

# Potato Cultivars with Late blight Disease Resistance and Higher Tuber Yield For Central Terai Under Rice-Based Cropping System

Surendra Lal Shrestha<sup>1</sup>, Raj Lal Sah<sup>2</sup>

<sup>1</sup>Horticulture Research Division, Khumaltar; <sup>1</sup>Regional Agriculture Research Station, Parwanipur;

<sup>2</sup>National Potato Research Program, Khumaltar

Email: [shsurendra@hotmail.com](mailto:shsurendra@hotmail.com)

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**Abstract:** Tubers of 13 cultivars; 4 released check cultivars, 9 superior cultivars from varietal evaluation trial in the past were planted in November and grown during winter season in consecutive two years at Regional Agriculture Research Station Parwanipur in rice-based cropping system. Experiment was laid out in RCBD with four replications. Tubers were planted on ridges in 60x25 cm spacing fertilized with 1000:100:60 kg NPK + 15 ton compost per hectare. Result showed that cv. DxLBR43-12 (24.45 t/ha) followed by cv. DxLBR40-75 (24.31 t/ha) which had significantly higher yield as compared to the rest of the cultivars and had increased tubers yield by 61.1 and 60.1 percent respectively as compared to widely adopted variety Kufri Sindhuri. These two superior clones in the yield performance and late blight disease resistance were selected and recommended for cultivation in central terai.

**Keywords:** Central terai, late blight, rice-based cropping system, tuber yield.

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## 1. INTRODUCTION

Potato is one of the important food crops in Nepal. At present it ranks fifth position in area coverage, second in quantity of production and first in productivity compared with the main staple food crops of rice, maize, wheat and millet. Area under potato is about 1,95,173 hectare and total production 28,81,829 tons with an average productivity of 14.765 ton/ha (MOAD, 2018). Out of the total area under potato, approximately 19% is in the high-hills and mountains, 44% in the mid hills and 37% in terai (APSD, 2016). It is probably only the crop in Nepal which has increased both its areas and yield since many years. It has been brought about by adoption of high yielding varieties and improved cultural practices.

In central region terai, area under potato crop is 20,011 hectare, production 3,00,886 tons and productivity 15.036 tons per hectare (APSD, 2016) which is much lower than the neighboring country India (19.2 t/ha) (<http://cpri.>). There are several reasons behind it and lack of suitable location specific potato varieties is one of the major constraints. Among the potato diseases, late-blight causes substantially yield loss and finally adversely affect the livelihoods of potato growing farmers (NPRP, 2006). Farmers need resistant varieties to replace traditional and old ones that are suitable to late-blight (Qunbao *et al.* 1994).

Most of the land races and introduced varieties during late 70's in Nepal are susceptible to late blight. Every after 3 to 4 years, this disease becomes epidemic and genotypes like Desiree, Cardinal, Kufri Sindhuri were completely destroyed during winter season (Ojha *et al.* 1998). Many varietal trials were conducted under on-station and on-farm condition in the country for several years which resulted to release Kufri Sindhuri, Desiree and Kufri Jyoti in 1992 and Khumal Rato and Janak Dev for terai region in 1997 (Khatri *et al.* 1999) and Khumal Laxmi for the hills and IPY 8 for terai in 2008 (NPRP 2009) but still lacking to fulfill the demand of farmers. Hence, central terai farmers are looking high yielding, late blight resistant suitable varieties for rice-based cropping system.

The main objective of this trial was to select suitable potato varieties having LB resistance and high-yielding under rice-based cropping system.

## 2. MATERIALS AND METHODS

Tubers of thirteen cultivars (9 improved and 4 released as check) were evaluated at Regional Agriculture Research Station Parwanipur, Bara. Planting was done in November and harvesting in February of two consecutive years with above mentioned cultivars. Field was prepared after paddy harvest and sprouted tubers were planted on ridges by maintaining ridge to ridge 60 cm and plant to plant 25 cm, fertilized with 100:100:60 NPK kg/ha. Field was laid out in Randomized Completed Block (RCB) design with three replications in plot size 9.6 m<sup>2</sup>. Fungicide against late blight was sprayed during cold wave period. All the cultural practices were according to the recommendations.

