and wider choice for consumers in their food basket.

BACKGROUND

Advanced clone MS/11-664 released as table purpose potato variety Kufri Lohit

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was bred and selected at Modipuram (Uttar Pradesh), a regional station of Central Potato Research Institute, Shimla (Himachal Pradesh) following breeding protocols (Luthra *et al*., 2020a). The clone was derived from a cross between Kufri Kanchan × Kufri Khyati made in 2009 at Kufri (Himachal Pradesh). Female parent Kufri Kanchan is an indigenous medium maturing variety that was released in 1999 for north Bengal hills and Sikkim. It produces red oblong tubers with fleet eyes and cream flesh, moderate resistance to late blight, and immunity to warts. Male parent Kufri Khyati is a medium maturing early bulking indigenous variety released in 2008 for North-Indian plains. It produces white-cream ovoid tubers with shallow eyes and creamy flesh and is moderately resistant to late blight. The pedigree of Kufri Lohit is described in Figure 1. The clone was in the seedling stage (2010-11), five-hill plots (2011-12), 30 hill-plots (2012-13), and multiple row trials (2013-14). It was evaluated in one preliminary (2014-15) and two confirmatory yield trials (2015-16 and 2016-17) at Modipuram. Advanced clone MS/11-664 was introduced in the All India Coordinated Research Project on Potato (AICRP on Potato) in 2017 for multi-location evaluation across the country.

Clone MS/11-664 was evaluated in multi-location replicated trials under AICRP on Potato during 2018-19 and 2019-20 at 14 locations, and during 2020-21 at 15 locations in North-Indian plains comprising northern, central, and eastern regions. 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). Based on its performance, the clone was recommended for release as table purpose potato variety for North-Indian plains (Eastern & Central plains) in the 39th Group Meeting of AICRP on Potato held during September 27-29, 2021 through virtual mode. Advanced clone MS/11-664 has been released and notified as variety in the name of Kufri Lohit 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 during its 30th meeting on 04.05.2023.

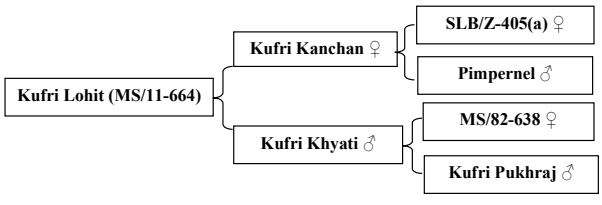


Fig. 1. Pedigree of Kufri Lohit

VARIETAL DESCRIPTION

Plants: Morphological characteristics of the variety Kufri Lohit (leaf, flower, sprout, and tuber) have been depicted in Figure 2.

Plant: Medium, plant canopy semi-compact, stem medium thick, predominantly green,



Fig. 2. Morphological characteristics of Kufri Lohit: Leaf, flower, sprout and tuber

secondary stem colour red brown throughout lightly scattered, wings highly developed and straight.

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

Inflorescence

Flowering: Medium, inflorescence large, floral stalk medium and coloured, pedicle articulation clearly visible in floral stalk and located above middle, calyx light red brown, corolla red violet, corolla shape semi-stellate, anther yellow, anther cone normally developed, stylar length longer than stamen column and stigma bi-lobed.

Tubers

Size: Medium to large, 8-9 tuber per plant; ***Shape:*** Ovoid; ***Skin:*** Smooth and red; ***Eyes:*** Shallow, predominantly apical; ***Eyebrows:*** Normal; ***Flesh:*** Cream with 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

In station trials at Modipuram during 2014-15, 2015-16, and 2016-17, advanced clone MS/11-664 (32.24 t/ha) yielded 16 and 15% higher total tuber yield over Kufri Lalit (27.91 t/ha) and Kufri Lalima (28.07 t/ha) at 75 days (**Table 1**). This clone produced nearly 95% marketable tubers as compared to Kufri Lalit and Kufri Lalima (91%). Clone MS/11-664 (42.76 t/ha) yielded 10 and 20% higher total tuber yield over Kufri Lalit (38.75 t/ha) and Kufri Lalima (35.65 t/ha) at 90 days. Its marketable tuber yield (96%) was slightly superior to Kufri Lalit (95%) and Kufri Lalima (94%).

Multi-location testing

Replicated multi-location yield trials along with controls were conducted under AICRP on Potato during 2018-19 and 2019-20 at 14 locations (**Table 2**) and during 2020-21 at 15 locations (**Table 3**) in North-Indian plains comprising its northern, central, and eastern parts.

