FIELD PERFORMANCE OF TWO PROMISING POTATO CLONES IN THE HILLS AND TERAI OF NEPAL

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ABSTRACT

Demand of high yielding potato varieties with major diseases and pest resistance has been tremendously increasing day by day in Nepal. With the objective of fulfilling this demand, a series of on-station and on-farm studies as Initial Evaluation Trials, Coordinated Varietal Trials and Coordinated Farmers' Field Trials were are continuously undertaken by National Potato Research Programme (NPRP) after its establishment (1991). Results from several on-station and on-farm trials conducted during the years of 2004/05 to 2009/010 demonstrated that clones L 235-4 and CIP 389746.2 are superior to check varieties tested for their growth, yield characteristics and farmers' preferences including better resistance level to late blight disease. Therefore, based on their overall performance, clone L 235-4 has been proposed to release as the variety for commercial cultivation for the hills and clone CIP 389746.2 for terai of Nepal, respectively.

Keywords: clones, hills, terai, potato, varieties

INTRODUCTION

Improvement in potato crop is only possible through the development of new varieties for cultivation and recommendation of improved package of practices for the cultivation. Variety development work in potato crop at NPRP is one of the major activities at present in Nepal and done either through own breeding programme or through the introduction, evaluation and recommendation of exotic clones. Since own national breeding programme is still in its infantry stage; NPRP mainly sources new germplasm from International Potato Center (CIP) Lima Peru, evaluates them and compares their performance and potentiality with established improved varieties under glasshouse and on-station conditions first. Selected high yielding and disease resistant clones promoted from on-station trials are later assessed under on-farm conditions and farmers' response on those clones are assessed. After the evaluation for couple of years, only few of the highly preferred clones are proposed to release as the varieties for respective agro-ecological zones.

To systematize the varietal research, NPRP has long developed a varietal evaluation scheme (Khatri *et al.*,1999) and follows the steps through preliminary observation nurseries (PONs), initial evaluation trials (IETs), co-coordinated varietal trials (CVTs) and coordinated farmers field Trials (CFFTs) in terai and hill both conditions (Khatri *et al.*, 2010). Each of these steps takes at least 2 years for each clone.

Past efforts of several years have resulted to release 8 potato varieties namely, Kufri Sindhuri, Kufri Jyoti, Desiree, Khumal Rato-2, Khumal Seto-1, Janakdev, IPY – 8 and Khumal Laxmi, so far for different agro-ecological domains of the country (NPRP, 2007). But, after the use for some years, these varieties start losing their resistance against diseases and yield potentiality both. As a result, demand rises for the replacement by superior clones every year Therefore, present study was conducted to screen for high yielding potatoes which are resistant to major diseases and suitable for the hills and terai of Nepal and release them for commercial cultivation in respective domains.

MATERIALS AND METHODS

As on-station trials, PONs were conducted at Hattiban Research Farm Khumaltar and Agriculture Research Station (ARS Hort.) Pokhara, IETs at NPRP Khumaltar, ARS (Hort.) Jumla and ARS (Hort.) Pokhara. Likewise, CVTs were conducted at NPRP Khumaltar, Regional Agriculture Research Station (RARS)

Lumle, ARS (Hort.) Pokhara, RARS Nepalgunj and RARS Tarahara. CFFTs were undertaken in farmer's fields in the outreach research sites of collaborative research stations and in Kathmandu valley. Though several clones were kept in the trials, to make the exact comparison of assessed clone with check varieties, only the results from assessed clone and respective check varieties are presented in this paper.
The vegetative and yield parameters were recorded as per the requirement of experiment throughout the study period following protocol developed by Khatri *et al.*, (1999). Experimental plots in all the locations were fertilized at the rate of 100:100:60 kg NPK along with 20 mt compost per hectare as basal dose. Seed of 25 -50 g sizes were used in all the trials and all other cultural practices were followed as per NPRP recommendations. No any fungicides were sprayed against any of the fungal disease in the trials.

