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Evaluation of Promising Potato Varieties for Yield Potentiality and Late Blight Disease Tolerance in Southern Dry Zone of Karnataka, India

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A B S T R A C T

The experiment was conducted under AICRP on Potato at Horticultural Research and Extension Station, Somanahallikaval, Hassan for three consecutive years from 2014-2016 during *Kharif* season to know their yield potentiality and late blight disease tolerance capability of 12 different promising varieties. The varieties *viz.*, Kufri Jyoti, Kufri Himalini, Kufri Bahar, Kufri Gaurav, Kufri Garima, Kufri Pushkar, Kufri Badshah, Kufri Khyati, Kufri Pukhraj, Kufri Surya, Kufri Ashoka and Kufri Lauvkar were evaluated under natural epiphytotic conditions. Out of twelve varieties evaluated, Kufri Himalini recorded significantly highest marketable tuber yield of 22.23 t/ha and total tuber yield of 24.17 t/ha at 90 days after sowing with least percentage of late blight incidence (3.76 %) followed by Kufri Jyoti recorded highest marketable tuber yield of 16.39 t/ha and total tuber yield of 17.95 t/ha with 5.40 per cent late blight incidence at 90 days after sowing. Therefore a variety Kufri Himalini could be recommended for commercial cultivation due to its high yield potential and late blight tolerance in Hassan district of Karnataka. Further to popularize a variety Kufri Himalini front line demonstrations were also conducted at various farmers fields of Hassan district.

Introduction

Potato (*Solanum tuberosum* L.) belongs to family Solanaceae is a most important crop among the vegetables. The crop finds prime position in the economy of poor and marginal farmers and plays a vital role in nutritional security by producing more food per unit area and time as compared to wheat, rice and maize in short period of time. Potato contains substantial quantity of energy, edible protein-2.8 g, starch-16.3 g, total sugar-0.6 g, crude fibre-0.5 g, carbohydrate-22.6 g and vitamin-C 25 mg per 100 g fresh weight of tubers (Bhuwneshwari *et al.*, 2013). In Hassan, it is grown during *Kharif* season from June-July to September-October. In India, potato is predominantly cultivated during *Kharif* (80%) followed by in *Rabi* season (20%).

It is grown over an area of 1.97 lakh hectares with the production of 344 lakh tones and average national yield per hectare is 21.10 tonnes in India and it is cultivated in an area of 41,000 hectares with the production of 3,61,000 tonns in Karnataka (Anon, 2015).

Even though India stands in fourth place with respect to the production of potato in the world, but the productivity is very low as compared to other advanced countries. The possible reason could be varied agro-climatic conditions. The higher productivity could be achieved by selection of proper varieties specific to areas and other agronomical practices. As many varieties have been developed by various research institutes, universities are yet to be evaluated at different locations as the response is location specific.

Besides potato varieties show wide variation in their yielding ability when grown over a varied agro-climatic conditions. The yield and quality of potato depends upon soil, climatic conditions and variety or hybrid used. Moreover, different varieties have different soil and climatic requirements for their optimum performances. India being a vast country with varied agro-climatic regions, a single variety or hybrid may not be suitable for all the agro-climatic conditions. Hence, new varieties are need to be introduced or evaluated for specific regions.

With the objective of finding out suitable variety with higher yield potential and late blight disease tolerance for cultivation in southern Karnataka following experiment was conducted at HRES, Hassan during *Kharif* season.

Materials and Methods

The experiment was conducted under AICRP on Potato centre at Horticultural Research and Extension Station, Somanahallikaval, Hassan district, Karnataka state for three consecutive years from 2014-2016 to know the yield potentiality and late blight disease tolerance capability of 12 different released varieties. The released varieties *viz.* Kufri Jyoti, Kufri Himalini, Kufri Bahar, Kufri Gaurav, Kufri Garima, Kufri Pushkar, Kufri Badshah, Kufri Khyati, Kufri Pukhraj, Kufri Surya, Kufri Ashoka and Kufri Lauvkar were evaluated under natural epiphytotic conditions. The experiment was laid out by using RCBD with three replications. The land was prepared for the research before sowing and FYM @ 25 t/ha was incorporated into soil. The tuber sowing was taken up during the first week of June in all three years by adopting scientific spacing of 60 cm x 20cm. The recommended dosage of NPK 100:75:75 kg/ha was incorporated. From the recommended quantity of nitrogen, 50 per cent of nitrogen applied at sowing and remaining 50 per cent of nitrogen after 30 days of sowing at earthing-up operation. The package of practices of UHS, Bagalkot was followed during different stages of crop growth and harvesting was done at 90 days after sowing. The observations related to vegetative growth attributes, yield attributes and disease scoring were recorded as follows.