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

Crop duration (75 days): Advanced clone MS/11-664 (32.14 t/ha) had 5 and 11 % higher

Table 1. Performance of advanced clone MS/11-664 at Modipuram during 2014-2017

Genotypes	Total tuber yield (t/ha)								Yield increase (%) over controls	
	2014-15		2015-16		2016-17		Mean			
	75 *DAP	90 DAP	75 DAP	90 DAP	75 DAP	90 DAP	75 DAP	90 DAP	75 DAP	90 DAP
MS/11-664	26.52	37.63	34.71	43.79	35.49	46.85	32.24	42.76		
Kufri Lalit	26.30	32.79	29.86	43.73	27.58	39.73	27.91	38.75	15.51	10.35
Kufri Lalima	23.73	29.99	30.62	40.15	29.84	36.80	28.07	35.65	14.86	19.94
CD (0.05)	2.00	2.34	2.65	1.84	2.09	1.80	2.18	1.59		
	Marketable tuber yield (t/ha)									
MS/11-664	24.70	35.55	33.54	42.51	33.49	45.00	30.58	41.02		
Kufri Lalit	23.31	30.83	27.41	41.62	25.24	38.04	25.32	36.83	20.77	11.38
Kufri Lalima	21.29	27.86	28.02	37.65	27.67	34.65	25.66	33.39	19.17	22.85
CD (0.05)	2.13	2.16	2.24	1.53	1.55	1.64	1.86	1.45		

*DAP: Days after planting

Table 2. Performance of advanced clone MS/11-664 in AICRP on Potato replicated yield trials pooled over 2018-19 and 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		
		MS/11-664	Kufri Lalit	Kufri Lalima	MS/11-664	Kufri Lalit	Kufri Lalima
Northern plains	Hisar	33.02	35.29	32.42	39.03	42.08	38.76
	Jalandhar	32.75	33.61	28.78	43.51	40.14	35.50
	Modipuram	37.70	31.97	33.23	53.23	48.30	45.83
	Pantnagar	25.08	22.16	21.50	28.16	25.31	27.87
	Mean	32.14	30.76	28.98	40.98	38.96	36.99
	% Yield ±		4.49	10.89		5.20	10.79
Central plains	Deesa	46.29	40.48	44.69	56.91	54.61	54.95
	Gwalior	41.31	35.64	34.61	44.27	39.55	39.41
	Kanpur	40.19	32.68	28.80	45.06	35.75	31.41
	*Kota	26.16	21.21	23.24	37.30	25.42	31.67
	Raipur	33.27	26.06	31.34	39.85	31.80	37.58
	Mean	37.44	31.21	32.54	44.68	37.43	39.00
	% Yield ±		19.96	15.08		19.38	14.55
Eastern plains	Bhubaneshwar	21.71	15.18	15.42	24.56	18.93	16.91
	Dholi	21.65	19.55	24.68	24.07	22.17	22.29
	Faizabad	29.56	28.46	23.11	37.33	35.71	32.03
	Kalyani	26.25	20.71	23.01	32.38	32.59	31.01
	Patna	22.80	25.85	22.54	30.87	27.07	24.80
	Mean	24.39	21.95	21.75	29.84	27.29	25.41
	% Yield ±		11.13	12.15		9.34	17.45
Overall mean		31.27	27.78	27.67	38.32	34.25	33.57
% Yield ±			12.57	13.00		11.91	14.15
CD (0.05)		Genotypes: 0.96, Genotype x location: 2.59			Genotypes: 0.70, Genotype x location: 2.52		

*Kota: Kufri Pukhraj/ Kufri Khyati in place of Kufri Lalit/ Kufri Lalima

total tuber yield over the controls Kufri Lalit (30.76 t/ha) and Kufri Lalima (28.98 t/ha), respectively in northern plains. Performance of MS/11-664 (37.44 t/ha) was 20 and 15% superior to Kufri Lalit (31.21 t/ha) and Kufri Lalima (32.54 t/ha) in central plains. In eastern plains, MS/11-664 (24.39 t/ha) outyielded the control Kufri Lalit (21.95 t/ha) and Kufri Lalima (21.75 t/ha) by a margin of 11% and 12% respectively (**Table 2**). Overall, MS/11-664 (31.27 t/ha) produced 13% higher total tuber yield than controls Kufri Lalit (27.78 t/ha) and Kufri Lalima (27.67 t/ha). This clone produced nearly 90% marketable tuber yield, which was at par with Kufri Lalit (90%) and Kufri Lalima (88%).