Twelve improved cultivars selected from initial evaluation trial (IET) were cv. CIP 392587.8, DxLBR 44-2, DxLBR 43-24, DxLBR 43-12, CIP 394005.115, DxLBR 40-75, CIP 393280.64, CIP 388576.3D, CIP 388556.4, and released cultivars for check were Kufri Sindhuri, Khumal Laxmi, Desiree and Janak Dev. where DxLBR 44-2, DxLBR 43-24, DxLBR 43-12 and DxLBR 40-75 were developed from late-blight resistant line crossed with Desiree in 2002 at Potato Research Program, Khumaltar. Data were collected on vegetative parameter; pest and disease aspect and tuber yield characteristics.

## 3. RESULT AND DISCUSSION

### Vegetative Characteristics

Plant uniformity ranged from 7.6 (DxLBR 43-24) to 9.0 (DxLBR 40-75, CIP 393280.64, and Desiree) followed by Kufri Sindhuri, CIP 388556.4 and CIP 392587.8. The most vigorous (9.0) plants were observed in cv. CIP 393280.64 and DxLBR 44-2 whereas the growth of the plants were very poor in DxLBR 43-24 and Janak Dev (7.8). The tallest plants were measured in cv. CIP 393280.64 (74.5 cm) followed by 388576.3D (72.6 cm) respectively, whereas the shortest plants were measured in Desiree (46.9 cm) and Janak Dev (52.2 cm). Effect of cultivars on plant height was significant in both the years where CIP 393280.64 was the tallest and Desiree shortest in both the years (Table 1). The highest ground coverage was recorded in cv. CIP 388556.4 (92.5%) followed by CIP 393280.64 (92%) and CIP 394005.115 (88%) respectively, whereas the least ground coverage was noticed in DxLBR 43-24 (70%). Effect of cultivars on ground coverage was significant in first year (Table 2).

The effect of cultivars on number of stems was significant. The highest number of stems per plant (4.3) was counted in cv. CIP 388556.4 followed by DxLBR 40-75 and Kufri Sindhuri (4.0) respectively whereas the least number of stems was in CIP 392587.8 and Khumal Laxmi (2.7). CIP 388556.4 had highest number of stems in both the years. Cv. Desiree showed early maturity, whereas CIP 392587.8, DxLBR 43-24, DxLBR 43-12, cv. 394005.115, cv. 388556.4 and Janak Dev were medium and the rest of the cultivars were late.

**Table 1. Vegetative characters of 13 potato cultivars at RARS Parwanipur**

Clones	Plant Uniformity <sup>x</sup>			Plant vigor <sup>x</sup>			Plant height (cm)			Maturity <sup>y</sup>
	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean	
CIP 392587.8	8.3	9.0	8.6	8.0	9.7	8.8	46.8	82	64.4	M
DxLBR 44-2	9.0	8.3	9.2	10.0	9.3	9.6	55.8	78	66.9	L
DxLBR 43-24	7.3	8.0	7.6	8.0	7.7	7.8	40.1	72	56.0	M
DxLBR 43-12	8.3	8.7	8.5	9.0	8.0	8.5	48.4	89	68.7	M
CIP 394005.115	8.7	8.3	8.5	10.0	8.7	8.8	37.8	76	56.9	M
DxLBR 40-75	9.3	8.7	9.0	9.5	9.3	9.4	37.6	68	52.8	L
CIP 388576.3D	9.0	8.0	8.5	9.5	9.0	9.3	59.2	86	72.6	L
CIP 388556.4	8.7	8.7	8.7	8.0	9.0	8.5	42.3	72	57.1	M
CIP 393280.64	9.3	8.7	9.0	10.0	9.3	9.6	56.0	93	74.5	L
Khumal Laxmi	8.0	7.7	7.8	8.5	8.3	8.4	40.7	81	60.8	L
Kufri Sindhuri	9.7	7.7	8.7	10.0	8.3	9.1	46.8	63	54.9	L
Desiree	9.3	8.7	9.0	9.0	8.7	8.8	34.8	59	46.9	E
Janak Dev	7.7	8.3	8.0	7.0	8.7	7.8	44.4	60	52.2	M
CV%	12.8	7.6	10.8	7.99	9.7		13.1	9.96	11.9	
F-test (0.05)	Ns	ns	ns	*	ns		**	**	**	
LSD (0.05)	1.85	1.15	7.67	1.27	1.42		8.27		30.0	
YxA			ns						*	

<sup>x</sup>1: poor, 10: excellent; <sup>y</sup>E: early, M: medium, L: late

### Pest and Diseases

Varietal response to late-blight was significant. The least foliar damage shown by late-blight disease was cv. DxLBR 44-2, CIP 392587.8, CIP 388576.3D followed by CIP 393280.64 respectively. Appearance of late blight disease symptoms were less in second year and interaction between year and cultivar was significant. Even though early blight was not problematic, it was more noticed in cv. DxLBR 43-12 (5.0), DxLBR 43-24 and Desiree (4.7) respectively. During harvesting tubers affected with scab was more observed in cv. Desiree (10.9%), followed by Kufri Sindhuri and Khumal Laxmi respectively.

