

Evaluation of potato (*Solanum tuberosum*) genotypes under heat stress condition

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ABSTRACT

Fifty-two potato (*Solanum tuberosum* L.) genotypes were evaluated in early crop season (75 days) at experimental field of ICAR-Central Potato Research Institute, Regional Station, Modipuram, Meerut, Uttar Pradesh, during 2020 and 2021. Significant differences were recorded among for tuber yield and tuber attributes like plant vigour (1-5 scale), foliage maturity (1-5 scale), tuber colour, tuber shape, eye depth and flash colour. The pooled results of 2020 and 2021 crop seasons indicated that eight genotypes namely Kufri Mohan (260 g), Kufri Lima (256 g), CP4149 (252g), Kufri Garima (241g), Kufri Bahar (239 g), CP3273 (236 g), Kufri Neelkanth (221 g), CP4143 (212 g), CP1326 (208 g) and Kufri Arun (207 g), were found high-yielding in term of total tuber yield/ plant. The highest marketable tuber yield/plant was recorded in Kufri Lima (234g), CP4149 (230 g), Kufri Mohan (225 g), CP3273 (213 g), Kufri Bahar (211 g), Kufri Garima (208 g), CP4143 (190 g), Kufri Neelkanth (182 g), Atlantic (178 g) and Kufri Arun (177 g). The genotypes, CP1931, CP3319, CP3322, CP3450, CP3470, CP3499, CP4149, CP4238, Kufri Garima, Kufri Lima, Kufri Surya and Lady Rossetta, were found highly tolerant with 0% hopper burn incidence. Most of the genotypes were highly tolerant with 0% mite damage incidence except CP3495, CP3341and CP3472 (20%) and Kufri Sindhuri and Kufri Pukhraj (40%). On an overall basis CP4149, Kufri Mohan, Kufri Garima and Kufri Lima were found promising for high plant stand, plant vigour, marketable/ total tuber yield, marketable/total tuber number and nil/low incidence of hopper and mite burn.

KEY WORDS: Genotypes, Yield, Heat stress, Hopper and Mite burn

Potato (*Solanum tuberosum* L.) is the most popular vegetable crop worldwide. The climate change has affected weather patterns, resulting in extremes of heat, drought, frequent frost and snow fall in high altitudes (Dahal *et al.*, 2019 and IPCC, 2014). The sub-optimal growth conditions associated with global warming and climate change negatively impact its plant growth, survival and crop yield (Lesk *et al.*, 2016). Such negative impact on yield are likely to be aggravated in future because continued greenhouse gas emissions will intensify crop plant's exposure to abiotic and biotic stresses (DeLucia *et al.*, 2012; IPCC, 2014). High temperature, drought, soil salinity and nutrient stresses adversely affect plant growth, tuberization, tuber bulking and tuber yield and quality (Minhas, 2012;

Wang-Pruski and Schofield, 2012). Therefore, selection of desirable parents could generate progenies with in-built capacity of grow-ing well and producing tubers under high temperature is essential (Luthra *et al.*, 2020; Chaudhary *et al.*, 2021). Thus, to improve tuber yield under heat stress conditions, there is a need to develop new potato cultivars.

MATERIALS AND METHODS

A total of 52 potato genotypes were evaluated in early crop season at 75 days crop duration at experimental field of ICAR-Central Potato Research Institute, Regional Station, Modipuram, Meerut, Uttar Pradesh (29°N and 76°E; 222 masl) during 2020 and 2021 crop seasons. The soil of experimental field was sandy loam in texture. The soil reaction is slightly alkaline with pH 7.6. The experiment was planted in mid-September under irrigated condition. The genotypes were evaluated in a randomized block design in three replications (1.8 m²) with 15 tubers per replication.