Crop duration (90 days): Advanced clone MS/11-664 (40.98 t/ha) recorded 5 and 11 % higher total tuber productivity over the controls Kufri Lalit (38.96 t/ha) and Kufri Lalima (36.99 t/ha) in northern plains. In central plains, clone MS/11-664 (44.68 t/ha) attained 19 and 15% higher yields as compared to Kufri Lalit (37.43 t/ha) and Kufri Lalima (39.00 t/ha). Whereas in eastern plains, MS/11-664 (29.84 t/ha) had 9% and 17% more total tuber productivity compared to the control Kufri Lalit (27.29 t/ha) and

Table 3. Performance of advanced clone MS/11-664 in AICRP on Potato replicated yield 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			
		MS/11-664	Kufri Manik	Kufri Lalit	Kufri Lalima	MS/11-664	Kufri Manik	Kufri Lalit	Kufri Lalima
Northern plains	Hisar	37.67	32.99	34.06	32.88	48.24	43.64	46.42	39.71
	Jalandhar	39.24	37.76	43.40	41.49	54.69	45.83	51.04	50.87
	Modipuram	31.64	30.79	27.92	29.19	48.09	38.32	43.94	38.12
	Pantnagar	22.51	-	23.11	23.87	27.34	-	27.88	26.80
	Mean	32.77	33.85	32.12	31.86	44.59	42.60	42.32	38.88
	% Yield ±		-3.20	2.00	2.85		4.68	5.36	14.70
Central plains	Chhindwara	34.33	25.78	34.55	33.77	39.60	33.23	41.09	38.80
	Deesa	46.09	-	44.90	40.71	51.25	-	51.43	42.86
	Gwalior	29.16	-	31.17	23.20	42.59	-	38.50	28.53
	Kanpur	34.28	28.58	23.96	23.65	45.70	27.50	27.47	34.31
	Kota	-	-	-	-	52.37	-	40.79	23.65
	Raipur	27.27		35.40	28.26	29.13	-	42.44	31.36
	Mean	34.23	27.18	34.00	29.92	43.44	30.37	40.29	33.25
	% Yield ±		25.92	0.68	14.40		43.06	7.83	30.64
Eastern plains	Bhubaneshwar	12.16	8.45	10.38	10.82	18.43	13.72	12.25	16.71
	Dholi	31.65	29.35	31.48	30.19	34.32	33.41	32.97	32.11
	Faizabad	32.04	33.48	33.08	25.97	34.19	37.52	36.05	35.02
	Kalyani	27.68		26.77	27.47	35.63		27.36	30.24
	Patna	29.68	24.78	23.90	18.92	30.70	27.79	27.43	21.84
	Mean	26.64	24.02	25.12	22.67	30.65	28.11	27.21	27.18
	% Yield ±		10.94	6.05	17.50		9.05	12.65	12.76
Overall mean		31.10	28.00	30.29	27.89	39.48	33.44	36.47	32.73
% Yield ±			11.09	2.67	11.53		18.08	8.26	20.64
CD (0.05):		Genotypes: 1.13, Genotype x location: 4.50				Genotypes: 0.92, Genotype x location: 3.57			

Kufri Lalima (25.41 t/ha). On an overall basis, MS/11-664 (38.32 t/ha) recorded 12 and 14% higher total tuber yield than the controls Kufri Lalit (34.25 t/ha) and Kufri Lalima (33.57 t/ha), respectively (**Table 2**). This clone had nearly 92% marketable tuber yield remaining statistically at par with Kufri Lalit (92%) and Kufri Lalima (91%).

Replicated yield trials (2020-21)

Crop duration (75 days): Advanced clone MS/11-664 (32.77 t/ha) attained 2 and 3% higher total tuber yield over Kufri Lalit (32.12 t/ha) and Kufri Lalima (31.86 t/ha) in northern plains. Performance of MS/11-664 (34.23 t/ha) was 26, 1, 14% better than Kufri Manik (27.18 t/ha), Kufri Lalit (34 t/ha), and Kufri Lalima (29.92 t/ha), respectively in central plains. In eastern plains, MS/11-664 (26.64 t/ha) out yielded the controls Kufri Manik (24.02 t/ha), Kufri Lalit (25.12 t/ha) and Kufri Lalima (22.67 t/ha) by 11, 6 and 18% respectively (**Table 3**). Overall, MS/11-664 (31.10 t/ha) observed 11, 3, and 12% higher total tuber yield than the controls Kufri Manik (28.00 t/ha), Kufri Lalit (30.29 t/ha) and Kufri Lalima (27.89 t/ha), respectively. Advanced clone MS/11-664 recorded nearly

88% marketable tuber yield comparable to cv. Kufri Manik (88%), Kufri Lalit (91%) and Kufri Lalima (92%).