Vegetative growth attributes

Plant emergence (%) at 30 days after sowing

$$\text{Plant emergence (\%)} = \frac{\text{Total no. of tubers germinated}}{\text{Total no. of tubers sown}} \times 100$$

Plant height (cm)

The maximum plant height was measured from the ground to the tip of longest leaf documented at 45 days after sowing. The mean of 5 plants in each treatment was worked out

Plant spread (cm^2)

The plant spread was measured in north to south and east to west from 5 randomly selected plants at 45 days after sowing and average of plant spread was calculated in centimeter square.

Yield attributes

Marketable tuber yield (t/ha)

Out of total tubers obtained in plant, the tubers were sorted in to 4 different grades based on their weight as small (<25g), medium (26-50g), large (51-75g) and extra-large (>76g). Out of these, excluding small tubers all other grades were considered as marketable and weight was recorded and using this data marketable tuber yield per ha were calculated

Total tuber yield (t/ha)

Total tuber yield (t/ha) = Marketable tuber yield (t/ha) + small tuber yield (<25 g)

Rottage (t/ha)

Weight of rotten tubers were recorded and using the data rottage tones per hectare was calculated

Disease scoring

Late blight incidence and late blight intensity were also computed using the following formula and Malcomson scale.

$$\text{Late blight incidence (\%)} = \frac{\text{No. of Infected Plants}}{\text{Total No. of Plants}} \times 100$$

Late blight Intensity (%) = (Sum of Individual Ratings / Total No. of Plants) x (100 / Max. Scale)

Results and Discussion

The observations on percentage of plant emergence, plant height, plant spread, marketable tuber yield, total tuber yield and tuber rottage were documented for three consecutive years (2014-16). All varieties shown significant difference over their growth performance, yield potentiality and disease tolerance capability.

Vegetative growth attributes

The pooled data analysis for growth parameters indicated that, among all the varieties Kufri Pushkar registered highest percentage of plant emergence of about 89.08 at 30 days after sowing (Table 1), highest plant height of 71.26 cm was noticed in Kufri Garima and highest plant spread of 51.67 cm^2 was registered in Kufri Khyati at 45 days after sowing (Table 1). The better performance of these varieties might be due to its genetic make-up and its better adoptability to prevailing environmental conditions (Gobana, 2002).

Yield attributes and late blight incidence percentage

The pooled data analysis for tuber yield indicated that, among twelve varieties evaluated Kufri Himalini registered significantly highest marketable tuber yield of 22.23 t/ha (Table 2) and total tuber yield of 24.17 t/ha at 90 days after sowing with least percentage of late blight incidence (3.76 %) (Table 3) followed by Kufri Jyoti recorded good marketable tuber yield of 16.39 t/ha and total tuber yield of 17.95 t/ha with moderate tolerance to late blight disease (5.40 %). However, least rottage of 0.39 t/ha tubers were noticed in Kufri Himalini followed by Kufri Surya (0.50 t/ha). The results are in agreement with other researchers who investigated that marketable tuber yield was significantly varied by variety, location and genotypes x environment interaction (Elfinesh, 2008, Gebreselassie *et al.,* 2016, Pandey *et al.,* 2004 and Kumar *et al.,* 2007). The results obtained demonstrated that genetic yield differences are not caused by one single growth or development parameter (Meyling *et al.,* 1971) (Fig. 1 and 2).

