

## Preliminary Screening of Advanced Potato Clones against Moisture Stress in Khumaltar, Lalitpur

Bhim B. Khatri<sup>1</sup>, Duryodhan Chaudhari<sup>1</sup>, Buddhi P. Sharma<sup>1</sup> and Surendra Sherstha<sup>2</sup>

### ABSTRACT

*A preliminary study on potato cultivars was undertaken at Hattiban Research Farm Khumaltar, Lalitpur (1340 masl) during the years 2008/09 and 2009/10 to compare the responses of different advanced potato cultivars for their tolerance against moisture stresses. Completely rain-fed, rice-straw mulching and frequently irrigated conditions were considered as the moisture treatments in the trial. Among the assessed clones, CIP 394003.161, CIP 392243.17, CIP 391058.35, CIP 392242.25, Khumal Seto-1, CIP 378711.7, Ca x 27/40-7, CIP 396011.47, Primicia, CIP 391598.75, LBr 40, L 235.4, CIP 394007.55, Kufri Chipsona-2, NPI-106 and Ca x LBr 40.6 were found performing better than the check variety Kufri Jyoti in completely rain-fed conditions. In frequently irrigated treatment, clones CIP 391011.47, Ca x LBr 40.6, CIP 378711.7 and LBr 40 were superior, whereas in the mulching treatment, clone LBr 40 performed the best followed by 394003.161, Ca x LBr 40.6, CIP 391011.47, Kufri Jyoti, CIP 392250.56, Primicia, CIP 391598.75, CIP 392236.6, Khumal Seto -1, CIP 389746.2, 27/40, Des x LBr 43.18, CIP 800947 and 391058.35 respectively in assessed phenotypic, yield and its attributes compared to Kufri Jyoti and Desiree. This result clearly indicated that the overall performance of the clone was more under genetic control rather than the environment factors. Based on the preliminary results, the best performing clones will be further assessed in multi-locational varietal trials of National Potato Research programme in the future.*

**Keywords:** Potato clones, variety section, moisture stress, rain-fed conditions.

### INTRODUCTION

Potato (*Solanum tuberosum* L) ranks 5<sup>th</sup> in area, 2<sup>nd</sup> in production and first in productivity among the major food crops of Nepal (ABPSD, 2011). It produces nutritious food more quickly, even in harsher climates than most of other crops. It is well adapted in different climates, but it can be adversely affected by temperature extremes than other warm season crops. Thus, potato may be among the crops most-affected by climate warming (Bonierbale *et al.*, 2008). Global warming has been expected to have profound effect on potato production worldwide including Nepal. One of the major effects of global warming is less availability and deterioration in quality of irrigation water.

Potato tuber itself consists of 80% water and plant is herbaceous in nature. Due to this, all the developmental stages of potato plant are susceptible to moisture stress (Acharya, *et al.*, 2008), which makes potato plant a highly sensitive crop to the stress which brings many physiological and bio-chemical changes in plants (Bansal and Nagarjan, 1987) and in the tubers as well.

Major focus of National Potato Research Programme (NCRP) in the past was on finding high yielding and disease resistant varieties which has resulted several commercial potato varieties suitable for different agro-climatic conditions (Khatri *et al.*, 2010).

---

<sup>1</sup> National Potato Research Programme, Khumaltar, Lalitpur (Email: [bhim\\_khatri@narc.gov.np](mailto:bhim_khatri@narc.gov.np))

<sup>2</sup> Regional Agricultural Research Station, Parwanipur Bara

Potato cultivar, named as NPI-106, one of the widely cultivated varieties in the hills, has been observed with moderate moisture stress tolerating trait in dry hills of Nepal (NPDP, 1988). Some of the mulching trials conducted in the past have significantly demonstrated very positive effect on moisture retention (NPRP, 1990). In some of the potato growing countries of the world including India drought tolerant varieties have been developed. International Potato Center (CIP) has identified a number of moisture stress resistance germplasm (CIP, 1992) which can be useful in Nepalese condition to develop climate smart varieties.

Therefore, aiming to cope with low moisture stress through variety selection and moisture conservation present study was undertaken first time in the country.

