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KUFRI ARUN : A NEW RED SKIN POTATO VARIETY

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ABSTRACT: Kufri Arun is a medium maturing, main season, high yielding table potato variety suitable for cultivation in north Indian plains. It is a clonal selection from the cross between Kufri Lalima and MS/82-797. Its plants are tall and vigorous with field resistance to late blight. Its tubers are red, oval with shallow to medium eyes and creamy-light yellow flesh, and having good keeping quality. It is fertilizer responsive and capable of yielding 350–400 q/ha under optimum agronomical practices.

INTRODUCTION

Traditionally red skin potatoes have been in demand in eastern India (2) and are now being preferred in north-western and west-central plains (3). Red skin potato varieties from Malaut, Muktsar and Abohar districts of Punjab are being regularly sent to Jammu and Kashmir predominantly for cooking with meat. In India, the west-central and eastern plains accounts for nearly 75% of the country's potato production. Two red tuber varieties, namely, Kufri Sindhuri (late maturing) and Kufri Lalima (medium maturing) released way back in 1967 and 1982, respectively failed to continue their hold in this region due to their late blight susceptibility (5), which has become a regular phenomenon in this part of the country. Keeping in view the increasing demand of red skin potatoes in the prevailing market, Central Potato Research Institute has developed a new red potato variety Kufri Arun.

BACKGROUND

Kufri Arun (MS/92-2105) was bred and

selected at Modipuram Campus of the Central Potato Research Institute, Shimla. The clone was derived from a cross between Kufri Lalima (female), a red skin round shaped, deep eyed, late blight susceptible variety and MS/82-797 (male), white skin, oval shaped, shallow eyed advance potato hybrid with late blight resistance. The cross was made in 1991 at CPRI Campus Modipuram under extended photoperiod conditions. The pedigree of Kufri Arun is described in **Figure 1**. The clone was in seedling stage in 1992, five-hill plots in 1993, 30 hill plots in 1994, multiple row trials in 1995 and in replicated trials during 1996-1999 at CPRI Campus, Modipuram. The hybrid was introduced to All India Potato Improvement Project in 1999 for multi-location evaluation across the country.

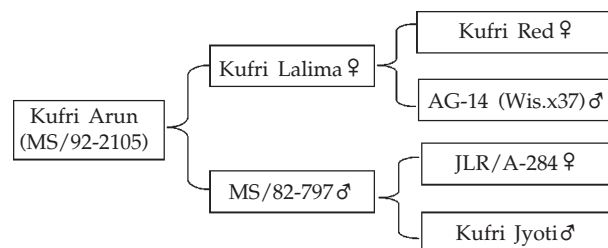


Fig. 1. Pedigree of Kufri Arun

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Under AICPIP, it was evaluated for two years at Modipuram and Patna (2000-2001 and 2001-2002), at 3 locations (Chindwara, Jalandhar and Patna) during 2000-2001, at 12 locations during 2001-2002 and at 7 locations during 2002-2003. It showed wider adaptability and higher yield than the controls. Based on its performance, the hybrid was recommended for release in Group Meeting of Potato Workers of AICPIP at Bangalore during September 5-7th, 2003 and subsequently it was released and notified as variety in the name of Kufri Arun by the Central Sub-Committee on Crop Standard Notification and Release of Varieties for Horticultural Crops, Ministry of Agriculture, Department of Agriculture and Co-operation, Government of India, New Delhi in January, 2005. The name of the variety was chosen as Kufri Arun because the colour of its tubers resembles the rays of setting sun known as arunima in Hindi.

VARIETY DESCRIPTION

Plants

Growth habit: Plant tall, erect, medium compact, vigorous.

Stems: Few, thick, uniformly coloured (Rp3) with moderately developed wavy wings.

Leaves: Dark grey green, open, rachis pigmented.

Leaflets: Ovate-lanceolate, weekly dissected, smooth glossy surface with entire margin.

Folioles: Medium.

Petiole: Green with anthocyanin pigmentation.

Inflorescence

Flowering: Moderate (**Figure 2**) with medium number of florets per inflorescence, floral stalk-pedicel articulation visible.

