

Performance of Potato Genotypes in Farmer's Field Trial at River Basins of Gandaki Province

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Abstract

The suitability of potato varieties in a particular location is a matter of economic return in Gandaki province condition. A RFFT consisting of nine genotypes was conducted in river basin conditions of Lahachowk, Kaski and Babiyachaur, Myagdi during the winter season of 2019/20 and 2020/21. The potato genotypes were: CIP 392920.1, CIP 393371.159, CIP 393371.164, CIP 394600.52, CIP 395443.103, CIP 396012.266, Khumal Ujjwal, PRP 336769.1 and Janakdev (check) in the first year and six promising genotypes were selected for the second year. The trial was replicated four times in RCBD where each treatment received 7.2 m² plot area. The spacing of 60 cm between rows and 25 cm between plants was maintained during planting which accommodated 48 plants per plot. Fertilizers and manure were applied @ 100:100:60 kg N, P₂O₅, K₂O/ha and FYM 20 t/ha, respectively. The tested genotypes were significantly different with each other. The first year results revealed that the genotypes CIP 396012.266 (39.41 t/ha at Lahachowk and 42.23 t/ha at Babiyachaur) and CIP-393371.164 (29.38 t/ha at Lahachowk and 37.29 t/ha at Babiyachaur) were superior with the high yield. Similarly, the second year results showed the same genotypes CIP 396012.266 (38.76 t/ha at Lahachowk and 38.89 t/ha at Babiyachaur) and CIP-393371.164 (29.86 t/ha at Lahachowk and 34.81 t/ha at Babiyachaur) were superior with highest yield. These two genotypes were recommended for farmers' preference test.

Keywords: RFFT, genotypes, RCBD, check variety, varietal trial

Introduction

Potato (*Solanum tuberosum* L.) is one of the most important vegetable recipes of Nepalese cuisine throughout the country and a staple food source for the residents of high hills and mountains (Upadhyay et. al., 2020). It occupies the fifth position in area coverage, second in total production and first in productivity among the food crops grown in the country (MoALD, 2021). The area and production of potato in Nepal is 188,098 ha and 3,131,830 t with

productivity of 16.64 t/ha (MoALD, 2021). In Gandaki Province, the area, production and productivity of potato are 20208 ha, 327205 t and 16.16, respectively; which are lower than that of Province 1, Madhesh and Bagmati (MoALD, 2021). Out of the total area under potato, around 10.7% is in the Gandaki province (MoALD, 2021). Comparing to other countries, the yields of potato were 20.82 t/ha, 11.28 t/ha, 18.54 t/ha, 23.77 t/ha, 42.67 t/ha and 50.79 t/ha in Bangladesh, Bhutan, China, India, The

Netherlands and the USA, respectively in 2020 (FAOSTAT, 2021). Low productivity of potato in Nepal is associated with some common factors such as irrigation, fertilizer, varieties, diseases, insect pests and other management practices. The mostly mentioned yield declining factors were low yielding varieties, inadequate cultivation practices with the soil-cultivars-climate complex, inadequate control measures for major diseases and insect pests, insufficient soil fertility management practices (Upadhyay et al., 2020; NPRP, 2021). The reason behind the low productivity in Gandaki province is low yielding potato varieties under cultivation since decades. Major pockets of Gandaki province such as Hemja, Dhorpatan, Salija, Dordi, Duwal, Tarakhola etc. use the generations of seed tubers of more than 25 years old. The farmers seek alternate high yielding varieties those suit in their cropping systems. National Potato Research Program released eleven varieties while it registered 5 varieties in the past (NPRP, 2020). There were some high yielding potential varieties such as CIP 395112.32 and CIP 393073.179 for hill conditions (Luitel et al., 2016); however they were not released due to their incomplete data from the ecological conditions.