Crop duration (90 days): Advanced clone MS/11-664 (44.59 t/ha) produced 5, 5, and 15% higher total tuber yield over the controls Kufri Manik (42.60 t/ha), Kufri Lalit (42.32 t/ha) and Kufri Lalima (38.88 t/ha), respectively in northern plains. In central plains, its performance (43.44 t/ha) was 43, 8, 31% superior to Kufri Manik (30.37 t/ha), Kufri Lalit (40.29 t/ha), and Kufri Lalima (33.25 t/ha). Advanced clone MS/11-664 (30.65 t/ha) had 9, 13 and 13% better tuber yields in eastern plains when compared with the controls Kufri Manik (28.11 t/ha), Kufri Lalit (27.21 t/ha) and Kufri Lalima (27.18 t/ha), respectively (**Table 3**). On an overall basis, MS/11-664 (39.48 t/ha) produced 18, 8 and 21% high total tuber yield than controls Kufri Manik (33.44 t/ha), Kufri Lalit (36.47 t/ha) and Kufri Lalima (32.73 t/ha). This clone had nearly 91% marketable tuber yield, which was at par with Kufri Manik (91%), Kufri Lalit (91%), and Kufri Lalima (93%).

Overall performance of advanced clone MS/11-664 in AICRP on Potato trials

Crop duration (75 days): Total tuber yield of this clone (32.45 t/ha) was 3 and 7 % higher over Kufri Lalit (31.44 t/ha) and Kufri Lalima (30.42 t/ha) in the northern plains. Performance of MS/11-664 (34.90 t/ha) was significantly higher by 28, 10, and 13% as compared to Kufri Manik (27.18 t/ha), Kufri Lalit (31.82 t/ha) and Kufri Lalima (30.77 t/ha) respectively in central plains. Whereas in eastern plains, MS/11-664 (25.52 t/ha) out yielded the control Kufri Manik (24.02 t/ha), Kufri Lalit (23.54 t/ha), and Kufri Lalima (22.21 t/ha) by a margin of 6, 8 and 15% respectively (**Table 4**). Overall, MS/11-664 (31.12 t/ha) recorded 11, 7, and 12% higher total tuber yield than the controls Kufri Manik (28.00 t/ha), Kufri Lalit (28.96 t/ha) and Kufri Lalima (27.83 t/ha), respectively. This advanced clone attained nearly 89% marketable tuber yield remaining at par with all the controls Kufri Manik (88%), Kufri Lalit (91%), and Kufri Lalima (90%).

Crop duration (90 days): In northern plains, advanced clone MS/11-664 (42.79 t/ha) produced 5, and 13% higher total tuber yield over Kufri Lalit (40.64 t/ha) and Kufri Lalima (37.93 t/ha) respectively. Performance of this clone (43.64 t/ha) was 44, 12, 21% better than the controls Kufri Manik (30.37 t/ha), Kufri Lalit (39.16 t/ha), and Kufri Lalima (36.11 t/ha) in central plains. In eastern plains, MS/11-664 (30.25 t/ha) yielded better over the controls Kufri Manik (28.11 t/ha), Kufri Lalit (27.25 t/ha), and Kufri Lalima (26.30 t/ha) by 8, 11 and 15% respectively (**Table 4**). Clone MS/11-664 (38.95 t/ha) recorded 16, 9, and 17% higher total tuber yield than controls Kufri Manik (33.44 t/ha), Kufri Lalit (35.59 t/ha) and Kufri Lalima (33.33 t/ha) on an overall basis in whole North-Indian plains. This clone had nearly 91% marketable tuber yield which was comparable with Kufri Manik (91%), Kufri Lalit (91%) and Kufri Lalima (92%).