Calyx: Pigmented.

Corolla: Light red purple having white secondary colour, pentagonal shaped.

Stigma: Capitate, pale green.

Anthers: Broad, orange-yellow, well developed, pollen quantity medium and pollen stainability high.

Fruit set: Low under field conditions.

Tubers

Size: Medium to large, 8-12 tuber per plant,

Shape: Oval.

Skin: Smooth, red.

Eyes: Shallow to medium, with a mean number of 7 eyes per tuber (range 5-9), predominantly apical.

Flesh: Creamy-light yellow, occasionally scattered spots of light red colour in flesh with mealy texture.

Sprout

Red purple, broad cylindrical, weakly pubescent of reddish green colour, sprout tip closed, frequency of sprout root initials medium, protrusions of lenticels weak and lateral shoots short.

YIELD PERFORMANCE

Kufri Arun out yielded the best control Kufri Sutlej (white skin variety) by a margin of 8 and 16% at 75 and 90 days crop duration, respectively in varietal trials at Modipuram during 1996-99 (**Table 1**). In trials with red varieties conducted at Modipuram during 2000-2002, it out yielded the best control Kufri Lalima by 22 and 27% for total as well as marketable tuber yield, respectively at both the dates of lifting (**Table 2**). However at Patna, Kufri Arun produced 5% (256q/ha) and 26% (424q/ha) higher tuber yield than red skinned control Kufri Sindhuri at 75 (245q/ha) and 90 (297q/ha) days harvest, respectively. In AICPIP trials conducted at

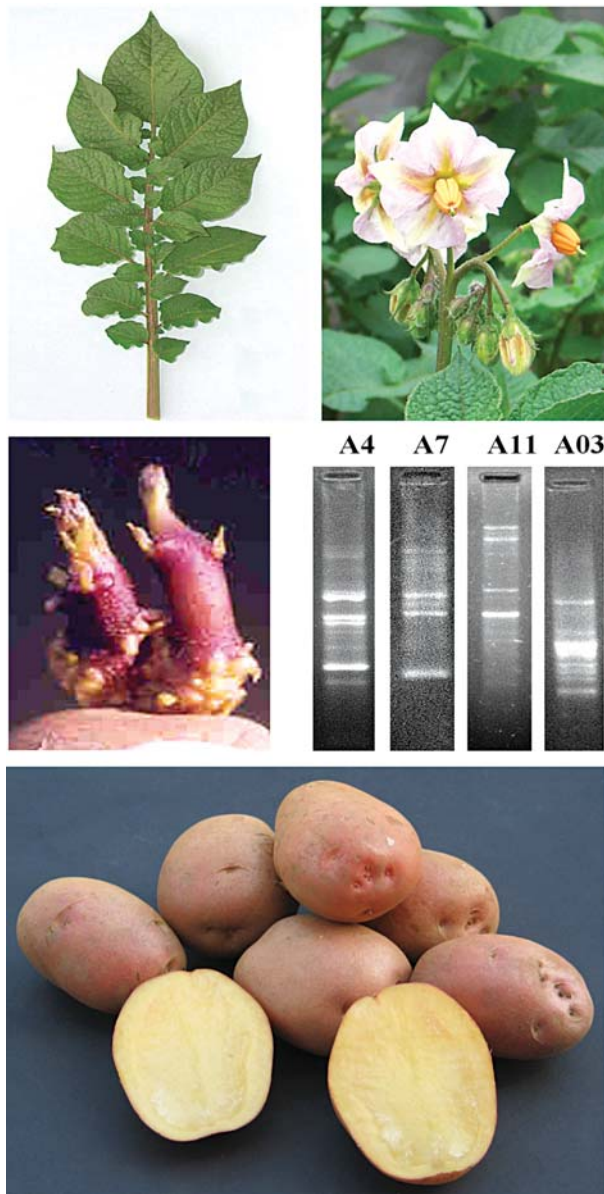


Fig. 2. Morphological characteristics of Kufri Arun- Leaf; flowers; sprout; DNA fingerprints and tubers