At its vegetative stage, observations were taken on percent plant emergence, plant uniformity (1 – 5 scale), percent ground cover, plant height (cm), average number of main stems per plant and plant type, whether it is erect or spreading type, whereas at harvest period, number and weight of under size (<25 gm), seed size (25 to 50 gm) and over size (>50 gm) tubers were recorded and calculated for total number and weight of tubers per plot and yield tons per hectare. Colour, shape and eye depth of the tubers were also recorded. For the on-farm trials, farmers' preferences rating on plant appearance, tuber appearance, tuber yield and taste were assessed additionally. Analysis of variance (ANOVA) was performed using MSTAT–C.

RESULTS AND DISCUSSION

Clone L 235-4 was assessed for its uniformity, ground cover, plant height, number of main stems per plant and late blight disease response in the hills and terai, both. Commercial varieties Desiree and Kufri Jyoti were compared as check in the hill experiments and Desiree and Kufri Sindhuri in terai.

Pooled data from hill on-station trials revealed that there was no difference in plant uniformity scaling 4 in 1 to 5 scales between tested clones and check varieties (Table 1). Percent ground cover was highest in variety Kufri Jyoti (88%) followed by Desiree (80%) and L 235-4 (79%), respectively. Tallest plants were measured in clone L 235-4 (38.9 cm) and shortest in Desiree (31.3 cm). Average number of main stems did not differ between both of the check varieties but L 235-4 had comparatively lower number of main stems per plant. Late blight disease severity was scored lowest (2) in L 235-4 and highest (4) in Desiree, a susceptible check.

Table 1: Vegetative characteristics of tested clone under on-station conditions of the hills and terai as compared to the check varieties

	On-station hills					On-station terai				
Clone	Uniformiity (1-5)	Ground cover (%)	Plant height (cm)	Stem /plant (#)	LB	Uniformiity (1-5)	Ground cover (%)	Plant height (cm)	Stem /plant (#)	LB
L235-4	4	79	38.9	3.3	2	4	73	43.7	1.5	3
Desiree (ch)	4	80	31.3	3.4	4	4	62	45.7	2.5	6
Kufri Jyoti/Sindhuri (ch)	4	88	31.9	3.4	3	3	61	51.7	2.0	5

In terai on-station trials, the same clone L 235-4 was compared with Desiree and Kufri Sindhuri (Table 1) as IETs and CVTs. Plant uniformity and % ground cover was higher in clone L 235-4 followed by Desiree. Plants of Kufri Sindhuri were taller (51.7 cm) than L 235-4 (43.7 cm) and Desiree (45.7 cm). Average number of main stems per plant was counted lowest (1.5) in clone L 235-4 and highest (2.5) in Desiree. Late blight disease was scored slightly higher in terai conditions compared o the hills. In both of the domains, the disease severity in completely un-sprayed conditions was lower scoring 2 (hills) and 3 (terai) in 1 to 9 CIP scale in tested clone compared to the check varieties. In terai also, Desiree was more susceptible variety (scoring 6) than Kufri Sindhuri (5). This result confirmed that clone L 235-4 is superior in some of the major vegetative characteristics such as in late blight disease response, compared to both of the commercially grown varieties in the hills and terai of Nepal.

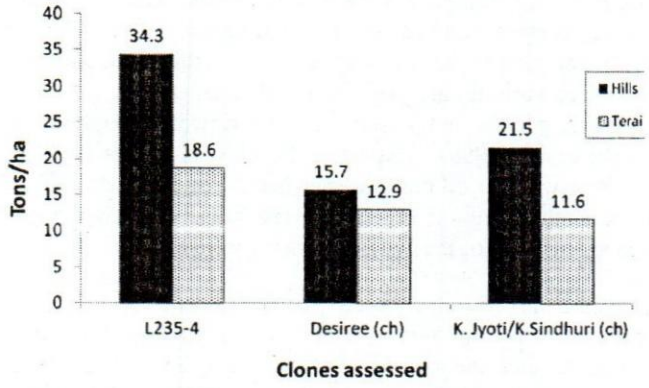

Figure 1: On-station yield comparison between clone L 235-4 and check varieties in the hills and terai of Nepal

