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Research Article

A New Heat Tolerant Potato Variety Kufri Lima Suitable for Early Planting in North-Western Plains of India

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ABSTRACT

Kufri Lima is an early maturing, heat tolerant and disease resistant potato variety with ovoid tubers, white-cream smooth skin, eyes shallow and pale cream flesh. It is resistant to PYX, PVY & moderately resistant to root knot nematode, susceptible to late blight. Kufri Lima is tolerant to hopper and mite burn under heat stress conditions. The produce of Kufri Lima is suitable for table purpose as the variety produces attractive, tubers without any deformities like cracking or hollow heart. The variety produces high tuber yield with high tuber dry matter.

Keywords: *Potato, Clones, Varieties, Disease resistant, Heat tolerant,*

INTRODUCTION

The elite CIP clone 397065.28 (CP4054) developed at International potato center (CIP), Lima Peru in 1997 was brought to India in 2007 under ICAR-CIP collaborative programme on potato crop improvement. In India, the advanced clone was evaluated for early planting conditions. A collaborative study was initiated at Shamgarh, Karnal, Haryana during 2008-16 to identify its suitability for semi-arid, agro-ecology of Haryana under AICRP trials. Being elite advanced clone, it was not bred in India, it was released directly from clone. Kufri Lima is high yielding varieties for early heat tolerant regions for early planting conditions in Indian plains with good keeping quality for table purpose.

To meet the needs of the increasing population of the country, the production of potato in the country has to be increased to 122 million tons by 2050 and the productivity from 23 tons to 35 tons per hectare (CPRI, 2015). To meet this production target there are plenty of challenges ahead for India in general and Haryana in particular. These include seed potato production under climate change scenario, the development of climate smart cultivars for the changed climate and increase in productivity by making quality seed available to the farmers.

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Further, Haryana required potato varieties with qualities of early planting, heat tolerance and virus resistance, in order to fit in the rice-wheat crop system in non-traditional warmer districts of Haryana. The early harvest of short duration varieties would allow better market prices to farmers as well.

The heat tolerance and disease resistance are the very important criteria for the new varieties to sustain the production for future needs of India. Hence, studies were initiated at Potato Technology Centre, Shamgarh, Karnal, Haryana in collaboration with International Potato Centre (CIP), Central Potato Research Institute (CPRI) to identify suitable varieties for semi-arid, agro-ecology of Haryana for creating better income opportunities for the farmers. Experiments were planned at PTC, Shamgarh with the objective to select robust, early heat tolerant and virus resistant potato varieties and to strengthen institutional capacity for quality seed production at farm-level and participatory multiple-environment selection of climate smart varieties to cater to the needs of the farmers of Haryana. Karnal had been always a very important district to evaluate the suitability of Kufri Lima in northern plains. There is need to extend the potato cultivation in the non-traditional districts of Haryana with heat tolerant early bulking varieties hence a project under RKVY for quality seed potato cultivation has been working for past two years, and Kufri Lima had been found a suitable for production of seed for Kufri Lima, as this has been one of the preferred variety by farmers since long.

MATERIALS AND METHODS

Under AICRP one of the districts selected was Karnal for evaluating suitability of CP-4054 (Kufri Lima) for heat tolerance and disease resistance at Haryana. This clone from CIP was evaluated in the early Rabi season from 15 September onwards with the early heat tolerant check varieties like K. Surya after primary trial evaluation in warmer district Ladol of Gujarat. Under AICRP, replicated yield trials with controls were conducted during 2011-17 at Karnal, Haryana along with 2 other districts like Ladol, at Gujarat and Burdwan at West Bengal.

Since the study emphasise to find the suitable varieties for non-traditional areas of Haryana the trials, evaluations and results discussed are from AICRP (All India coordinated research project) trials conducted at PTC Karnal, Haryana. In AICRP, replicated yield trials with controls were conducted during 2011-12 and 2012-13 at Karnal along with the on-farm trials conducted during 2013-14 Karnal, 2014-15, 2015-16 and 2016-17. The CP4054 (Kufri Lima) performed well at all the locations than the control.