The present varieties cannot meet the requirement of farmers in Gandaki province river basin conditions. These varieties could not be adopted widely in this region due to low productivity, late blight susceptibility, and poor keeping quality. There is always a demand of high yielding varieties which are resistant to diseases and insect pests and even perform in the drought and dry condition (Khatri and Luitel; 2014). Apart from the high yielding varieties, area specific varieties and quality planting material is the other most important part for the successful cultivation of the crop. Therefore, the present study was carried out to evaluate potato genotypes selected from the Coordinated Varietal Trials (CVTs) conducted in the previous years with the collaboration of NPRP, Khumaltar.

Materials and Methods

Site characteristics

Experiments were conducted at OR sites of Directorate of Agricultural Research (DoAR), Lumle in the winter season (November to March) 2019/20 and 2020/21. The OR site, Lahachowk, Kaski is situated between 28°18'03" North latitude and 83°05'22" East longitude, representing the river basin ecology (800 – 1000 masl) with a subtropical climate. This site is situated in North-East direction and 12 km far from Pokhara city. Major crops under cultivation are paddy in rainy season and potato in winter. The site receives sufficient rainfall for the crops as it is near Pokhara and Lumle where heavy rainfall occurs. The other OR site Babiyachaur is in Myagdi district and is situated between 28°02'31" North latitude and 83°02'24" East longitude, representing the river basin (1000-1200 – masl) environment with a subtropical climate. The site receives less rainfall than Lahachowk where the major crops are paddy, wheat and potato. Babiyachaur is 15 km North from Beni city of Myagdi district, which is characterized by fertile irrigated basins.

Experimental Details

A Regional Farmers' Field Trial (RFFT) consisting of nine genotypes was conducted at Lahachowk, Kaski and Babiyachaur, Myagdi during the winter season of 2019/20. The potato genotypes were: CIP 392920.1, CIP 393371.159, CIP 393371.164, CIP 394600.52, CIP 395443.103, CIP 396012.266, Khumal Ujjwal, PRP 336769.1 and Janakdev (check). In 2020/21, six promising genotypes were selected: CIP 396012.266, CIP 394600.52, CIP 393371.159, PRP 336769.1, CIP 393371.164 and Janakdev (check variety). The trial was replicated four times in RCBD where each treatment received 7.2 m² plot area in both the years. The spacing of 60 cm between rows and 25 cm between plants was maintained during planting which accommodated 48 plants per plot. Fertilizers and manure were applied @ 100:100:60 kg N, P₂O₅, K₂O/ha and FYM 20 t

ha, respectively.

Observations were recorded on emergence, plant uniformity, ground cover, plant vigor, number of main stems per plant, plant height, number of harvested plants, number and weight of under size, seed size, over size and total tuber. Finally adjusted tuber yield per hectare was derived from the yield of harvest plants per plot. The data recording was undertaken according to the guidelines provided by NPRP.

Data were managed in a spreadsheet and analyzed with Genstat version 18 (VSN International, 2015) software for windows. Analysis of variance was used to determine statistically significant differences between means. Post hoc analysis was done by Duncan's Multiple Range Test. Least significant differences were determined for all significant data (Gomez & Gomez, 1984; Shrestha, 2019).

Result

Performance of potato genotypes in farmer's field trial at Lahachowk, Kaski

In the year 2019/20, highly significant differences between genotypes were observed

for emergence count, number of main stems per plant, number of seed size tubers, weight of oversize tubers, total tuber weight, adjusted weight and yield (Table 1 and 2), whereas no differences were noticed for plant uniformity, ground cover, plant vigor, plant height, number of harvested plants, number and weight of under size tubers, weight of seed size tubers, number of oversize tubers and number of total tubers. The highest emergence count (46) was recorded in CIP 392920.1 and CIP 393371.159 which was statistically at par with CIP 393371.164, CIP 39400.52, CIP 396012.266, Khumal Ujjwal and Janakdev. The lowest emergence count (29) was observed in CIP 395443.103 and PRP 336769.1. The highest number of main stems per plant (6) was found in CIP 396769.266 whereas other genotypes had similar results. Number of seed size tubers was greater in CIP 396012.266 (133), Khumal Ujjwal (163), PRP 336769.1 (122) and CIP393371.159 (101) than the others. The genotypes CIP 396769.266 and CIP 393371.164 had higher weight of oversize tubers, total tubers weight, adjusted weight and yield than the other genotypes.