Table 2. Performance of Kufri Arun in red-varieties trial at Modipuram (pooled over 2000-2001 and 2001-2002)

Variety	75 DAP		90 DAP	
	TTY*	MTY**	TTY	MTY
Desiree	205.20	178.49	209.46	179.38
Kufri Kanchan	170.84	113.96	217.32	172.90
Kufri Lalima	231.92	200.55	274.45	239.32
MP/92-56	221.59	171.22	287.17	232.91
Kufri Arun	285.63	269.08	334.69	303.53
CD (0.05)	19.21	22.23	33.80	38.14

*Total tuber yield (q/ha),**Marketable tuber yield (q/ha).

3 locations (Chindwara, Jalandhar and Patna) during 2000-2001, the variety yielded at par or higher than controls at both the crop durations. In subsequent trials at 12 locations under AICPIP during 2001-2002, Kufri Arun produced 10 and 14% higher total and marketable tuber yield, respectively than the best control Kufri Pukhraj (259 q/ha) at 90 days crop duration; however at 75 days it remained at par with the best control Kufri Ashoka (Table 3). In trials with red varieties conducted at 7 locations during 2002-2003, Kufri Arun produced 15% higher total and marketable tuber yield than the best control Kufri Lalima at 75 days crop duration (Table 4). The total and marketable tuber yield was 20 and 22% higher, respectively than the best control Kufri Lalima at 90 days harvest. The variety has ability to produce more than 90% tubers of marketable size at both the dates of lifting.

Keeping quality: The variety Kufri Arun possesses long tuber dormancy (>8weeks),

Table 1. Performance of Kufri Arun in advance stage trials at Modipuram

Variety	Total tuber yield q/ha							
	1996-1997		1997-1998		1998-1999		Average	
	75 DAP*	90 DAP	75 DAP	90 DAP	75 DAP	90 DAP	75 DAP	90 DAP
Kufri Ashoka	-	-	176	178	206	195	191	187
Kufri Bahar	204	225	143	151	223	213	190	196
Kufri Sutlej	191	246	234	234	250	307	225	262
Kufri Arun	229	300	259	305	243	309	244	305
CD (0.05)	NS	54	27	25	40	57		

* days after planting

Table 3. Tuber yield of Kufri Arun at different locations under AICPIP during 2001-2002

Location	At 75DAP							
	Total tuber yield (q/ha)				Marketable tuber yield (q/ha)			
	Kufri Arun	Kufri Ashoka	Kufri Jawahar	CD (0.05)	Kufri Arun	Kufri Ashoka	Kufri Jawahar	CD (0.05)
Bhuvneshwar	135.44	131.44	105.33	NS	127.22	125.78	96.44	23
Chindwara	245.92	204.99	195.55	NS	228.15	188.52	179.99	8.3
Deesa	263.33	241.59	178.26	27	260.53	236.36	173.22	27
Dholi	177.78	155.55	122.22	25	167.99	143.33	109.99	11
Faizabad	256.52	265.55	251.66	17	242.08	246.66	233.89	5.5
Hissar	102.59	96.12	92.79	8	94.37	87.54	84.04	6.5
Jalandhar	333.11	369.11	321.99	36	313.33	352.89	292.66	9.5
Kota	167.11	165.11	165.11	17	147.99	151.78	145.11	6.4
Modipuram	260.95	281.67	261.91	23	250.66	247.25	255.08	7.7
Pantnagar	293.33	322.22	293.33	10	287.77	316.66	287.77	2.4
Patna	192.22	255.78	155.33	24	184.89	227.55	142.89	19
Raipur	219.78	272.78	180.00	55	199.22	251.44	161.33	15
Average	220.67	230.16	193.62		208.68	214.65	180.2	