Tuber dry matter content

Advanced clone MS/11-664 possessed comparable mean tuber dry matter content (%) of 17 and 19% at 75 and 90 days crop duration, 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 5**). During 2020-21 (**Table 6)**, this clone maintained 17 and 18% tuber dry matter content across the locations at 75 and 90 days as compared to Kufri Manik (17 and 18%), Kufri Lalit (17 and 19%) and Kufri Lalima (18 and 19%).

Table 4. Mean performance of advanced clone MS/11-664 in AICRP on Potato 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			
		MS/11-664	Kufri Manik	Kufri Lalit	Kufri Lalima	MS/11-664	Kufri Manik	Kufri Lalit	Kufri Lalima
Northern plains	Hisar	35.35	32.99	34.68	32.65	43.64	43.64	44.25	39.24
	Jalandhar	36.00	37.76	38.51	35.14	49.10	45.83	45.59	43.19
	Modipuram	34.67	30.79	29.95	31.21	50.66	38.32	46.12	41.98
	Pantnagar	23.80	-	22.64	22.69	27.75	-	26.60	27.34
	Mean	32.45	33.85	31.44	30.42	42.79	42.60	40.64	37.93
	% Yield ±		-4.12	3.22	6.68	-	0.45	5.28	12.80
Central plains	Chhindwara	34.33	25.78	34.55	33.77	39.60	33.23	41.09	38.8
	Deesa	46.19	-	42.69	42.70	54.08	-	53.02	48.91
	Gwalior	35.24	-	33.41	28.91	43.43	-	39.03	33.97
	Kanpur	37.24	28.58	28.32	26.23	45.38	27.50	31.61	32.86
	Kota	26.16	-	21.21	23.24	44.84	-	33.11	27.66
	Raipur	30.27	-	30.73	29.80	34.49	-	37.12	34.47
	Mean	34.90	27.18	31.82	30.77	43.64	30.37	39.16	36.11
	% Yield ±		28.42	9.70	13.42		43.70	11.42	20.84
Eastern plains	Bhubaneshwar	16.94	8.45	12.78	13.12	21.50	13.72	15.59	16.81
	Dholi	26.65	29.35	25.52	27.44	29.20	33.41	27.57	27.20
	Faizabad	30.80	33.48	30.77	24.54	35.76	37.52	35.88	33.53
	Kalyani	26.97	-	23.74	25.24	34.01	-	29.98	30.63
	Patna	26.24	24.78	24.88	20.73	30.79	27.79	27.25	23.32
	Mean	25.52	24.02	23.54	22.21	30.25	28.11	27.25	26.30
	% Yield ±		6.26	8.42	14.88		7.61	10.99	15.03
Overall mean		31.12	28.00	28.96	27.83	38.95	33.44	35.59	33.33
% Yield ±			11.16	7.48	11.84		16.47	9.44	16.87

Keeping quality

Advanced clone MS/11-664 was adjudged to be a very good keeper as it exhibited long tuber dormancy (>10 weeks), comparatively less weight loss, rottage, sprout weight, and firm tuber appearance after 75 days of on-farm storage in station trials. Storage study clearly showed that advanced hybrid MS/11-664 has very good keeping quality (**Table 7**) by virtue of having less rottage (0.23%) and total weight loss (7.82%) as compared to new red skin variety Kufri Lalit (2.60 and 9.34%). It had lower rottage and at par total weight loss than the prevalent red skin variety Kufri Lalima (0.99 and 7.64%).

In AICRP on Potato trials (**Table 8**), the clone showed lower total weight loss (12.67%) over the controls Kufri Manik (14.16%) and Kufri Lalit (15.88%). Very good keeping quality of MS/11-664 will benefit small and marginal farmers, those do not store potatoes in cold stores. They store potatoes in heaps under shade or on farm stores for 75 days or till the onset of monsoon which enables them to periodically take out tubers for the local market.