Table.1 Performance of promising potato varieties on different growth parameters during *Kharif* season

Variety	Plant Emergence (%) at 30 DAS				Plant Height (cm) at 45 DAS				Plant Spread (cm^2) at 45 DAS			
	2014	2015	2016	Pooled	2014	2015	2016	Pooled	2014	2015	2016	Pooled
Kufri Himalini	74.00	90.00	82.46	**82.15**	40.00	55.00	65.25	**53.42**	43.75	52.00	54.13	**49.96**
Kufri Jyoti	78.00	91.70	86.28	**85.33**	51.50	57.00	53.1	**53.87**	44.75	53.25	45.25	**47.75**
Kufri Surya	97.00	81.29	86.58	**88.29**	48.00	51.50	61.9	**53.80**	52.50	43.50	49.75	**48.58**
Kufri Pukhraj	94.00	87.19	85.73	**88.97**	65.50	71.50	62.45	**66.48**	45.00	47.00	51.50	**47.83**
Kufri Pushkar	97.00	86.05	84.19	**89.08**	70.00	79.50	63.05	**70.85**	42.75	50.75	51.63	**48.38**
Kufri Bahar	81.00	84.66	85.44	**83.70**	42.50	59.50	55.6	**52.53**	32.25	50.25	44.38	**42.29**
Kufri Khyati	97.00	83.08	81.78	**87.29**	67.50	71.00	70.25	**69.58**	48.50	47.25	59.25	**51.67**
Kufri Gaurav	79.00	84.92	84.68	**82.87**	49.50	54.00	49.5	**51.00**	43.50	48.50	56.63	**49.54**
Kufri Badshah	82.00	80.28	83.38	**81.89**	66.00	73.50	63.7	**67.73**	41.75	53.75	45.50	**47.00**
Kufri Ashoka	94.00	76.93	80.11	**83.68**	68.00	74.00	71.45	**71.15**	54.25	46.00	44.19	**48.15**
Kufri Garima	92.00	88.52	86.42	**88.98**	67.00	76.00	70.78	**71.26**	38.75	55.25	51.00	**48.33**
Kufri Lauvkar	78.00	81.46	83.5	**80.99**	40	47.15	51.24	**46.13**	48.25	52.26	51.50	**50.67**
S Em±	**2.57**	**5.36**	**1.33**	**3.51**	**1.68**	**6.47**	**2.33**	**3.00**	**4.16**	**1.63**	**3.45**	**3.03**
CD(p=0.05)	**8.00**	**12.14**	**3.86**	**10.29**	**5.23**	**14.40**	**6.77**	**8.80**	**12.20**	**4.77**	**10.00**	**8.88**
CV	**4.18**	**6.40**	**3.16**	**7.13**	**5.13**	**9.53**	**7.57**	**8.57**	**16.13**	**5.63**	**13.72**	**10.85**

DAS: Days After Sowing

Table.2 Performance of promising potato varieties on different yield parameters during *Kharif* season