**Table 2. Vegetative characters of 13 potato cultivars at RARS Parwanipur in 2067 and 2068**

Clones	Groundcoverage(%)			Late blight			Stems (#)/plant			Early blight	Scab tuber(%)
	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean		
CIP 392587.8	73	93	83.0	6.3	2.0	4.2	2.1	3.3	2.7	4.3	1.3
DxLBR 44-2	87	83	85.0	5.3	2.0	3.7	3.1	3.4	3.3	2.7	0.7
DxLBR 43-24	80	60	70.0	9.0	3.7	6.4	2.3	3.5	2.9	4.7	0.5
DxLBR 43-12	90	78	84.0	5.7	4.0	4.4	2.9	3.5	3.2	5.0	0
CIP 394005.115	93	83	88.0	7.0	6.3	6.6	3.0	3.4	3.2	4.0	0
DxLBR 40-75	87	87	87.0	5.3	4.3	4.8	4.7	3.4	4.0	3.3	0.3
CIP 388576.3D	87	73	80.0	5.7	2.7	4.2	3.4	3.6	3.5	3.7	1.7
CIP 388556.4	97	88	92.5	4.7	5.0	4.8	4.5	4.1	4.3	2.7	1.8
CIP 393280.64	97	87	92.0	3.7	5.0	4.3	3.2	3.5	3.3	2.0	0.4
Khumal Laxmi	97	63	80.0	4.7	4.7	5.2	2.6	2.9	2.7	3.3	3.0
Kufri Sindhuri	97	68	82.5	5.5	5.7	4.7	4.5	3.5	4.0	1.3	3.3
Desiree	83	68	75.5	7.0	6.3	6.8	4.3	3.3	3.8	4.7	10.9
Janak Dev	73	73	73.0	4.7	4.3	4.5	3.7	3.2	3.6	2.0	1.1
CV%	11.2	15.2	12.3	29.8	33.9	26.6	24.1	23.4	19.4	39.2	
F-test (0.05)	*	ns	**	**	ns	*	**	ns	**	*	
LSD (0.05)	16.02	19.66	20.4	2.83	3.34		1.39	1.34	2.08	2.17	
YxA			*			**			*		

### Tubers yield characteristics

DxLBR 43-12 (24.45 ton/ha) gave significantly higher tuber yield as compared to check cultivars followed by cv. DxLBR 40-75 (24.3 ton/ha) and CIP 388576.3D (20.6 ton/ha) which had superior yield as compared to the released varieties. Effect of cultivars on tubers yield was significant in both the years. As compared to Kufri Sindhuri, the yield increment from DxLBR 43-12, cv. DxLBR 40-75 and CIP 388576.3D was 61.1, 60.1 and 35.9 percent respectively (Table 3). All the released cultivars; Khumal Laxmi (13.77 ton/ha), Kufri Sindhuri (15.18 ton/ha), and Janak Dev (14.11 ton/ha) were inferior in tubers yield as compared to Desiree. Tubers number per plant was recorded the highest in Kufri Sindhuri (14.8) followed by cv. DxLBR 40-75 (11.3), and DxLBR 43-12 (10.5) respectively whereas the least number of tubers per plant (6.8) were counted in Desiree and Khumal Laxmi. The highest tuber yield was obtained from DxLBR 43-12 (367 g) followed by DxLBR 40-75 (365 g) respectively. Significant difference was noticed among the cultivars on this aspect. In both the years, DxLBR 43-12 and DxLBR 40-75 gave higher tubers weight (Table 3).

Among the tuber yield, highest percent of oversized tubers was recorded in CIP 388576.3D (37.4%) followed by 394005.115 (33.6%) and 392587.8 (29.7%) respectively whereas DxLBR 40-75 had 8.4 percent that was the least among the tested cultivars. Likewise, the highest percent of seed sized tubers was recorded in Khumal Laxmi (65.7%) followed by Desiree (63.9%) and Kufri Sindhuri (63.8%) respectively. But the cultivar having higher percent of under sized tubers was cv. DxLBR 40-75 (28.4%) followed by Kufri Sindhuri (21.8%) and DxLBR 44-2 (19.9%) respectively (Table 4).