Location	At 90DAP							
	Total tuber yield (q/ha)				Marketable tuber yield (q/ha)			
	Kufri Arun	Kufri Pukhraj	Kufri Sutlej	CD (0.05)	Kufri Arun	Kufri Pukhraj	Kufri Sutlej	CD (0.05)
Bhuvneshwar	102.99	66.33	97.44	24	99.44	62.78	95.33	23
Chindwara	267.78	216.11	220.37	34	248.15	193.70	196.66	33
Deesa	317.86	315.46	252.66	44	314.53	307.33	247.19	43
Dholi	244.44	155.55	177.78	NS	236.66	145.55	167.99	33
Faizabad	281.28	251.66	269.86	19	268.78	236.66	251.25	19
Hissar	162.82	121.68	138.48	12	148.29	108.55	121.68	9
Jalandhar	465.11	468.88	440.44	NS	443.55	447.11	418.66	NS
Kota	222.89	236.66	221.99	29	197.11	209.33	201.99	20
Modipuram	295.85	289.77	307.27	46	284.54	256.49	287.37	38
Pantnagar	327.77	335.55	325.55	8	322.22	229.99	319.99	8
Patna	373.33	365.27	339.72	NS	360.55	344.72	328.89	NS
Raipur	334.81	283.33	298.33	NS	277.40	262.59	279.44	NS
Average	283.08	258.85	257.49		266.77	233.73	243.04	

Table 4. Tuber yield of Kufri Arun along with red varieties at different locations under AICPIP during 2002-2003

Location	At 75 DAP							
	Total tuber yield (q/ha)				Marketable tuber yield (q/ha)			
	Kufri Arun	Kufri Lalima	Kufri Sindhuri	CD (0.05)	Kufri Arun	Kufri Lalima	Kufri Sindhuri	CD (0.05)
Bhuvneshwar	179.24	176.63	144.08	36.65	154.94	159.71	128.90	34.46
Chindwara	209.58	203.11	202.20	NS	189.01	189.57	181.54	22.51
Dholi	297.72	256.92	266.91	NS	290.78	247.38	251.72	NS
Faizabad	453.67	370.35	339.97	60.74	429.95	352.41	323.47	56.30
Kalyani	315.51	276.45	232.62	33.18	279.93	246.07	184.45	29.70
Modipuram	342.62	331.84	307.38	NS	320.42	302.43	269.12	NS
Patna	269.95	188.36	188.36	38.42	264.31	180.54	174.03	38.97
Average	295.47	257.67	240.22		275.62	239.73	216.18	

(Contd.)

Table 4. (Contd.)

Location	At 90 DAP							
	Total tuber yield (q/ha)				Marketable tuber yield (q/ha)			
	Kufri Arun	Kufri Lalima	Kufri Sindhuri	CD (0.05)	Kufri Arun	Kufri Lalima	Kufri Sindhuri	CD (0.05)
Bhuvneshwar	204.84	208.75	169.39	55.36	191.83	191.39	149.73	52.76
Chindwara	251.33	225.29	237.75	26.15	235.18	203.89	214.70	27.63
Dholi	387.12	314.65	272.55	44.85	373.24	303.80	264.74	43.70
Faizabad	624.96	484.63	434.00	81.37	597.18	470.17	417.80	79.10
Kalyani	336.35	299.46	276.45	40.51	318.55	270.16	242.17	41.34
Modipuram	454.31	402.36	384.09	NS	432.89	375.08	341.50	NS
Patna	431.83	302.50	259.53	36.91	420.55	289.91	243.47	70.26
Average	384.39	319.66	290.54		367.06	300.63	267.73	

comparatively less weight loss, rottage, sprout weight and firm tuber appearance after 90 days of on-farm storage (Table 5); therefore adjudged to be a good keeper. The multi-location storage studies conducted under

AICPIP also confirmed its good keeping quality. This will benefit small/marginal farmers who are unable to store potato in cold store and have to sell their produce in the market. It possesses high tuber dry matter (>19%; Table

Table 5. Keeping quality of Kufri Arun at Modipuram (pooled over 1996-1997, 1997-1998 and 1998-1999)