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Table 1. Mean performance of genotypes during 2020 and 2021

Genotype	G%	PV	FM	Tubes/plant		Tuber yield (g/plant)		Burn (%)	
				Marketable	Total	Marketable	Total	Hopper	Mite
Atlantic	70	3.50	3.50	3.94	5.79	177.50	195.00	53.34	0.00
CP1137	53	2.50	4.40	2.25	3.75	76.75	103.57	50.00	0.00
CP1312	97	2.50	4.25	1.45	6.35	33.81	71.33	43.34	0.00
CP1326	43	2.50	3.25	1.88	5.21	45.83	207.50	50.00	0.00
CP1328	77	2.50	3.90	3.81	7.29	121.38	173.77	30.77	0.00
CP1526	63	2.50	4.25	3.60	5.43	146.07	176.19	51.67	0.00
CP1637	77	3.00	3.25	3.71	5.46	164.25	190.92	33.34	0.00
CP1814	80	2.50	4.50	2.25	3.21	72.45	87.69	31.82	0.00
CP1931	47	3.00	3.50	3.54	6.35	123.33	155.42	0.00	0.00
CP1991	73	2.25	4.00	3.41	9.09	116.82	191.82	70.00	0.00
CP2101	83	2.25	4.50	1.67	6.07	37.47	68.05	50.00	0.00
CP2135	70	3.00	4.25	2.64	3.89	110.56	133.61	80.00	0.00
CP2382	70	2.25	4.50	3.89	6.46	112.86	138.57	46.43	0.00
CP3005	53	3.00	3.50	3.55	6.06	139.09	173.18	31.82	0.00
CP3273	67	3.00	4.00	4.70	6.70	212.50	236.00	50.00	0.00
CP3282	83	3.00	3.25	2.53	3.67	98.94	117.05	10.00	0.00
CP3291	83	2.25	4.00	0.99	2.80	22.79	41.15	39.23	0.00
CP3319	80	3.00	3.75	2.90	6.25	93.43	131.54	0.00	0.00
CP3322	93	3.00	3.50	2.32	3.42	93.08	106.03	0.00	0.00
CP3325	80	2.25	4.50	2.48	5.87	92.34	133.60	70.00	0.00
CP3341	100	3.25	2.75	3.50	9.00	83.33	126.67	0.00	20.00
CP3346	53	2.50	4.15	2.00	4.17	85.67	118.00	60.00	0.00
CP3354	70	2.50	4.25	2.71	5.47	78.89	111.39	20.84	0.00
CP3368	50	2.75	3.50	1.44	3.21	59.23	89.62	50.00	0.00
CP3383	100	3.25	3.25	3.33	5.20	137.67	168.33	31.25	0.00
CP3450	80	3.50	3.25	3.07	4.43	120.93	141.36	0.00	0.00
CP3470	87	3.00	3.75	2.42	3.96	120.00	143.85	0.00	0.00
CP3472	80	3.00	3.25	3.17	5.10	147.41	181.19	20.00	20.00
CP3473	70	2.50	4.00	3.77	5.94	117.31	153.85	50.77	0.00
CP3495	80	2.75	4.00	1.79	6.35	55.59	95.56	0.00	20.00
CP3496	73	2.25	3.50	1.96	4.78	49.73	83.66	35.72	0.00
CP3497	70	2.75	3.75	3.03	5.75	112.21	151.44	45.00	0.00
CP3499	43	2.50	4.00	3.26	4.79	145.56	179.17	0.00	0.00
CP4143	83	2.25	4.00	3.34	4.84	189.74	212.31	50.00	0.00
CP4149	77	3.00	3.75	3.83	4.82	229.92	251.94	0.00	0.00
CP4236	63	2.50	4.25	3.07	4.12	118.75	142.78	70.00	0.00
CP4238	90	3.25	3.40	3.33	5.54	144.33	172.25	0.00	0.00
CP4243	70	2.50	4.25	3.33	5.78	116.25	141.25	60.00	0.00
K Arun	77	3.00	3.75	4.04	6.44	176.67	206.67	33.34	0.00
K Bahar	73	3.50	4.25	3.76	5.64	211.37	239.02	26.93	0.00
K Chipsona-3	87	3.25	4.00	3.27	7.38	146.82	192.42	33.34	0.00
K Ganga	70	2.25	4.00	4.37	6.58	165.00	189.76	20.00	0.00
K Garima	90	2.75	3.25	4.44	6.81	207.58	240.55	0.00	0.00
K Lalima	93	2.75	3.75	4.09	5.78	169.10	186.67	30.77	0.00
K Lalit	73	2.75	3.50	4.17	7.06	147.65	164.23	26.67	0.00
K Lima	90	3.25	2.75	3.54	5.11	234.40	256.21	0.00	0.00
K Mohan	93	3.00	3.50	4.35	7.83	225.26	259.74	6.67	0.00
K Neelkanth	87	2.75	3.25	4.23	6.96	182.38	220.54	17.86	0.00
K Pukhraj	97	2.75	3.50	3.10	6.57	78.45	122.26	0.00	40.00
K Sindhuri	98	2.38	3.90	3.38	6.62	79.23	105.46	0.00	40.00
K Surya	97	2.75	3.25	3.46	5.54	148.33	185.12	0.00	0.00
Lady Rossetta	87	2.50	3.90	3.35	7.00	85.00	125.00	0.00	0.00