Table 1: Plant characteristics of potato genotypes at Lahachowk, Kaski during the winter of 2019/20

Treatment	Emergence count (45-DAP)	Uniformity (1-5)	Ground Cover (%)	Main Stem/Plant	Plant Vigor (1-5)	Plant height (cm)	Harvested Plant (no)
CIP 392920.1	46a	4	88	2c	4.5	37.4	46
CIP393371.159	46a	4	82	3bc	4.25	51.6	47
CIP393371.164	45a	4	85	3bc	4.00	56	46
CIP39400.52	43a	5	88	3bc	4.75	47.7	43
CIP 395443.103	29b	3	74	4b	3.75	48.2	40
CIP 396012.266	38a	3	84	6.a	3.75	58.1	45
Khumal Ujjwal	44a	4	74	3bc	3.75	39.5	43
PRP 336769.1	29b	4	84	2c	4.75	52.9	45
Janakdev (check)	46a	4	88	3bc	4.25	52.5	46

Treatment	Emergence count (45-DAP)	Uniformity (1-5)	Ground Cover (%)	Main Stem/Plant	Plant Vigor (1-5)	Plant height (cm)	Harvested Plant (no)
CV (%)	15.8	19.9	23	26	20.6	20.3	7.4
P-Value	<.001	0.493	0.93	<.001	0.532	0.092	0.162
LSD (0.05)	8.11	2.1	17.74	1.2	1.256	14.55	4.808

The values followed by same letters in the same column are not significantly different.

Table 2: Tuber characteristics of potato genotypes at Lahachowk, Kaski during the winter of 2019/20.

Treatment	Under Size tuber (<25 g)		Seed size tuber (25-50 g)		Over size tuber (>50 g)		Total Tuber No.	Total Tuber wt. (kg)	Adjusted weight (kg)	Yield (t/ha)
	No.	Wt. (kg)	No.	Wt. (kg)	No.	Wt. (kg)				
CIP 392920.1	235	2.84	82b	2.84	141	8.64c	458	14.32bc	14.94bc	20.75bc
CIP393371.159	85	1.28	101ab	3.50	141	11.47bc	327	16.25bc	16.59bc	23.03bc
CIP393371.164	68	1.01	73b	3.32	188	15.95ab	329	20.28ab	21.16b	29.38b
CIP39400.52	80	1.28	72b	2.42	123	9.29bc	275	12.99bc	14.50bc	20.13bc
CIP 395443.103	119	1.7	86b	3.26	148	12.47bc	353	17.43bc	20.92b	29.05b
CIP 396012.266	182	2.1	133ab	5.28	210	19.29a	525	26.66a	28.37a	39.41a
Khumal Ujjwal	206	2.36	163a	5.05	131	8.44c	500	15.85bc	17.69bc	24.57bc
PRP 336769.1	114	0.93	122ab	3.42	133	9.65bc	369	14.00bc	14.93bc	20.73bc
Janakdev (check)	126	0.97	80b	2.36	141	8.80c	347	12.13c	12.65c	17.56c
CV (%)	63.7	60.1	40.6	40.5	39.6	37.0	31.0	26.8	22.7	22.7
P-Value	0.101	0.081	0.049	0.067	0.511	0.012	0.079	0.003	<.001	<.001
LSD (0.05)	124.7	1.4	59.79	2.053	86.82	6.196	174.6	6.474	5.838	8.109

The values followed by same letters in the same column are not significantly different.