## **MATERIALS AND METHODS**

Total of 33 advanced potato clones available at National Potato Research Programme (NPRP) Khumaltar were assessed at Hattiban Research Farm of NPRP at Khumaltar in the years 2008/09 and 2009/10. The treatments applied were completely rain-fed, mulching and irrigated conditions. Rice straw was used as the mulching material. All other cultural practices were followed as per the NPRP recommendations. The crop was planted at first week of February both the years. To help tuber emergence, first irrigation was provided immediately after planting to all the treatments after then only irrigated plot was irrigated when needed and in other two treatments irrigation was completely stopped. In a plot, 12 tubers were planted per row in rod-row design with 60 x 25 row to row and plant to plant spacing. Fertilizer was applied at the rate of 100:100:60 kg NPK and 20 tons FYM per hectare.

Plant growth parameters (% plant emergence, plant height, plant uniformity, plant vigor and number of main stems per plant) and tuber yield and its attributes such as the number of plants harvested, number and weight fraction of the tubers in three grades, total number and weight of tubers per plot, yield tons per hectare and color, shapes and eye depth of the tubers at harvest were the observations taken from experimental plots both the years.

## **RESULTS AND DISCUSSION**

In the completely rainfed condition, LBr 40, CIP 391061.73, BR 63/65 and BSU PO3 were highest emerging clones, however, none of the clones had 100% emergence even at 45 days after planting (Table 1) which could be due to the moisture stress at emergence stage of the tubers. Single irrigation provided immediately after planting seems not sufficient to boost emergence in potato if soil is dry at planting. Probably due to the second irrigation in the irrigated treatment, emergence of clones ranged from 71 to 100%, whereas in mulching treatment, clones CIP 394007.55, CIP 393574.71B, LBr 40 and NPI 106 were the best performing clones in emergence. The average plant emergence was highest (94%) in irrigation treatment followed by mulching (90%) and lowest in rainfed treatment (77%). Percent ground cover of the clones was highest (75%) in CIP 393574.72B and lowest (20%) in Ca x 27/40 in rainfed treatment, whereas in irrigated conditions, highest (99%) ground cover was observed in the clone CIP 393385.39 followed by CIP 392242.25 (85%). Clone CIP 393574.72B had the highest percentage ground cover (83%). However, the percent ground cover of irrigated treatment was higher than the rainfed and mulching treatments.

Average plant vigour did not differ between irrigated and rainfed conditions, but slightly differed with mulching. Except Kufri Kanchan, none of the tested clones were superior in plant vigour, however, majority of the tested clones in irrigated treatment and some of the clones in rainfed conditions were scored 5 in 1-5 scales in plant vigour.

Average number of main stems was highest (4.7) in the clone CIP 393385.39 in rainfed treatment followed by CIP 389660.9 (4.5). Khumal Seto-1 had the highest number of main

stems in irrigated conditions. The average number of main stems was less with mulched treatment.