Usage

Red skin advanced clone MS/11-664 recently released as variety Kufri Lohit is

suitable for table purposes with attractive red coloured 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

Table 5. Tuber dry matter content (%) in AICRP on Potato trials (pooled over 2018-19 & 2019-20)

Regions	Locations	75 days			90 days		
		MS/11-664	Kufri Lalit	Kufri Lalima	MS/11-664	Kufri Lalit	Kufri Lalima
Northern plains	Hisar	16.10	15.87	16.99	16.98	16.09	20.20
	Jalandhar	13.58	15.71	18.12	14.50	16.83	18.73
	Modipuram	13.80	15.51	18.17	14.03	15.73	19.74
Central plains	Chindwara	18.26	17.28	18.15	19.28	18.29	19.24
	Deesa	15.90	17.07	18.15	19.04	19.44	21.15
	Gwalior	15.71	16.42	19.92	18.07	18.75	21.53
	Kanpur	21.04	21.21	21.28	23.77	24.32	24.25
	Kota	20.37	-	-	21.25	17.63	-
	Raipur	19.11	19.50	19.87	20.18	20.28	20.34
Eastern plains	Bhubaneshwar	18.08	19.36	19.24	18.46	18.72	19.10
	Dholi	16.69	17.29	17.10	19.19	20.88	19.99
	Faizabad	17.28	17.43	17.32	18.31	18.68	18.38
	Kalyani	18.38	18.50	21.44	23.51	21.55	22.46
	Patna	16.23	17.05	15.47	17.25	17.65	17.88
	Mean	17.18	17.55	18.56	18.84	18.92	20.23
	CD (0.05)	Genotypes: 0.16, Genotype × location: 0.52			Genotypes: 0.26, Genotype × location: 0.61		

Table 6. Tuber dry matter content (%) in AICRP on Potato trials (2020-21)

Regions	Locations	75 days				90 days			
		MS/11-664	Kufri Manik	Kufri Lalit	Kufri Lalima	MS/11-664	Kufri Manik	Kufri Lalit	Kufri Lalima
Northern plains	Hisar	15.75	15.75	16.75	17.00	16.70	17.73	18.00	19.00
	Jalandhar	13.33	14.63	15.60	16.75	15.25	15.78	16.30	17.60
Central plains	Chindwara	18.40	18.20	17.85	18.13	19.00	18.53	18.55	19.00
	Deesa	14.15	-	14.48	17.35	15.40	-	19.23	20.33
	Gwalior	16.47	-	17.19	18.92	16.64	-	17.67	19.45
	Kanpur	16.85	16.98	17.73	17.08	19.20	18.85	20.60	20.03
	Kota	-	-	-	-	20.60	-	17.83	17.08
	Raipur	18.29	-	17.74	18.99	18.49	-	19.07	18.99
Eastern plains	Bhubaneshwar	16.26	15.92	16.35	18.40	16.74	17.08	17.78	18.95
	Dholi	18.18	18.48	18.21	17.55	20.14	20.16	21.24	19.13
	Faizabad	17.40	17.71	16.30	17.50	18.48	18.89	17.09	18.40
	Kalyani	17.72	-	18.46	18.83	21.49	-	21.58	20.29
	Patna	14.23	14.63	15.90	16.30	16.90	16.87	16.90	16.67
	Mean	16.42	16.54	16.88	17.73	18.08	17.99	18.60	18.84
	CD (0.05)	Genotypes: 0.26, Genotype × location: 0.96				Genotypes: 0.24, Genotype × location: 0.85			

Table 7. Keeping quality (mean of 4 years) in station trials at Modipuram

Genotypes	Dormancy	Sprouting (%)		Loss due to sprouting (%)	Loss due to rottage (weight basis) (%)	Physiological weight loss (%)	Total weight loss (%)	Appearance
	(<or> than 6 weeks	At 6 weeks	At 75 days					
MS/11-664	>10 weeks	0.15	29.80	0.01	0.23	7.59	7.82	4.33
Kufri Lalit	>10 weeks	33.80	60.88	0.10	2.60	6.64	9.34	4.31
Kufri Lalima	>10 weeks	2.25	30.06	0.06	0.99	6.60	7.64	4.25

Table 8. Total weight loss (%) under AICRP on Potato trials (mean of 2018-19, 2019-20 and 2020-21)

Locations	MS/11-664	*Kufri Manik	Kufri Lalit	Kufri Lalima
Deesa	17.10	-	19.80	11.70
*Faizabad	4.710	7.75	15.45	6.35
Kanpur	14.70	18.00	19.00	14.00
Modipuram	11.62	15.00	9.87	7.17
*Patna	15.20	15.90	15.30	8.20
Overall mean	12.67	14.16	15.88	9.48

*Faizabad (2021-21) and *Patna (2018-19), *Kufri Manik (2020-21)

Table 9. Late blight reactions of advanced clone MS/11-664 in station trials at Modipuram