In the year 2020/21, highly significant differences between genotypes were observed for emergence count, number of main stems per plant, number of seed size tubers, weight of oversize tubers, total tuber weight, adjusted weight and yield (Table 3 and 4), whereas no differences were noticed for plant uniformity, ground cover, plant vigor, plant height, number of harvested plants, number and weight of under size tubers, weight of seed size tubers, number of oversize tubers and number of total tubers. The emergence count was similar and higher in

all tested genotypes than PRP 336769.1. The highest number of main stems per plant (6) was found in CIP 396769.266 whereas other genotypes had similar results. Number of seed size tubers was greater in CIP 396012.266, PRP 336769.1 and CIP 393371.159. The genotypes CIP 396769.266 and CIP 393371.164 had higher weight of oversize tubers, total tubers weight, adjusted weight and yield.

Table 3: Plant characteristics of potato genotypes at Lahachowk, Kaski during the winter of 2020/2021

Treatment	Emergence (45-DAP)	Uniformity (1-5)	Ground Cover (%)	Main Stem/Plant	Plant Vigor (1-5)	Plant height (cm)	Harvested Plant (no)
CIP 396012.266	40ab	3.7	86	6a	3.5	62.4	45
CIP39400.52	44a	4.5	86	3bc	4.5	54.8	43
CIP393371.159	47a	4.0	82	3bc	4.5	52.4	46
PRP 336769.1	31b	4.0	85	2c	4.5	50.9	45
CIP393371.164	46a	3.5	83	3bc	4.0	55.8	46
Janakdev (check)	45a	4.0	87	3bc	4.0	53.5	46
CV (%)	15.8	19.9	23	26	20.6	20.3	7.4
P-Value	<.001	0.493	0.93	<.001	0.532	0.092	0.162
LSD (0.05)	11.1	1.176	7.74	1.5	1.256	14.55	4.808

The values followed by same letters in the same column are not significantly different.

Table 4: Tuber characteristics of potato genotypes at Lahachowk, Kaski during the winter of 2020/21.

Treatment	Under Size tuber (<25 gm)		Seed size tuber (25-50 gm)		Over size tuber (>50 gm)		Total Tuber No.	Total Tuber wt. (kg)	Adjusted weight (kg)	Yield (t/ha)
	No.	Wt. kg	No.	Wt. kg	No.	Wt. kg				
CIP 396012.266	173	2.20	135a	5.38	200	18.59a	508	26.17a	27.91a	38.76a
CIP39400.52	92	1.20	77b	2.40	113	10.29bc	282	13.89bc	15.50bc	21.52bc
CIP393371.159	87	1.25	98ab	3.50	133	10.70bc	318	16.25bc	16.95bc	23.54bc
PRP 336769.1	111	1.03	119ab	3.50	122	8.88bc	352	15.45bc	16.48bc	22.80bc
CIP393371.164	70	1.11	76b	3.00	179	16.50ab	325	20.61ab	21.50b	29.86b
Janakdev (check)	122	1.17	84b	2.54	150	9.56c	356	13.27c	13.84c	19.22c
CV (%)	63.7	60.1	40.6	40.5	39.6	37.0	31.0	26.8	22.7	22.7
P-Value	0.101	0.081	0.049	0.067	0.511	0.012	0.079	0.003	<.001	<.001
LSD (0.05)	124.7	1.4	59.79	2.053	86.82	6.196	174.6	6.474	5.838	8.109

The values followed by same letters in the same column are not significantly different.

Performance of potato genotypes in farmer's field trial at Babiyachaur, Myagdi

In the year 2019/20, highly significant differences between genotypes were observed for emergence count, number of main stems per plant, number of seed size tubers, weight of oversize tubers, total tuber weight, adjusted weight and yield (Table 5 and 6), whereas no differences were noticed for plant uniformity, ground cover, plant vigor, plant height, number of harvested plants, number and weight of under size tubers, weight of seed size tubers,

number of oversize tubers and number of total tubers. The emergence count was similar but higher in all genotypes than PRP 336769.1 and CIP 395443.103. The highest number of main stems per plant was found in CIP 396769.266. Number of seed size tubers was greater in CIP 396012.266, Khumal Ujjwal, PRP 336769.1 and CIP 393371.159 than the other genotypes. The genotypes CIP 396769.266 and CIP 393371.164 had higher weight of oversize tubers, total tubers weight, adjusted weight and yield than the other genotypes.