REPLICATED TRIALS

The results of evaluation of CP4054 (Kufri Lima) during 2011-12 & 2012-13 at Karnal (Kufri Badshah, Kufri Bahar & Kufri Surya), reflected its superiority for total and marketable tuber yield over the controls in crop planted 15-20 days early than main season (Table 2, 3, 4). On overall basis, CP4054 (Kufri Lima) with 46 t/ha yield recorded nearly 15 % yield increase over-heat tolerant variety Kufri Surya with 40 t/ha yield and CP4054 (Kufri Lima) also produced 95% marketable tuber yield as compared to Kufri Surya produced 94% marketable yield at 90 days crop duration.

Distinguishing morphological characters of CP4054 (Kufri Lima)

Plant: Medium, plant canopy compact, stem thick, predominantly green, red brown highly scattered throughout, wings highly developed and straight.

Plant Height: Medium 55-60 cm

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

Flower: Flowering medium, inflorescence medium, floral stalk colored, floral stalk-pedicle articulation clearly visible and located above the middle, calyx colored, corolla red violet, white acumen, corolla shape semi-stellate, anther yellow, anther cone normally developed, stylar length equal with stamen column and stigma uni-lobed.

Tubers: Tubers (5-7), ovoid, skin white-cream, eyes shallow, eyebrows normal, flesh cream, texture mealy.

Sprout: Sprout red purple, shape conical, pubescence at sprout

Early bulker (80DAP) but best at Medium (90 DAP)

Agronomic features: The following norms are recommended

Planting time: 15-20 days early planting than main season crop with Seed rate of 35-40 q/ha, Seed size: 40-60 gram with Spacing of 60 x 20 cm in a Normal regional fertilizer application using 50% N at the time of planting and 50% N at earthing up.

Plant protection is achieved by Imidacloprid 200 SL, @ 0.3ml/litre or Thiamethoxam 25WGm, @0.5g/litre (seed crop only).

Yield Performance of Kufri Lima

The AICRP Trials were conducted from 2011-17 before it could be released as variety for which the yield of marketable tuber and total tuber yield were taken the criteria's to evaluate for already existing similar varieties for heat tolerance and early bulking like Kufri Surya, Kufri Bahar and in few instance with Kufri Badshah.

RESULTS AND DISCUSSION

Evaluation of CP-4054 (Kufri Lima) clones dehaulmed at 90 days

By dehaulming at 90 DAS, maximum pooled mean total tuber yield was recorded under AICRP year 2011-12 of CP-4054 (Kufri Lima) (41.15 t/ha) followed by Kufri Surya (32.17 t/ha), followed by Kufri Badshah (27.15 Mt/ha) and Kufri Bahar (31.6 t/ha) in succession (Table 1). Similarly in year 2012-13 of CP-4054 (Kufri Lima) produced (40.54 t/ha) followed by Kufri Surya (31.24 t/ha), followed by Kufri Badshah (26.1 Mt/ha) and Kufri Bahar (19.22 t/ha) in succession (Table 1). This indicated Kufri Lima's suitability for Karnal and other districts of Haryana.

Table 1. Performance of CP4054 (Kufri Lima) in AICRP replicated trials at Karnal at

Genotypes	Total tuber yield (t/ha)			Marketable tuber yield (t/ha)		
	2011-12	2012-13	Pooled mean	2011-12	2012-13	Pooled mean
CP-4054 (Kufri Lima)	33.74	48.56	41.15	33.21	47.88	40.54
Kufri Badshah	23.81	30.49	27.15	22.53	29.68	26.1
Kufri Bahar	17.1	22.77	19.93	16.46	21.97	19.22
Kufri Surya	28.08	36.85	32.17	27.46	35.01	31.24
CD (0.05)	Genotype		3.17			3.09
	Year x Genotype		4.49			4.37
CP4054 showed 28% total tuber yield advantage over K Surya						

The mean performance of CP-4054 (Kufri Lima) was compared with Kufri Surya, the total tuber yield was recorded under AICRP year 2011-12 and 2012-13 showed a remarkable difference (Table 2). This indicated CP-4054 suitability for short duration early maturity at Karnal.