Genotypes	Field screening		Detached leaf	
	AUDPC	rAUDPC	Lesion area (cm^2)	Grading
MS/11-664 (4*)	382.37	0.20	4.52	MR
Kufri Lalit (3*)	549.57	0.28	6.68	S
Kufri Lalima (2*)	569.69	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)

are high (Luthra *et al.*, 2006 and Kumar *et al.*, 2014). Tubers of this clone seldom exhibit external/internal defects and are not susceptible to skin damage at harvest. The tubers are easy to cook (15-20 minutes) and cooked/boiled tubers are free from any kind of discolouration. Advanced clone MS/11-664 possesses a pleasant flavour, mealy texture, and good organoleptic taste. Thus, the advanced clone's desirable tuber characters, good keeping, and culinary quality will favour its acceptance.

Disease resistance

Advanced clone MS/11-664 has field resistance to late blight (AUDPC: 382.37; lesion area: 4.52 cm^2) as compared to the red-skinned varieties like Kufri Lalit (AUDPC: 549.57; lesion area: 6.68 cm^2) and Kufri Lalima (AUDPC: 569.69; lesion area: 4.70 cm^2), when investigated under field conditions and through standard detached leaf method (Lal *et al.* 2020), respectively (**Table 9**).

Production technology

Crop management: Optimum tuber productivity of 36-38 t/ha is achievable with advanced clone MS/11-664 following worked-out nutrition doses and the recommended package of practices. Optimum planting time in north Indian plains remains between the second fortnight of October to the first fortnight of November when the daily maximum day temperature comes down to around 32°C. Potato planting at 20 cm in 60 cm rows for seed size tubers (40-60g) provides optimum tuber yield and seed rate shall be approximately 3.5-4.0 t/ha. Take out seed tubers from the cold store at least 10 days before planting. Do not bring out seed bags in direct sunlight as it may result in rottage due to sudden exposure to high temperatures. Spread the tubers in thin layers under shade in diffused light for sprouting and allow sprouts to become 0.5-1.0 cm long, thick, and green. Carry sprouted tubers to the fields in seed trays or baskets for planting to avoid sprout damage. Fertilizer doses have

been worked out after field experimentation at Modipuram in the west-central plains. This clone responded up to 240 N, 60 P_2O_5, and 80 K_2O kg/ha, respectively for 90 days of crop duration of ware potatoes. Hence for seed crops, 150 kg nitrogen (N), 60 kg phosphorous (P_2O_5), and 80 kg potassium (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 beds with a better tilth and nutrition to the potato crop. These crop management practices shall reduce approximately one-third dose of nitrogen and half doses of phosphorus and potassium. Thus, a half-adjusted dose of nitrogen and full-adjusted doses of P_2O_5 and K_2O should be applied at planting. The remaining half-adjusted dose of nitrogen should be applied 20-25 days after planting i.e. at the time of inter-cultivation and earthing. Nutrient management in different agroecologies may differ, so, the regional recommendation may be fine-tuned and adopted for obtaining optimum productivity of this clone. 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 in view unseasonal rains during crop season (Rawal *et al*., 2021).

Plant Protection Measures: To manage 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, however, 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 potato 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 the tuber skin. All damaged and rotten tubers should be removed and graded to fetch a better price in the market. Potatoes are packed in 45-50 kg gunny or leno bags and labeled either for selling in the market or storing in cold storage (Rawal *et al*., 2021).

ADAPTABILITY

Advanced clone MS/11-664 named and released as variety Kufri Lohit has performed well in multi-location trials conducted under AICRP on Potato and has been recommended

for cultivation in North-Indian plains (Eastern and Central plains). This variety can also successfully be grown in northern plains due to its yield advantage, particularly to meet the seed requirement of regions having a preference for red-skin tubers. Thus variety Kufri Lohit can easily be adopted in Orissa, Bihar, West Bengal (Eastern plains); Madhya Pradesh, Gujarat, Rajasthan, Chhattisgarh (Central plains), and Haryana, Punjab, Uttar Pradesh (Northern plains).

CONCLUSION

Kufri Lohit is a medium maturing red skin variety and can be a better choice for farmers and consumers where red-skinned potatoes are preferred. The variety produces attractive red coloured, ovoid tubers with shallow eyes, cream flesh, and mealy texture. This variety possesses approximately 18% tuber dry matter content and has very good keeping quality. It is responsive to crop nutrition and yields 36–38 t/ha total tuber yield under optimum crop management. Its export potential can also be harnessed in the coming time for destinations like 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.

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