Variety	Marketable tuber yield (t/ha) at 90 DAS				Total tuber yield (t/ha) at 90 DAS				Rottage (t/ha) at 90 DAS			
	2014	**2015**	**2016**	**Pooled**	**2014**	**2015**	**2016**	**Pooled**	**2014**	**2015**	**2016**	**Pooled**
Kufri Himalini	28.23	17.44	21.02	**22.23**	30.68	19.69	22.14	**24.17**	0.20	0.40	0.56	**0.39**
Kufri Jyoti	14.07	14.50	20.60	**16.39**	15.70	16.60	21.56	**17.95**	1.00	1.24	0.39	**0.88**
Kufri Surya	13.62	9.83	16.78	**13.41**	15.12	11.00	19.19	**15.10**	0.40	0.60	0.49	**0.50**
Kufri Pukhraj	17.52	11.70	18.28	**15.83**	19.26	13.80	20.59	**17.88**	0.86	1.08	0.54	**0.83**
Kufri Pushkar	20.24	11.50	15.59	**15.78**	21.88	13.50	18.13	**17.84**	0.68	0.94	0.36	**0.66**
Kufri Bahar	15.86	13.50	11.80	**13.72**	17.44	14.90	13.61	**15.32**	0.98	1.35	0.29	**0.87**
Kufri Khyati	15.06	7.40	10.22	**10.89**	16.54	9.48	12.53	**12.85**	0.87	1.26	0.18	**0.77**
Kufri Gaurav	8.08	5.17	12.58	**8.61**	9.25	7.950	14.56	**10.59**	0.30	0.40	1.26	**0.65**
Kufri Badshah	21.77	10.40	14.60	**15.59**	24.29	12.50	16.67	**17.82**	0.90	1.18	0.27	**0.78**
Kufri Ashoka	18.99	12.60	12.00	**14.53**	20.66	14.70	14.02	**16.46**	1.27	1.06	2.00	**1.44**
Kufri Garima	12.60	6.28	11.00	**9.96**	14.14	9.06	11.50	**11.57**	0.37	0.65	0.50	**0.51**
Kufri Lauvkar	14.18	11.84	12.00	**12.67**	14.77	13.77	15.00	**14.85**	1.40	1.00	2.50	**1.63**
S Em+	**0.62**	**0.67**	**1.14**	**1.70**	**1.43**	**0.72**	**0.88**	**1.67**	0.09	0.07	0.04	**0.26**
CD(p=0.05)	**1.94**	**2.15**	**3.30**	**4.97**	**4.44**	**2.30**	**2.55**	**4.90**	0.29	0.23	0.13	**0.77**
CV	**3.19**	**12.80**	**14.81**	**19.37**	**6.69**	**11.40**	**10.15**	**18.05**	17.28	14.61	14.88	**55.61**

DAS: Days After Sowing

Table.3 Performance of promising potato varieties against late blight disease tolerance during *Kharif* season

Variety	Late Blight incidence (%)	Late Blight Intensity	Leaf Spot Disease (%)	Viral Disease (%)
Kufri Jyoti	5.40	8	-	5.25
Kufri Bahar	13.68	8	-	6.12
Kufri Gaurav	20.42	9	-	5.65
Kufri Himalini	3.76	9	-	4.12
Kufri Pushkar	23.54	9	-	5.45
Kufri Badshah	11.17	8	-	8.50
Kufri Khyati	25.21	8	-	7.50
Kufri Pukhraj	11.11	9	-	15.17
Kufri Surya	4.69	9	-	6.25
Kufri Ashoka	31.96	9	-	20.16
Kufri Garima	18.00	9	-	3.00
Kufri Lauvkar	21.35	9		6.23

Table.4 Front Line Demonstration (FLD) on promising varieties conducted at Hassan District, Karnataka state during 2015-16

S. No.	Name of the farmer	Locations	Tuber yield (t/ha)		
			Kufri Surya	Kufri Jyoti	Kufri Himalini
1	Mr. Thimmegowda	Bageshapura (Village) Arasikere (Taluk) Hassan (District)	19.17	18.70	**26.40**
2	Mr. Devegowda	Marenhalli (Village) Shantigrama (Hobli) Hassan (Taluk) Hassan (District)	6.90	14.60	**19.70**
3	Mr. Shankarlingegowda	Sopnahalli (Village) Hassan (Taluk) Hassan (District)	11.25	8.00	**23.90**
4	Mr. Ningegowda	Hullangane (Village) Arakalgudu (Taluk) Hassan (District)	20.83	25.83	**25.83**
5	Mr. Krishnegowda	Hulikallu (Village) Arakalgudu (Taluk) Hassan (District)	15.00	14.41	**19.16**
6	Mr. Laxmegowda	Annenahalli (Village) Channarayapattana (Taluk) Hassan (District)	17.49	20.67	**28.62**
7	Mr. Eshwaregowda	Umadevarhalli (Village) Alur (Taluk) Hassan (District)	14.60	16.20	**23.17**
		Average yield (t/ha)	**15.03**	**16.92**	**23.83**

Malcomson scale

Per cent Area Infected (%)	Score
Trace of infection	9
10	8
11-25	7
26-40	6
41-60	5
61-70	4
71-80	3
81-90	2
Collapsed	1