Table 5: Plant characteristics of potato genotypes at Babiyachaur, Myagdi during the winter of 2019/20

Treatment	Emergence (45-DAP)	Uniformity (1-5)	Ground Cover (%)	Main Stem/Plant	Plant Vigor (1-5)	Plant height (cm)	Harvested Plant (no)
CIP 392920.1	48a	4	80	2c	4.50	47.4	45
CIP393371.159	48a	4	82	3c	4.25	60.6	46
CIP393371.164	47a	4	85	3bc	4.00	67.0	45
CIP39400.52	45a	5	85	3bc	4.50	58.2	40
CIP 395443.103	20c	3	73	4b	3.50	48.0	38
CIP 396012.266	40ab	4	83	6a	3.50	67.8	44
Khumal Ujjwal	46a	4	73	3bc	3.50	49.4	44
PRP 336769.1	31b	4	80	2c	4.50	62.2	47
Janakdev (check)	48a	4	80	3bc	4.25	62.5	44
CV (%)	18.8	14.9	20.0	23.0	22.5	22.3	8.4
P-Value	<.001	0.930	0.43	<.001	0.322	0.098	0.120
LSD (0.05)	8.00	1.06	31.40	1.20	1.560	24.00	7.808

The values followed by same letters in the same column are not significantly different.

Table 6: Tuber characteristics of potato genotypes at Babiyachaur, Myagdi during the winter of 2019/20.

Treatment	Under Size tuber (<25 gm)		Seed size tuber (25-50 gm) no.		Over size tuber (>50 gm) no.		Total Tuber No.	Total Tuber wt. (kg)	Adjusted weight (kg)	Yield (t/ha)
	No.	Wt. (kg)	No.	Wt. (kg)	No.	Wt. (kg)				
CIP 392920.1	226	2.80	88b	3.14	131	9.64c	445	15.58cd	16.61cd	23.06cd
CIP393371.159	77	1.19	102ab	3.71	145	12.47bc	324	17.37bc	18.12bc	25.17bc
CIP393371.164	60	1.00	83b	3.23	194	20.95ab	337	25.18ab	26.85ab	37.29ab
CIP39400.52	74	1.21	82b	2.40	132	11.29bc	288	14.90bc	17.88bc	24.83bc
CIP 395443.103	100	1.72	84b	3.33	132	11.47bc	316	16.52bc	22.65bc	31.45bc
CIP 396012.266	170	2.11	129ab	5.48	225	20.29a	524	27.88a	30.41a	42.23a
Khumal Ujjwal	198	2.46	157a	5.55	138	10.40c	493	18.41bc	20.08bc	24.57bc
PRP 336769.1	107	1.02	112ab	3.20	122	8.50bc	341	12.72cd	12.99cd	20.73cd
Janakdev (check)	112	1.02	82b	2.60	130	9.80c	324	13.42cd	14.64cd	17.56cd
CV (%)	42.8	40.4	34.6	33.4	36.7	32.2	28.0	24.7	23.1	23.1
P-Value	0.12	0.071	0.042	0.077	0.555	0.023	0.066	0.002	<.001	<.001
LSD (0.05)	144.8	2.4	53.90	2.53	88.2	5.16	216.6	5.744	4.388	6.102

The values followed by same letters in the same column are not significantly different.

In the year 2020/21, highly significant differences between genotypes were observed for emergence count, number of main stems per plant, number of under size tubers, number and weight of seed size tubers, weight of oversize tubers, total tuber number and weight, adjusted weight and yield (Table 7 and 8), whereas no differences were noticed for plant uniformity, ground cover, plant vigor, plant height, number of harvested plants, weight of under size tubers and number of oversize tubers. The emergence count was similar and higher in all tested genotypes than PRP 336769.1. The highest number of main stems per plant was found in

CIP 396769.266 whereas it was the lowest in PRP 336769.1. Number of under size tubers was greater in PRP 336769.1 and CIP 39400.52 whereas it was less in Janakdev and CIP 393371.164. Number and weight of seed size tubers were greater in PRP 336769.1 and CIP 39400.52 whereas it was less in CIP 393371.164 and Janakdev. The genotypes CIP 396769.266 and CIP 393371.164 and CIP 393371.159 had higher weight of oversize tubers. Total number of tubers was greater in CIP 396769.266 and CIP 39400.52 whereas it was less in PRP 336769.1. CIP 396769.266 and CIP 393371.164 were superior to others in yield.