**Table 1.** Treatment effects on vegetative characteristics of different clones, NPRP Khumaltar

Clones	Emergence (%)			Ground cover (%)			Plant height (cm)			Plant vigor (1-5 scale)			Stem/plant (#)		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
CIP378711.7	71	100	84	43	58	53	8.4	36.6	28.5	3	4	3	2.2	2.0	2.3
CIP389660.9	88	100	75	60	65	55	21.4	24.6	23.0	3	5	2	4.5	4.5	3.7
CIP391011.47	84	100	96	38	45	48	11.9	16.9	16.2	3	4	3	2.8	3.8	2.9
CIP391058.35	63	75	96	30	55	53	22.7	26.0	27.3	3	3	3	3.2	3.2	2.6
CIP 391061.73	96	100	96	45	53	48	19.5	24.0	21.8	3	4	4	3.0	2.8	2.4
CIP 391598.75	75	100	92	63	73	53	22.9	24.9	23.8	4	4	3	3.7	3.1	2.6
CIP 392242.25	88	91	91	63	85	60	27.0	30.2	23.6	4	5	3	3.2	3.4	3.1
CIP 392243.17	84	100	96	60	63	43	18.3	23.5	20.1	4	4	3	2.6	2.8	2.5
CIP 392244.3	88	92	88	68	78	53	27.4	31.6	28.8	5	4	4	4.0	4.2	3.6
CIP 393385.39	88	100	92	73	88	73	23.8	27.8	23.2	5	5	4	4.7	4.3	3.6
CIP394003.161	84	96	100	58	65	63	29.6	27.8	29.3	5	5	4	3.0	3.2	2.6
CIP 394007.55	75	100	96	45	68	60	22.4	31.5	28.6	4	5	4	2.9	3.5	2.5
CIP 394051.4	88	100	100	38	53	53	17.7	24.4	22.9	3	4	4	3.8	4.2	3.5
CIP 393574.72B	92	96	92	75	78	83	20.4	21.9	24.4	5	5	4	3.9	4.4	2.7
BR 63-65	96	100	92	63	68	55	20.7	24.6	22.3	5	5	4	3.1	3.1	3.4
BSU PO3	96	100	88	58	70	58	31.2	30.1	29.8	5	4	3	3.7	3.9	2.6
BW3	88	88	79	58	38	40	21.2	19.8	16.5	2	4	2	3.2	2.5	2.5
Cax 27/40.7	63	88	71	25	65	45	21.2	26.6	22.3	2	4	2	1.0	2.2	2.2
CaxLBr40.6	50	100	92	20	48	38	20.3	24.5	29.8	5	3	2	2.2	2.8	2.9
Des x LBr40.10	59	100	84	28	70	58	20.5	24.3	22.3	2	4	4	2.4	1.9	2.8
Des x LBr 44.8	67	96	75	26	58	65	16.8	19.4	22.3	3	4	3	2.5	2.5	3.1
K. Ashoka	59	84	84	28	50	48	16.8	30.3	28.1	2	2	3	2.0	2.4	2.6
K. Kanchan	79	96	92	50	75	73	23.3	22.1	24.5	4	5	6	3.0	2.5	2.9
K. Sutlez	75	100	83	21	68	43	29.3	29.3	23.6	2	2	2	2.5	3.4	2.6
K. Chipsona2	59	96	83	30	65	43	17.5	26.9	29.4	2	4	3	2.6	2.5	3.1
K. Seto 1	63	100	92	39	75	45	20.7	32.1	31.6	2	3	3	3.7	4.7	2.8
L 235-4	75	96	96	35	78	63	18.1	27.2	21.1	4	5	3	2.1	2.5	2.1
LBr 40	96	96	100	60	78	78	18.2	25.9	25.3	3	5	4	3.2	3.8	3.2
MS 35.9	58	75	92	38	48	63	18.6	22.9	23.8	32	3	3	2.6	2.8	2.3
NPI 106 (ch)	75	88	100	30	58	55	19.4	23.6	21.8	3	4	3	3.7	4.3	3.0
Primicia	71	71	96	28	33	65	21.4	25.1	24.8	2	2	3	3.2	2.8	2.3
Desiree (ch)	75	75	84	45	48	50	25.0	26.9	16.5	3	3	3	3.2	3.6	2.8
K. Jyoti (ch)	67	96	84	25	68	60	18.4	27.1	23.1	3	4	3	2.3	2.4	2.2
<b>Mean</b>	<b>77</b>	<b>94</b>	<b>90</b>	<b>44</b>	<b>63</b>	<b>56</b>	<b>21.0</b>	<b>26.1</b>	<b>24.3</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>3.0</b>	<b>3.2</b>	<b>2.8</b>

Treatments (T): T1: Rainfed, T2: Irrigated, T3: Mulched

Table 2 presents tuber yield and its attributes. Highest number of tubers per plot (1.5 m<sup>2</sup>) was harvested in the clone CIP 391598.75 (157) followed by NPI 106 (146) in the treatment rainfed, whereas in irrigated plots, clone L 235-4 was the highest tuber producing clone (194). In rainfed treatment, total tuber weight per plot was obtained highest (3.9 kg) from the clone CIP 391598.75 followed by NPI 106 (3.1), CIP 391011.47 (3.0 kg) and CIP 392242.25 (2.9 kg), respectively. In irrigated plot, clone CIP 391011.47 produced highest (4.7 kg) tuber yield. Clones CIP 391011.47, CIP 378711.7 and Ca x LBr 4.06 were found superior to Kufri Jyoti. Almost all of the tested clones were superior to Desiree one of the check varieties in the study. CIP 391011.47 and LBr 40 were highest yielding clones (Table 2) in mulching treatment. Clone CIP 391598.75 was found highest tuber yielder (25.7 t/ha) among all the clones tested in the trial in rainfed conditions followed by NPI 106 (22.6 t/ha) and CIP 391011.47 (20.7 t/ha), CIP 391058.35 (20.5 t/ha), respectively. In irrigated conditions, clone CIP 391011.47 produced highest yield (31.2 t/ha) and Kufri Kanchan produced lowest (9.7 t/ha). Kufri Jyoti, one of the check varieties also gave satisfactory yield (24.7 t/ha). In mulching treatment, clone CIP 391011.47 was found highest yielder (26.9 t/ha) followed by LBr 40 (26.0 t/ha).