Table 2. Mean performance of CP4054 (Kufri Lima) in AICRP

Genotypes	Total tuber yield (t/ha)	Marketable tuber yield (t/ha)
CP4054 (Kufri Lima)	41.15	40.54
Kufri Surya	32.17	31.24
CD (0.05)	3.17	3.09

The mean performance of CP-4054 (Kufri Lima) was compared with Kufri Surya, Kufri Bahar in years 2013-14, 2014-15, 2015-16 the total tuber yield was recorded under AICRP again showed a remarkable difference (Table 3) for on form trial at 90 days when compared for percentage increase over control varieties. This indicated CP-4054 (Kufri Lima) superiority in mean total tuber yield increase was 32.37 % more than Kufri Surya at Karnal.

Table 3. Mean performance CP-4054 in AICRP on-farmtrials at 90 days

Regions	Karnal	Total tuber yield (t/ha)			% yield increase over Kufri Surya
		CP4054	Kufri Surya	Kufri Bahar	
Northern plains	2013-14	44.02	30.9	31.84	42.46
	2014-15	34.88	30.35	33.39	14.93
	2015-16	42.73	30.58	37.36	39.73
	Mean	40.54	30.61	34.2	32.37
	% yield increase		32.45	18.56	

Evaluation of CP-4054 (Kufri Lima) clones dehaulmed at 75 days

The mean performance of CP-4054 (Kufri Lima) was compared with Kufri Surya, Kufri Bahar in years 2016-17 the total tuber yield was recorded under AICRP again showed a remarkable difference (Table 4) for on-form trial at 75 days. This indicated CP-4054 (Kufri Lima) superiority in mean total tuber yield increase was 21.26 % more than Kufri Surya at northern plane that included Karnal. While for total marketable tuber yields CP-4054 (Kufri Lima) showed superiority in mean marketable tuber yield increase was 30.92 % more than Kufri Surya at at northern plane that included Karnal. Even the dry matter was higher in CP-4054 (Kufri Lima) at 17.5 % than for Kufri Surya at 16 %.

Table 4. Performance of CP4054 (Kufri Lima) in AICRP on-farm trials at 75 days (2016-17)

Locations	Total tuber yield (t/ha)		Marketable tuber yield (t/ha)		Tuber dry matter (%)	
	CP4054 (Kufri Lima)	Kufri Surya	CP4054 (Kufri Lima)	Kufri Surya	CP4054 (Kufri Lima)	Kufri Surya
Northern plains						
Karnal	31.78	24.41	29.96	21.76	17.5	16.00
Modipuram	15.22	14.35	14.29	12.04	17.04	17.16
Mean	23.5	19.38	22.13	16.9	17.27	16.58
% yield increase		21.26		30.92		

Evaluation of CP-4054 (Kufri Lima) for on-farm trial dehaulmed at 90 days in 2016-17

The performance of CP-4054 (Kufri Lima) was compared with Kufri Surya, Kufri Bahar in years 2016-17 the total tuber yield was recorded under AICRP again showed a remarkable difference (Table 5) for on form trial at 90 days 41.06 t/ha for CP-4054 (Kufri Lima) and for Kufri Surya it was 31.98 t/ha. While Marketable yield was 39.57 t/ha for CP-4054 (Kufri Lima) and for Kufri Surya it was 29.43 t/ha. While Tuber dry matter was 18.5 for CP-4054 (Kufri Lima) and for Kufri Surya it was 16.6 %.

Table 5. Performance of CP4054 (Kufri Lima) in AICRP on-farm trials at 90 days (2016-17)

Locations	Total tuber yield (t/ha)		Marketable tuber yield (t/ha)		Tuber dry matter (%)	
	CP4054 (Kufri Lima)	Kufri Surya	CP4054 (Kufri Lima)	Kufri Surya	CP4054 (Kufri Lima)	Kufri Surya
Northern plains						
Karnal	41.06	31.98	39.57	29.43	18.5	16.6
Pantnagar	28.68	28.92	28.09	28.43	18.07	17.27
Mean	34.87	30.45	33.83	28.93	18.29	16.94
% yield increase		14.52		16.94		