Best performing potato varieties

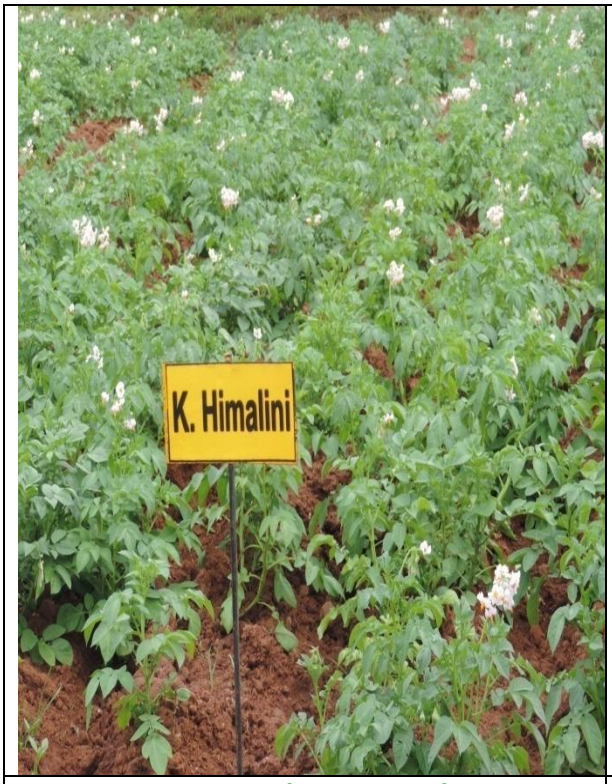


Plate.1 Crop view of variety Kufri Himalini

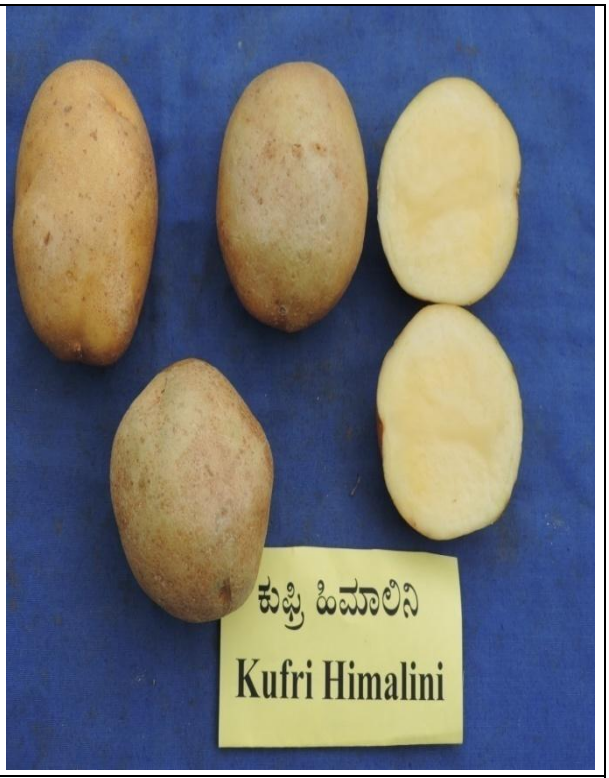


Plate.2 Kufri Himalini tubers

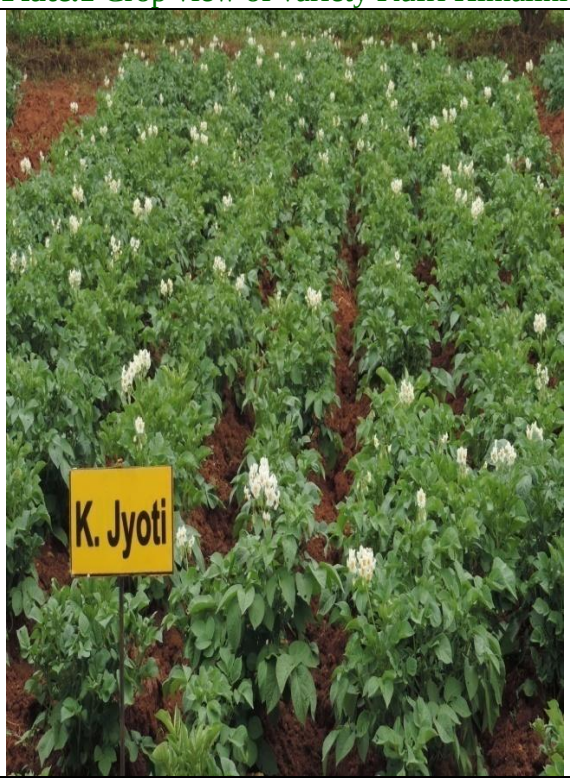


Plate.3 Crop view of variety Kufri Jyoti

Plate.4 Kufri Jyoti tubers

Fig.1 Marketable and total tuber yield (t/ha) of different potato varieties as influenced by *Kharif* season