The yield performance of tested clone L 235-4 in both the hills and terai conditions has been given in Figure 1. Clone L 235-4 was found highest yielder compared to both of the check varieties, producing 34.3 tons/ha in the hills and 18.6 t/ha in terai. Variety Desiree produced 15.7 t/ha tuber yield in the hills and 12.9 t/ha in terai, which is 18.6 t/ha higher in the hills 21.4 t/ha higher in terai than variety Desiree. Average yields from variety Kufri Jyoti was obtained 21.5 t/ha in the hills and from Kufri Sindhuri 11.6 t/ha in terai. The yield difference between tested clone and variety Kufri Jyoti remained 12.8 t/ha and with Kufri Sindhuri 22.7 t/ha. The overall on-station yields in hills were obtained comparatively higher than the terai.

Same clone was evaluated and compared with major commercial varieties for its major vegetative and yield characteristics under on-farm conditions in the hills and terai both (Table 2). Variety Desiree had highest plant uniformity in on-farm conditions compared to clone L 235-4 and Kufri Jyoti. In percent ground cover and number of main stems per plant, clone L 235-4 was superior to both of the check varieties. Plants of this clone were shorter in height than both of the check varieties. Late blight disease response in the plants was almost similar to the on-station results, showing low severity in L 235-4 (2) and high in Desiree (4).

Table 2: Vegetative characteristic comparison of tested clone under on-farm conditions in the hills and terai, both

	On-farm hills					On-farm Terai				
Clone	Uniformity (1-5)	Ground Cover (%)	Plant ht. (cm)	Stem /plt (#)	LB	Uniformity (1-5)	Ground Cover (%)	Plant ht. (cm)	Stem /plt (#)	LB
L 235.4	4	79	25	4	2	4	68	37	2	2
Desiree (ch)	5	76	29	4	4	3	62	30	2	3
K.Jyoti/Sindhuri (ch)	4	78	26	4	3	4	72	21	3	3

In on-farm terai conditions, plant uniformity of clone L 235-4 was equal to check variety Kufri Sindhuri in 1 to 5 rating scale (Table 2). Percent ground cover of variety Kufri Sindhuri (72) was better than L 235-4 (68) and Desiree (62). Plant height of L235-4 was measured highest (37 cm) than both of the check varieties. Average number of main stems was counted highest in variety Kufri Sindhuri (3). In un-sprayed on-farm conditions also, late blight infection was scored lower in clone L 235-4 (2) than both of the check varieties.

Tuber yields of clone L 235-4 in terai on-farm condition was very low compared to the hills, however 2.2 t/ha higher than variety Kufri Jyoti and 4.3 t/ha higher than Desiree (Fig. 2). Since the yields of assessed clone had unsatisfactory yields in o-station and on-farm conditions both in terai, this clone can be recommended for such field domain.

Tuber yields in tested clone L 235-4 under on-farm station conditions was about 4.3 tons/ha higher than Desiree and 2.2 tons higher than Kufri Jyoti in the hills. The average of 27.5 t/ha yields were obtained from the clone L 235-4 in the hills and 14.8 t/ha in terai, which is about 50% lower than the hill on-farm yields.

(Fig 2). Same trend was observed in check varieties also. As in on-station conditions (Fig 1), yields of on-farm trials were higher in the hills compared to terai.

Table 3 Vegetative performance of tested clone in the hills and terai under on-station conditions

	On-station hills					On-station terai				
Clone	Uniformity (1 – 5)	Ground Cover (%)	Plant ht. (cm)	Stem /plt (#)	L B	Uniformity (1 – 5)	Ground Cover (%)	Plant ht. (cm)	Stem /plt (#)	L B
CIP 389746	5	83	48.2	2	2	4	87	34.3	3.2	3
Desiree (ch)	4	71	35.9	3	3	4	85	42.1	3.4	4
K. Jyoti/Sindhuri (ch)	4	77	31.1	4	4	4	75	48.8	3.1	4

Another clone CIP 389746.2 was compared with Desiree and Kufri Jyoti in the hills and in terai both as on-station and on-farm trials. In the hill on-station trials, plant uniformity and percent ground cover of this tested clone was highest (5) than both of the check varieties. Average plant height was also measured tallest in assessed clone (48.2 cm) followed by Desiree (35.9 cm) and Kufri Jyoti (31.1 cm). Number of main stems per plant was counted highest (4) in variety Kufri Jyoti, followed by Desiree (3) and CIP 389746.2 (2), respectively. Though environment was not that conducive to late blight pathogens these years, variety Kufri Jyoti was more affected than Desiree scoring 4 in 1- 9 scales. No differences were observed in late blight severity between both of the check varieties.