**Table 2:** Treatment effects on vegetative characteristics of different clones, 2067/68 and 2068/69 at NPRP Khumaltar

Clones	Total tuber/plot						Adjusted yield (t/ha)			
	Number			Wt. kg			T1	T2	T3	Mean
	T1	T2	T3	T1	T2	T3				
CIP 391598.75	157	98	122	3.9	3.8	3.4	25.7	23.5	24.2	24.5
NPI 106	146	136	115	3.1	3.6	3.1	22.6	22.9	19.8	21.8
CIP 391011.47	99	149	104	3.0	4.7	3.9	20.7	31.2	26.9	26.3
CIP 392242.25	110	136	101	2.9	2.6	3.1	20.5	16.2	20.7	19.1
CIP 391058.35	94	103	147	1.9	1.9	3.2	19.8	13.7	20.4	18.0
CIP 394003.161	105	111	83	2.9	3.0	2.8	19.0	18.1	18.9	18.7
CIP 392243.17	73	110	83	2.0	2.6	2.5	17.4	15.9	15.8	16.4
Primicia	91	89	95	2.7	2.9	3.1	17.4	18.1	20.5	18.7
CIP 378711.7	64	109	98	2.1	4.4	2.1	17.3	26.4	12.9	18.9
LBr 40	72	87	144	2.6	4.1	3.9	17.2	25.1	26.0	22.8
L 235-4	139	194	161	2.4	3.5	2.2	17.1	22.3	14.4	17.9
Ca x 27/40.7	57	64	63	1.9	1.9	1.8	16.3	14.3	13.2	14.6
K. Seto 1	79	96	122	1.7	2.8	3.4	16.0	20.0	21.3	19.1
CIP 394007.55	54	77	103	1.6	2.2	1.8	15.5	13.1	13.1	13.9
K. Chipsona2	116	63	102	1.9	1.6	2.5	15.5	12.9	16.2	14.9
CaxLBr40.6	74	127	44	2.2	4.6	3.6	15.4	28.7	23.7	22.6
CIP 393385.39	84	139	135	1.8	2.9	3.1	13.8	17.5	20.7	17.3
CIP 389660.9	85	98	41	1.9	3.1	1.9	13.7	19.3	12.6	15.2
Des x LBr40.10	77	82	85	1.9	3.0	1.6	13.4	20.2	10.1	14.6
MS 35.9	134	119	91	1.9	2.5	1.4	13.2	15.3	9.9	12.8
Des x LBr 44.8	73	76	108	1.7	2.5	2.0	10.9	14.9	12.9	12.9
K. Sutlez	63	59	41	1.6	1.6	1.1	10.9	10.2	7.8	9.6
CIP 394051.4	32	89	44	1.2	2.9	1.8	10.4	18.8	12.1	13.8
K. Ashoka	69	93	63	1.5	2.6	2.0	10.4	16.1	12.4	13.0
BSU PO3	56	93	108	1.4	2.3	3.2	10.0	14.3	21.2	15.2
CIP 393574.72B	34	63	33	1.4	1.6	1.1	9.4	10.8	8.7	9.6
CIP 391061.73	38	60	91	1.2	1.9	2.3	8.6	13.2	16.9	12.9
BW3	58	41	63	1.1	1.7	1.9	7.9	10.7	12.3	10.3
CIP 392244.3	41	79	96	1.0	2.5	1.9	7.4	15.9	15.4	12.9
BR 63-65	62	118	85	1.0	2.2	2.2	7.1	13.6	15.9	12.2
K. Kanchan	38	67	63	0.5	1.5	100	3.4	9.7	6.7	6.6
Desiree (ch)	65	61	3	1.5	1.9	2.9	12.7	15.2	20.0	16.0
K. Jyoti (ch)	74	114	108	2.2	3.9	3.7	14.3	24.7	22.9	20.6
<b>Mean</b>	<b>79.2</b>	<b>97.0</b>	<b>89.2</b>	<b>1.9</b>	<b>2.8</b>	<b>2.5</b>	<b>14.3</b>	<b>17.7</b>	<b>16.6</b>	<b>16.2</b>