Table 7: Plant characteristics of potato genotypes at Babiyachaur, Myagdi during the winter of 2020/21

Treatment	Emergence (45-DAP)	Uniformity (1-5)	Ground Cover (%)	Main Stem/Plant	Plant Vigor (1-5)	Plant height (cm)	Harvested Plant (no)
CIP 396012.266	42a	4	88	6a	3.5	65.4	47
CIP39400.52	44a	4	86	3bc	4.5	57.8	44
CIP393371.159	44a	4	82	3bc	4.5	52.0	47
PRP 336769.1	33b	4	85	2c	4.5	50.5	46
CIP393371.164	45a	3	82	3bc	4.0	58.8	44
Janakdev (check)	44a	4	87	3bc	4.0	50.5	44
CV (%)	18.8	16.9	21	26	20.6	20.3	7.4
P-Value	<.001	0.493	0.33	<.001	0.532	0.092	0.162
LSD (0.05)	8.1	1.30	7.74	1.5	1.256	16.52	4.8

The values followed by same letters in the same column are not significantly different.

Table 8: Tuber characteristics of potato genotypes at Babiyachaur, Myagdi during the winter of 2020/21

Treatment	Under Size tuber (<25 gm)		Seed size tuber (25-50 gm)		Over size tuber (>50 gm)		Total Tuber No.	Total Tuber wt. kg	Adjusted weight (kg)	Yield (t/ha)
	No.	Wt. kg	No.	Wt. kg	No.	Wt. kg				
CIP 396012.266	182a	2.10	133b	5.28abc	210	19.29a	525a	26.67a	27.23a	38.89a
CIP 39400.52	194a	1.88	211a	5.86ab	182	12.59b	587a	20.33bc	22.17b	31.67b
CIP 393371.159	105abc	1.28	120b	4.17bc	207	16.98ab	432b	22.43ab	22.91b	32.72b
PRP 336769.1	166ab	1.85	217a	6.49a	167	13.09b	550a	21.43b	22.36b	31.94b
CIP 393371.164	68bc	1.01	73b	3.32c	188	17.95ab	329b	22.28bc	24.30ab	34.71ab
Janakdev (check)	61c	0.57	86b	3.37c	143	12.87b	290b	16.81c	18.33c	26.18c
CV (%)	49.0	50.0	31.1	29.8	29.5	21.8	22.2	13.4	12.8	12.8
P-Value	0.023	0.055	<.001	0.022	0.513	0.053	0.002	0.004	0.001	0.001
LSD (0.05)	94.2	1.75	64.79	2.103	80.1	4.908	149.4	4.237	3.219	4.86

The values followed by same letters in the same column are not significantly different.

Maturity and tuber characters

Out of the nine, four genotypes were characterized as medium maturing types whereas five as late maturing types (Table 9). Tuber shapes of the genotypes were oval,

round, long and oblong. Tuber color varied from white, light red to purple. Skin type of tubers ranged from rough to smooth where eye depth from deep through shallow to medium.