**Table 3. Tuber yield (t/ha) performance of 13 potato cultivars at RARS Parwanipur in 2067 and 2068**

Clones	Yield (t/ha)			Tubers (no/plant)			Wt. of tuber (g)/plant			% Yield increment
	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean	
CIP 392587.8	16.50	13.62	15.06	5.6	13.9	9.7	248	204	226	-0.79
DxLBR 44-2	19.62	21.04	20.33	9.4	9.8	9.6	294	326	305	33.9
DxLBR 43-24	14.25	16.19	15.22	7.2	7.9	7.5	213	243	228	0.26
DxLBR 43-12	25.31	23.59	24.45	12.2	8.8	10.5	380	354	367	61.1
CIP 394005.115	21.82	14.50	18.16	8.9	9.3	9.2	327	218	272	19.6
DxLBR 40-75	21.47	27.15	24.31	13.4	9.3	11.3	321	407	365	60.1
CIP 388576.3D	22.17	19.11	20.64	8.4	10.2	9.5	333	287	310	35.9
CIP 388556.4	19.47	15.43	17.45	8.7	7.6	8.2	292	231	262	14.9
CIP 393280.64	20.01	18.35	19.18	8.2	7.5	7.8	299	275	288	26.3
Khumal Laxmi	14.14	12.23	13.77	6.5	7.1	6.8	232	183	206	-9.3
Kufri Sindhuri	16.96	13.41	15.18	21.8	7.8	14.8	370	201	311	0.0
Desiree	18.45	17.62	18.03	6.5	7.1	6.8	276	264	270	18.8
Janak Dev	13.20	15.03	14.11	5.7	6.2	5.9	198	225	212	-7.0
CV%	19.30	25.35	22.11	27.6	34.2	38.6	25.5	25.3	22.1	
F-test (0.05)	**	*	**	**	ns	Ns	Ns	ns	**	
LSD (0.05)	6.16	7.03	9.99	3.87	4.92	6.2	126.8	105.4	149.8	
YxA			*						*	

**Table 4. Tubers grading performance of 13 potato cultivars at RARS Parwanipur in 2067 and 2068**

Clones	Under size (%)			Seed size (%)			Over size (%)		
	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean	1 <sup>st</sup> Yr	2 <sup>nd</sup> Yr	Mean
CIP 392587.8	25.5	12.6	19.0 ab	40.1	62.5	51.3	34.4	24.9	29.7 abc
DxLBR 44-2	16.7	23.3	19.9 ab	57.7	46.9	52.3	25.6	29.8	27.7 abc
DxLBR 43-24	17.6	17.9	17.8 ab	58.7	66.1	62.3	23.6	16.1	19.9 abc
DxLBR 43-12	20.2	16.6	18.3 ab	57.3	64.3	60.8	22.5	19.2	20.8 abc
CIP 394005.115	14.4	20.0	17.2 ab	44.2	54.1	49.2	41.4	25.8	33.6 ab
DxLBR 40-75	23.7	33.0	28.4 a	69.0	57.3	63.2	7.2	9.7	8.4 c
CIP 388576.3D	13.4	11.5	12.4 b	46.3	54.0	50.1	40.2	34.5	37.4 a
CIP 388556.4	15.8	20.3	18.0 ab	55.0	62.0	58.5	29.2	17.8	23.5 abc
CIP 393280.64	10.1	10.3	10.2 b	67.5	57.2	62.3	22.4	32.5	27.4 abc
Khumal Laxmi	14.4	11.9	13.1 b	54.9	76.5	65.7	30.6	11.6	21.1 abc
Kufri Sindhuri	15.4	28.3	21.8 ab	66.3	61.4	63.8	18.3	10.3	14.3 bc
Desiree	10.7	9.5	10.1 b	65.3	62.6	63.9	24.0	27.9	26.0 abc
Janak Dev	17.6	13.2	15.4 ab	57.2	64.0	60.6	25.3	22.8	24.0 abc
CV%	39.6	42.3	40.7	16.5	16.5	14.3	23.8	52.4	34.7
F-test (0.05)	*	Ns	**	**	Ns	**	**	Ns	**
LSD (0.05)	8.8	13.5	14.3	14.5	16.4	16.8	12.8	17.2	21.8
YxA			ns			*			ns

Tubers damaged percent (weight) was highest (11.9%) in Janak Dev followed by CIP 388556.4 (7.7%) and the least damage percent was in DxLBR43 -12 (1.0%). Likewise tubers damaged percent (number) was highest in Desiree (12.6%) followed by Janak Dev (8.1%) and least damage percent was in DxLBR43 -12 (0.6%). Damaged were either from cut worm or scabbed. Average weight of the tubers was obtained highest (39 gm) in Janak Dev followed by Desiree (37 gm) and the least weight was in CIP 394005.115 (21 gm) (Table 5).