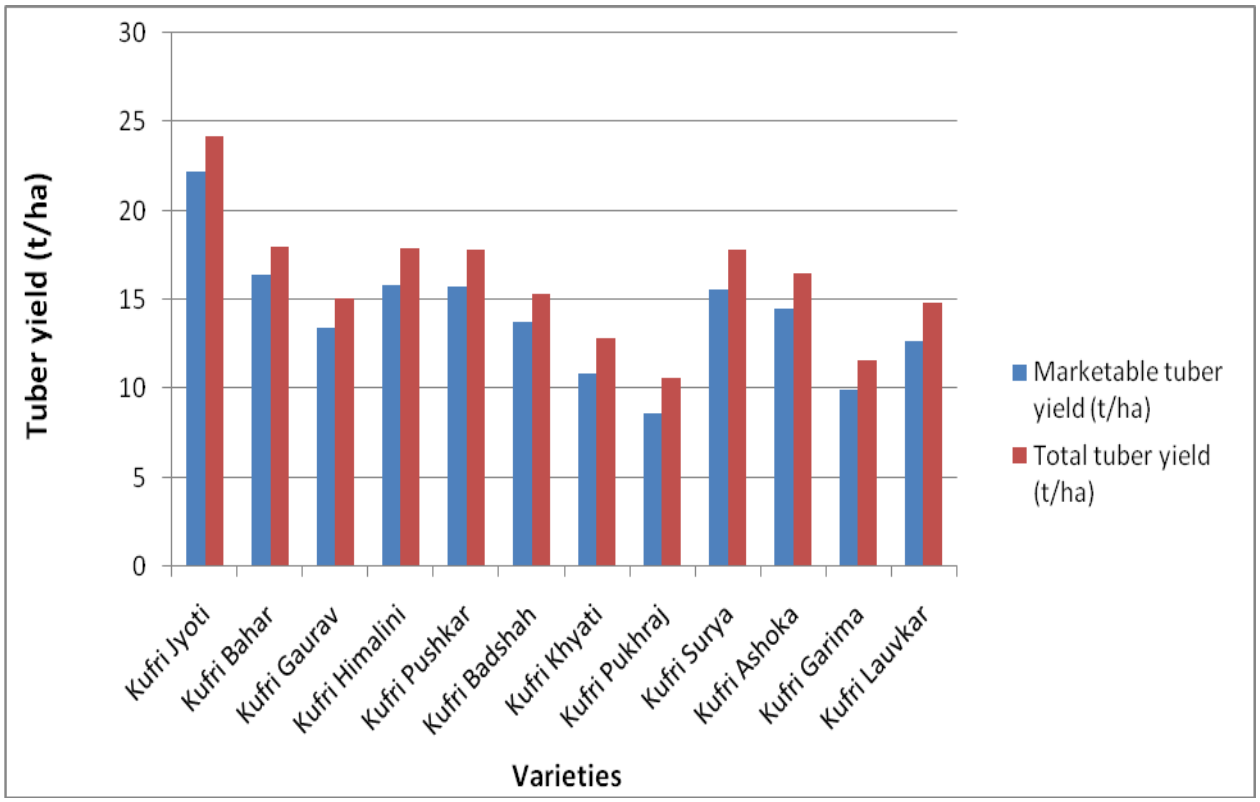
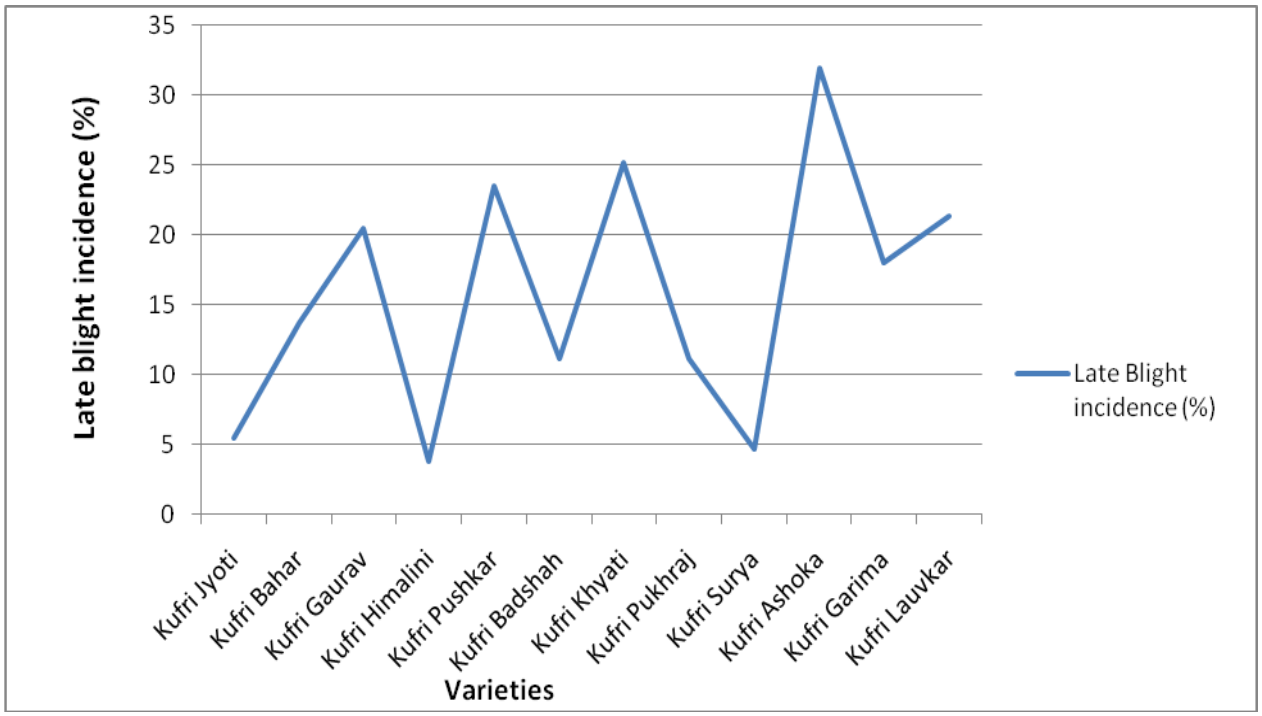