Table 9: Maturity and tuber characters of potato genotypes in both locations

Treatment	Maturity*	Tuber shape	Tuber colour	Skin type	Eye depth
CIP 392920.1	Medium	Round	White	Rough	Deep
CIP393371.159	Late	Oval	Light red with dark red eyes	Smooth	Shallow
CIP393371.164	Medium	Round	White with reddish eyes	Smooth	Shallow
CIP39400.52	Late	Oval	White	Smooth	Shallow
CIP 395443.103	Late	Oblong	White	Smooth	Medium
CIP 396012.266	Medium	Round	Purple	Rough	Deep
Khumal Ujjwal	Late	round	Light yellow	smooth	Medium
PRP 336769.1	Medium	Oblong	Purple	Rough	Deep
Janakdev (check)	Late	Long	Red	Smooth	Medium

*Early = < 90 days, Medium = 90-120 days, Late = >120 days

Discussion

Yield and yield attributing parameters are commonly governed by genetic and environmental factors. In the present study the genotypes showed the significant differences for some parameters including yield. The coefficient of variation was greater in some parameters indicating instable performance over replications. In some genotypes germination count was less in 45 DAP but number of harvested plants was similar indicating long dormancy of tubers with late germination. In all genotypes, plant uniformity, vigor and ground coverage were similar reflecting the purity and healthy seed tubers. Genotypes differ genetically in their growth habit (Tessema et al. 2020) whereas the present study showed no differences in the genotypes. Deblonde and Ladent (2001) reported the reduced plant height in late cultivars while it showed no such indication.

The genotypes CIP 396012.266, CIP 39400.52,

CIP 393371.159 and CIP 393371.164 were promising for tuber yield in previous Initial Evaluation Trials (IET) conducted in NPRP Hattiban Farm and RARS, Parwanipur during the winter season of 2017 and 2018 (NPRP, 2017; NPRP 2018) and CVTs conducted in the OR sites of RARS, Lumle (RARS Lumle 2018). Tuber yield is the product of intercepted photo synthetically active radiation (PAR) and efficiency to convert into dry matter. For potato, the ability of the leaf to convert the PAR into carbohydrates and the storage capacity of the tubers affect growth of tubers, tuber size and tuber yield (Oliveira et al., 2016).

The significant variations in yield attributing parameters were associated with heredity, especially for tuber sizes (Muthuraj et al., 2005). The variation in number of main stems per plant among the genotypes might be due to genetic traits (Nielson et al., 1989; Luitel et al., 2020, the length of the pre-sprouting period (Allen, 1978), size of the seed tuber (Eaton

et al. 2017) and physiological age (Irritani, 1698). Patel et al. (2008) found that rapid plant emergence and better plant growth results in higher number of seed (medium) size tubers. The highest yield of small size tubers may be the genotypic effect. More number of under size tubers may be due to the higher vigor of plants coupled with delayed maturity (Sharma & Singh, 2009). Genotypic difference in tubers size might be due to genetic and environmental factors. Masarirambi et al. (2012) had also found difference in tuber size per plant. Seed sized tuber yield determines the economic value of tuber production (Kim et al., 2017). Potato tuber yields are linked to the duration of the growth cycle, which depends on climate, cultivar, and crop management (Kooman et al., 1996). In the optimum management conditions, potato tuber yield could be different among genotypes which could be due to differences in accumulated intercepted radiation, the utilization coefficient of foliage followed by dry matter partition within the plant (Oliveira et al, 2016).

In the present study, the data showed the higher yield (>17 t/ha) of most of the genotypes crossing the national average yield (16.64 t/ha; MOALD, 2021). It indicated that the genotypes are promising but need verification in famers' fields in different ecological conditions to confirm their stability. Upadhyay et al. (2017) reported that the tested genotypes in famers' field showed a great variation in yield and yield attributing parameters. The tuber distribution also showed significant variation with the highest oversize tuber number per plant (Gainju et al., 2019) which agreed to the present study. According to Cho and Iritani (1983), tuber number is the function of stem population but is influenced by cultivars and several other factors, which control vegetative growth. Dhakal et al. (2011) and Chapagain et al. (2014) also indicated the role of varieties on the development of yield of tuber per plant.

Conclusion

Overall results from the OR sites of DoAR, Lumle viz. Lahachowk, Kaski and Babiyachaur, Myagdi showed that CIP 396012.266 and CIP 393371.164 were superior to standard check variety Janakdev. On the basis of performance, CIP 396012.266 and CIP 393371.164 could be recommended for farmers' preference test.

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