### Tubers characteristics

Among the 13 cultivars, 9 cultivars had round shape tubers, 1 cultivar with oblong shape and the rest were with oval shaped tubers. Small sized tubers bearing habit was recorded in DxLBR 43-12 and DxLBR 40-75, big sized tubers in CIP 388576.3D, CIP393280.64 and , Desiree, and the rest were with medium sized bearing cultivars. Likewise, 4 cultivars had white to yellow skin tubers, 1 cultivar (CIP 388576.3D) with purple patches tubers and the rest were with red skinned tubers. As far as tubers eye depth is concerned, 6 cultivars had medium depth eye tubers followed by 4 cultivars with deep eyed tubers and 3 cultivars with shallow depth eyed tubers. As tubers were cut, 4 cultivars were noticed with yellow color flesh, 5 with cream color flesh and the rest with white flesh tubers (Table 6).

**Table 5. Tubers average weight and damage percent of 13 potato cultivars at RARS Parwanipur**

Clones	Tubers damage no.(%)	Tubers wt.(%)	Av.tuber wt.(g)
CIP 392587.8	3.4	2.1	30
DxLBR 44-2	2.3	2.4	29
DxLBR 43-24	3.5	5.6	27
DxLBR 43-12	0.6	1.0	32
CIP 394005.115	5.5	5.5	21
DxLBR 40-75	1.4	3.2	30
CIP 388576.3D	1.7	2.6	30
CIP 388556.4	5.1	7.7	28
CIP 393280.64	1.2	1.9	33
Khumal Laxmi	3.3	2.8	32
Kufri Sindhuri	2.3	2.4	28
Desiree	12.6	3.9	37
Janak Dev	8.1	11.9	39

**Table 6. Tuber characteristics of 13 potato cultivars at RARS Parwanipur**

Clones	Shape	Size	Color <sup>z</sup>	Eye depth <sup>y</sup>	Flesh color <sup>z</sup>
CIP 392587.8	Round	Medium	White*	Medium	White
DxLBR 44-2	Round	Medium	L.Yellow	Medium	Cream
DxLBR 43-24	Oval	Medium	Red	Medium	White
DxLBR 43-12	Round	Small	Light red	Medium	White
CIP 394005.115	Oval flat	Medium	Red	Shallow	Cream
DxLBR 40-75	Round	Small	L.Yellow	Shallow	Cream
CIP 388576.3D	Round	Big	Red**	Deep	Yellow
CIP 388556.4	Round	Medium	L.Yellow	Shallow	Yellow
CIP 393280.64	Round	Big	Red*	Deep	Yellow
Khumal Laxmi	Round	Medium	Red	Deep	Yellow
Kufri Sindhuri	Round	Small	Red	Deep	White
Desiree	Oval	Big	Red	Medium	Cream
Janak Dev	Oblong	Big	Red	Medium	Cream

\* red eye, \*\*purple patch eye

## 4. CONCLUSION AND RECOMMENDATION

On the basis of over all performances Cv. DxLBR 43-12 and DxLBR 40-75 which had significantly higher tuber yield as compared to the rest of the cultivars, and had increased tubers yield by 61.1 and 60.1 percent respectively as compared to Kufri Sindhuri, and having moderately resistant to late-blight disease showed superior performance were selected and

recommended for cultivation in central terai. In 2010, National Potato Research Program had released and recommended red skin potato variety Khumal Laxmi and white skin potato variety IPY-8 for terai. This tested cultivar DxLBR 43-12 is red skin, round shape, scab infection free, medium depth eye is the best alternate variety for Kufri Sindhuri and Khumal Laxmi whereas the DxLBR 40-75 is white skin, shallow eye, light yellow tuber, minimum scab infection could be the alternate variety for and IPY-8 are recommended for cultivation in central terai condition.

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