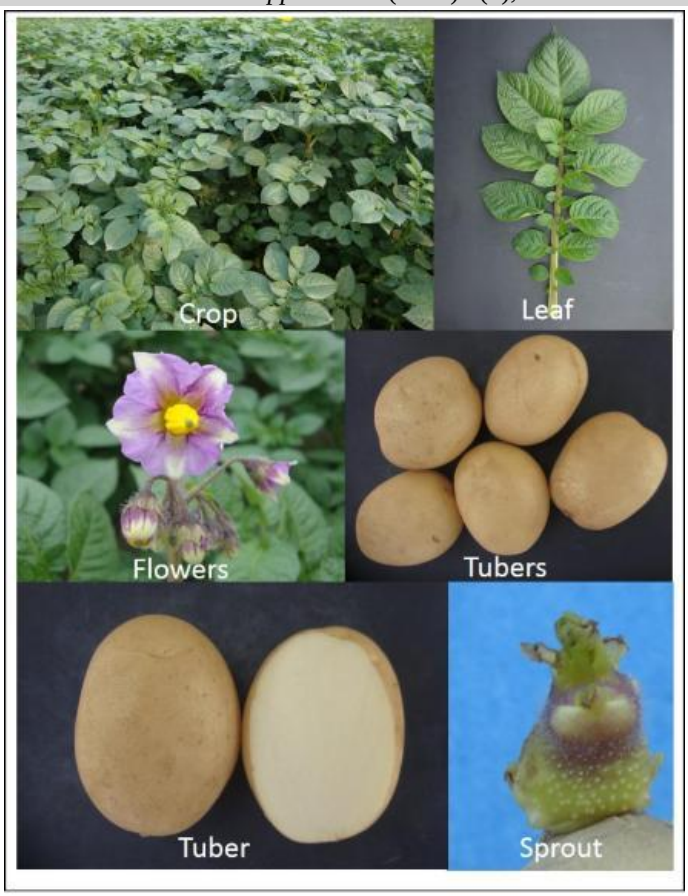
Keeping Quality Evaluation

CP-4054 (Kufri Lima) has very good keeping quality with long tuber dormancy, low rottage, low
weight loss and low sprouting intensity.
Tubers of Kufri Surya, Kufri Bahar and Kufri Badshah from the main crop were stored at room temperature (24-35°C) from mid-March to mid-May during 2013-14 at Karnal.

The keeping quality of CP-4054 (Kufri Lima) was compared with Kufri Surya, Kufri Badshah and, Kufri Bahar in years 2013-15 at 75 days was found that dormancy period was less than 6 weeks in CP-4054 (Kufri Lima) under AICRP, Karnal. Even physiological weight loss was minimum 9.14% in CP-4054 (Kufri Lima) highest was in Kufri Surya at 10.55% again showed a remarkable difference (Table 6) for on form trial at 75 days. The same was found true for total weight loss in CP-4054 (Kufri Lima) at 9.98% than for Kufri Surya at 10.55 %.

Table 6. Keeping quality of CP4054 (Kufri Lima) at 75 days in AICRP trials during 2013-15 at karnal, Haryana

Keeping quality	CP-4054 (Kufri Lima)	Kufri Surya	Kufri Badshah	Kufri Bahar
Dormancy period (weeks)	>6	-	-	-
Physiological weight loss (%)	9.14	10.55	9.31	7.82
Total weight loss (%)	9.98	10.55	13.47	9.9



Notification proposal of potato variety Kufri Lima, CPRI, 2018 7

CONCLUSION

Advantages of CP4054 (Kufri Lima) over Kufri Surya in several parameters like higher tuber yield (up to 22%) in north Indian plains in 15-20 days early crop than main season crop, attractive white-cream ovoid tuber shape and shallow eyes, good keeping quality. Tubers do not show deformities like cracking or hollow heart. A good keeper under country store conditions and possesses medium tuber dormancy period: >6 weeks. It possesses 19% tuber dry matter content. It is easy to cook (15-20 minutes). Peeling losses are minimal due to ovoid shape and shallow eyes. Cooked/boiled potato has acceptable aroma, mealy texture and good palatability. Above all the preference by the farmers specially made the hybrid CP4054 (Kufri Lima) to be released as potato variety Kufri Lima for cultivation in North Indian plains.

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