Fig.2 Late blight incidence (%) in different potato varieties as influenced by *Kharif* season



Front Line Demonstration (FLD)

Front line demonstrations were conducted at various farmers' fields in different talukas of Hassan district of Karnataka state with best three varieties of the region *viz*., Kufri Himalini, Kufri Surya and Kufri Jyoti. A variety Kufri Himalini was documented highest tuber yield (average yield- 23.83 t/ha) in all farmers field over other varieties and found highly tolerant to late blight disease (Table 3 and 4).

Therefore, it is evident from these results that Kufri Himalini is a high yielding, late blight resistant variety than other cultivars. The cultivation of this variety will replace the other varieties in combating late blight disease more effectively as these carry resistance genes from different sources.

In addition, it has a high level of resistance to late blight in foliage and moderate resistance in the tubers was reported by Joseph *et al.*, 2007.

The area and production of potato in Karnataka especially in Hassan district has been reduced drastically since 2005 due to severe incidence of late blight disease. This is mainly due to occurrence of congenial weather condition for development of late blight during cropping season and susceptibility showed by Kufri Jyoti variety to late blight disease.

The results of experiment conducted at HRES, Hassan over three consecutive years revealed that, a variety Kufri Himalini is found best suitable variety having higher yield potentiality and late blight disease tolerance over other released promising varieties evaluated at this centre. Therefore, this variety could be recommended for commercial cultivation in Southern Dry Zone of Karnataka.

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