In terai on-station conditions, plant uniformity of clone CIP 389746.2 did not differ with both of the check varieties (Table 3). Percent ground cover was slightly higher (87) in tested clone compared to Desire (85). Plants of Desiree and Kufri Sindhuri taller than tested clone measuring 48.8 cm in Kufri Sindhuri, 42.1 cm in Desiree and 34.3 cm in tested clone. There was no remarkable difference in average number of main stems per plant between tested clone and control. Late blight infection was rather slightly lower in CIP 389746.2 (3) compared to the check varieties.

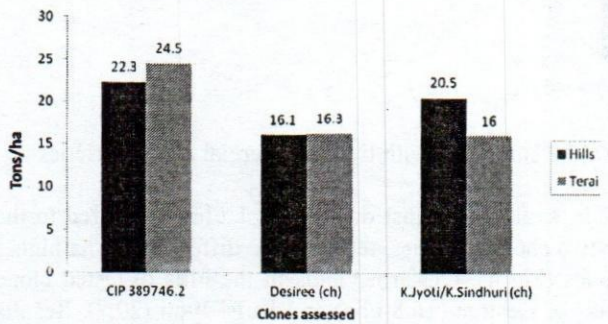

Fig. 3: On-station yield performance (tons/ha) of clone CIP 389746.2 in the hills and terai of Nepal compared to 2 commercial potato varieties.

On-station tuber yields of clone CIP 389746.2 was lower in hills (22.3 t/ha) than in terai (24.5 t/ha) (Fig. 3), however, 6.2 t/ha higher than Desiree and 1.8 t/ha than Kufri Jyoti. Assessed clone in terai gave 2.2 t/ha higher yield than in the hills. In terai on-station conditions, the yield difference between assessed clone a Desiree remained 8.2 t/ha and with Kufri Sindhuri 8.5 t/ha respectively.

Not much difference was observed in variety Desiree between hills and terai on-station conditions in the yields. Variety Kufri Jyoti gave higher yield (20.5 t/ha) than Kufri Sindhuri (16.0 t/ha). In both of the hills and terai conditions, clone CIP 389746.2 was better performing.

Table 4: Performance of tested clone in the hills and terai under on-farm conditions

Clone	On-farm hills					On-farm terai				
	Uniformity (1-5)	Ground cover (%)	Plant ht. (cm)	Stm /plt (#)	LB	Uniformity (1-5)	Ground cover (%)	Plant ht (cm)	Stm /plt (#)	LB
CIP 389746.2	4	87	34.3	3.2	3	5	88	58	3.6	3
Desiree (ch)	4	85	42.1	3.4	4	4	73	56.5	4	4
K.Jyoti/Sindhuri (ch)	4	75	48.8	3.1	4	4	67	50.4	3.6	5

Plant uniformity of clone CIP 389746.2 did not differ with both of the check varieties in on-farm hills (Table 4). Percent ground cover was slightly higher (87) in tested clone. Average number of main stems per plant also did not differ that much. Late blight was rated slightly lower (3) in CIP 389746.2 than Desiree (4) and Kufri Jyoti (4) in the hills. In terai on-farm conditions, highest plant uniformity was scored (5) in clone CIP 389746.2.

Percent ground cover and plant height was also observed highest in clone CIP 389756.2. Average number of main stems per plant was counted slightly higher in Desiree (4) than tested clone and variety Kufri Sindhuri (3.6). Late blight infection was slightly lower than both of the check varieties in terai.