Treatments (T): T1: Rainfed, T2: Irrigated, T3: Mulched

The average yields of all the tested clones were highest (17.7 t/ha) in irrigated treatment followed by mulching (16.6 t/ha) and lowest 14.3 t/ha) in rainfed treatment. The average yield of all 3 different treatments was highest (26.3 t/ha) in the clone CIP 391011.47 followed by CIP 391598.75 (24.5 t/ha), LBr 40 (22.8 t/ha), Ca x LBr 40.6 (22.6 t/ha) and NPI 106 (21.8 t/ha), respectively, whereas check varieties Desiree gave 16.0 and Kufri Jyoti 20.6 t/ha respectively in the trial.

In completely rain-fed conditions, clones CIP 394003.161, CIP 392243.17, CIP 391058.35 CIP 392242.25, Khumal Seto-1, CIP 378711.7, Ca x 27/40-7, CIP 396011.47, Primicia, CIP 391598.75, LBr 40, L 235.4, CIP 394007.55, Kufri Chipsona-2, NPI-106 and Ca x LBr 40.6 were found performing comparatively better than the check variety Kufri Jyoti. In the irrigated treatment, clones CIP 391011.47, Ca x LBr 40.6, CIP 378711.7 and LBr 40 were superior to Kufri Jyoti (Table 2). In the mulching treatment, clone LBr 40 performed the best followed by 394003.161, Ca x LBr 40.6, CIP 391011.47, Kufri Jyoti, CIP 392250.56, Primicia, CIP 391598.75, CIP 392236.6, Khumal Seto -1, CIP 389746.2, 27/40, Des x LBr 43.18, CIP 800947 and 391058.35 respectively.

Some of the clones like CIP 391598.75, NPI 106 CIP 39242.25 and CIP 391011.47, CIP 394003.161 and LBr 40 were found the best performing in all of the three conditions. The highest yield in irrigated treatment was obtained 31.2 t/ha whereas in rainfed conditions it was 23.5 t/ha and in mulching treatment, highest yield was 26.9 t/ha indicating that the contribution of moisture in tuber yield increment is highly significant. Based on all the performance, some of best clones will be assessed next year in replicated way at Hattiban Research Farm Khumaltar, in Physiology lab at NPRP Khumaltar, Lalitpur and in major collaborating research stations of NARC.

## LITERATURE CITED

- Acharya, K. *et al.*, 2008. Increased tolerance to drought stress in transgenic potato plants that over express TLP gene, Abstract, Global Potato Conference, 9-12 Dec., 2008, New Delhi.
- ABPSD, 2007. Agri-business Promotion and Statistics Division, Ministry of Agriculture and Cooperatives, Singh Durbar, Kathmandu, Nepal
- Bansal, K. C. and S. Nagarjan, 1987. Reduction of leaf growth by water stress and its recovery in relation to transpiration and stomata conductance in some potato genotypes, *Potato Research*, 30 (1987) #4.
- Bonierbale *et al.*, 2008. Breeding potato for wide adaptation: conventional and molecular approaches, Abstract, Global Potato Conference, 9-12 Dec., 2008, New Delhi.
- CIP, 1992. Pathogen tested potato germplasm for distribution, International Potato Center, Lima Peru.
- Joshi, D. 1997. Soil Fertility and Fertilizer Use in Nepal, Social Science Division, Nepal Agricultural Research council, Khumaltar, Lalitpur, Nepal.
- Khatri, B. B., B. P. Sharma, D. Chaudhari, B. P. Luitel, S. Ahamad and TR Chapagain, 2010. On-farm performance of three advanced potato clones in different agro-ecological zones of Nepal, In: Proc. of the 9<sup>th</sup> National Outreach Research Workshop 7-8 June 2010, at Khumaltar, Outreach Research Division, NARC Khumaltar.
- NPDP, 1988. Annual Report, National Potato Development Programme, Khumaltar, Lalitpur.
- Singh, N., M. C. Sood and R.C. Sharma, 2002. Effect of irrigation levels, cultural practices and nitrogen application on potato production under drip and sprinkler methods of irrigation, In: *Potato, Global Research and Development*, Vol. 11, pp. 923-925. Edited by S. M. Paul Khurana and others.