Variety	Sprouting (%) after			Weight loss (%) after			Rottage (%)	Sprout weight at 90 days (g/Kg)	Tuber appearance at 90 days
	30*	45	60	30	60	90			
Kufri Ashoka	0	0	7	5	8	13	0	0.4	Good
Kufri Bahar	0	0	38	4	4	12	0	1.4	Good
Kufri Chandramukhi	0	3	21	4	7	10	0	1.3	Good
Kufri Sutlej	0	6	52	5	8	14	0	3.6	Good
Kufri Arun	0	1	18	5	8	14	0	0.5	Good

*days

Table 6. Tuber dry matter (percent) of Kufri Arun under AICPIP at 90 days crop

Location	2001-2002				2002-2003			
	Kufri Arun	Kufri Pukhraj	Kufri Sutlej	CD (0.05)	Kufri Arun	Kufri Lalima	Kufri Sindhuri	CD (0.05)
Bhuvneshwar	20.14	15.74	18.01	1.20	20.22	20.03	19.39	1.71
Chindwara	21.27	19.79	20.29	NS	19.38	19.10	19.28	NS
Deesa	20.61	17.30	18.74	0.51	-	-	-	-
Dholi	20.20	18.50	18.80	0.77	21.12	20.95	20.75	NS
Faizabad	17.01	16.78	16.83	NS	18.10	18.20	18.65	0.66
Hissar	18.93	15.26	15.64	1.22	-	-	-	-
Jalandhar	16.92	14.32	15.38	0.55	-	-	-	-
Kota	25.68	18.80	23.14	0.94	-	-	-	-
Kalyani	-	-	-	-	17.62	17.12	19.05	0.48
Modipuram	23.78	17.58	18.99	0.92	20.00	17.97	19.59	1.52
Pantnagar	18.80	19.20	19.10	0.44	-	-	-	-
Patna	18.30	13.64	13.98	1.15	16.93	16.40	15.85	1.36
Average	20.15	16.99	18.08		19.05	18.54	18.94	

6) and therefore will provide better nutrition to the consumers at similar cost.

Usage: Kufri Arun is likely to be preferred by consumers for its oval shape and shallow/medium eyes resulting in lower peeling losses compared to Kufri Sindhuri, which has round shape with deep eyes and high peeling losses (1). It is easy to cook (15-20 minutes) and cooked/boiled potatoes are free from discolouration. It possesses pleasant flavour, mealy texture and good palatability. The desirable tuber characters, good keeping and culinary quality of Kufri Arun will favour its acceptance.

Disease resistance: The variety Kufri Arun possesses field resistance to late blight and therefore it is likely to replace the red skinned late blight susceptible varieties like Kufri Lalima and Kufri Sindhuri. Also, the tubers of this variety seldom exhibit external or internal defects and are not susceptible to skin damage at harvest.

Agronomic management: Normal agronomical schedule for medium maturing varieties is required for production of optimum tuber yield of Kufri Arun.

Planting time: Mid-October to Mid-November.

Seed rate: 35-40 q/ha.

Seed size: 40-50 gram.

Spacing: Plants spaced at 20 cm within row and 60 cm between rows provide optimum tuber size distribution for production of desirable tuber size for seed or table potatoes.

Fertilizer: Recommended doses are 180 kg N, 80 kg P and 100 Kg K/ha with 50% N at the time of planting and 50% at earthing up. However, nutrient management for different environment needs to be worked out for obtaining optimum productivity of Kufri Arun.

Plant Protection Measures: Thimet @10 kg/ha at earthing up and foliar spray of Oxy-demeton

methyl @ 1.5ml/litre after 75 DAP in seed crop only.

Adaptability: Kufri Arun has performed well in multi-location trails conducted under AICPIP and has been recommended and notified for cultivation in north Indian plains. It had been adjudged stable and widely adaptable under different environmental conditions of North-central and eastern plains of India (6). Kufri Arun can aptly replace the late blight susceptible varieties Kufri Lalima and Kufri Sindhuri and can meet the long felt demand of farmers for a variety with red skin oval tubers, resistance to late blight and higher yield. The variety has also promise for export to Bangladesh, Bhutan, Nepal, Pakistan and Philippines, where red skin potatoes are traditionally preferred. (4).

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