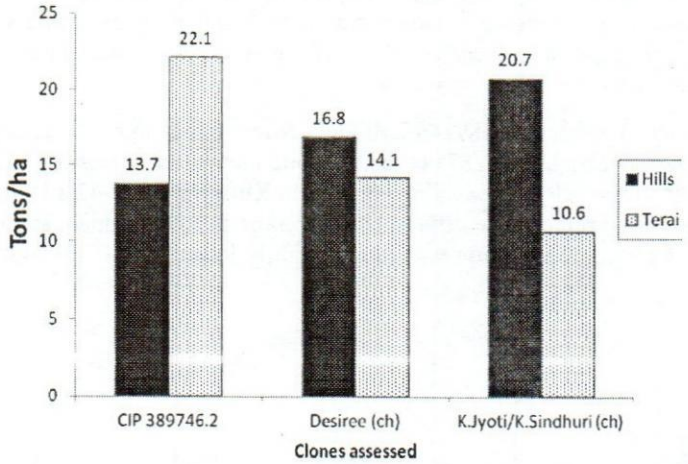

Fig. 4: On-farm yield comparison of clone CIP 389746.2 compared with two commercial check varieties

On-farm yield performance of clone CIP 389746.2 in terai was almost double (22.1 t/ha) compared to the hill conditions (13.7 t/ha). But if compared to other two check varieties, tested clone differed 5.3 t/ha higher to Desiree and 1.4 t/ha higher to Kufri Jyoti varieties (Fig 4). On-farm yields in the hills of tested clone remained very low (13.7 t/ha) compared to the yields of Desiree (16.8 t/ha) and Kufri Jyoti (20.7). Results from on-station and on-farm trials showed that clone CIP 389746.2 is highly suitable for terai but not suitable for hill conditions of Nepal.

Table 5: Tuber characteristics and farmers' preference on tested clone L 235-4

		Tuber characteristics			Farmers' preferences ranking		
Clones	Plant type	Color	Shape	Eye depth	Plant	Taste	Tuber appearance
L 235-4	Spreading	Creamy white	Round	Medium	Very good	Very good	Very good
Desiree (ch)	Spreading	Red	Oblong	Medium	Good	Very good	Very good
Kufri Jyoti (ch)	Spreading	White	Oval	Medium	Good	Good	Good
K. Sindhuri (ch)	Spreading	Red	Round	Deep	Very good	Good	Good

Along with all of the three check varieties compared, plants of clone L 235-4 were also observed spreading type (Table 5). Tubers of tested clone were round shape very attractive with creamy white color and medium eye depth, whereas in Kufri Sindhuri, tubers were deep eyed. Farmer's preferences as assessed on plant appearance during crop growth, taste and tuber appearances at harvest was rated as very good (Vg) with L 235-4, whereas for check varieties the response of farmers remained in between. Taste and tuber appearance of variety Desiree was also rated as very good, but the plants of Kufri Sindhuri were better preferred by the farmers during the evaluation.

Plants of clone CIP 389746.2 were erect type but all of other check varieties were spreading type (Table 6). Tuber color of this clone was mixed with red and white in color. Shape of the tubers of the tested clone was oval. Eye depth was rated as deep. Plant and tuber appearance of clone CIP 389746.2 was comparatively inferior to both of the check varieties, but taste of this clone was rated as very good (Vg) as was Desiree.

Table 6: Tuber characteristics and farmers' preference on tested clone CIP 389746.2

Clones	Plant type	Tuber characteristics			Farmers' preferences ranking		
		Color	Shape	Eye depth	Plant appearance	Tuber appearance	Taste
CIP 389746.2	Erect	Red*	Oval	Deep	Good	Good	Very good
Desiree (ch)	Spreading	Red	Oblong	Medium	Good	Good	Very good
Kufri Jyoti (ch)	Spreading	White	Oval	Medium	Good	Good	Good
K.Sindhuri (ch)	Spreading	Red	Round	Deep	Very good	Very good	Good

*mixed color with white

CONCLUSION

Results from a series of on-station and on-farm studies carried out during the years 2004 to 20010 throughout the country demonstrated that the clone L235-4 is highly suitable in the hills and clone CIP 389746.2 in terai, hence are recommended to release as the commercial varieties for the hills and terai, respectively. If the climate is highly conducive for late blight disease, few fungicidal sprays might be necessary to obtain economic yield from potato crop.

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