G germination%; PV plant vigour; FM foliage maturity

The plants were spaced 20 cm within and 60 cm between rows. The crop was dehaulmed 75 days after planting. The recommended cultural practices were adopted. The application of insecticide was not done in order to allow the population build up of hoppers and mites so that data were recorded on tuber yield and tuber attributes like plant vigour (1-5 scale), foliage maturity (1-5 scale), marketable tuber yield (more than 20 gram), total tuber yield/plant (g), tubers /plant, mite and hopper burn (%). Data on genotypes were analysed for two years 2021 and 2022 on pooled basis.

RESULTS AND DISCUSSION

The pooled data on germination (%) ranged from 43 to 100. High germination was found in CP3341 and CP3383 (100%), Kufri Sindauri (98%), Kufri Pukhraj, Kufri Surya and CP1312 (97%), CP3322, Kufri Mohan, Kufri Lalima (93%), CP4238 Kufri Lima and Kufri Garima (90%). The data of foliage maturity was recorded in the scale of 1 (late) -5 (early) and ranged from 2.75 to 4.50. The genotypes CP1814, CP2101, CP3325, CP2382 (4.50), CP1137 (4.40), Kufri Bahar, CP2135, CP1312, CP3354, CP4243, CP1526, CP4236 (4.25), CP3346 (4.15), Kufri Chipsona3, CP3273, CP3495, CP3473, CP3499, CP3291, CP4143, CP1991 and Kufri Ganga (4.00), Lady Rossetta, CP1328 and Kufri Sindhuri (3.90), CP3470, CP3319, Kufri Arun, CP4149, Kufri Lalima and CP3497 (3.75), Atlantic, CP3322, K Mohan and CP3005, CP1931, Kufri Pukhraj, Kufri Lalit, CP3368 and CP3496 (3.50) were found early maturing.

The plant vigour was recorded in scale of 1 (poor)-5 (very good) and ranged from 2.25 to 3.50. The genotypes, CP3450, Kufri Bahar and Atlantic were very good with scale of 3.50. The CP3341, CP3383, CP4238, Kufri Lima and Kufri Chipsona-3 showed medium plant vigour with 3.25. The genotypes CP3322, Kufri Mohan, CP3470, CP3282, CP3319, CP3472, CP1637, Kufri Arun, CP4149, CP2135, CP3273, CP3005 and CP1931 showed good plant vigour with scale of 3.00.

The total tuber yield (g/plant) ranged from 41.15 to 259.74g/plant and high total tuber yield was recorded in Kufri Mohan (259.74g), followed by Kufri Lima (256.21g), CP4149 (251.94g), Kufri Garima (240.55g), Kufri Bahar (239.22g), CP 3273 (236.00g), Kufri Neelkanth (220.54g), CP 4143 (212.31g), CP 1326 (207.50) and Kufri Arun (206.67g). The marketable tuber yield (g/plant) ranged from 22.79 to 234.40 g/plant and high marketable tuber yield was found in Kufri Lima (234.40g) followed by CP4149 (229.92g), Kufri Mohan (225.26g), CP3273 (212.50g), Kufri Bahar (211.37g), Kufri Garima (207.58g), CP4143 (189.74g), Kufri Neelkanth (182.38g), Atlantic (177.50g), Kufri Arun (176.67g), Kufri Lalima (169.10g) and Kufri Ganga (165.00g) respectively.

The total tuber number ranged from 2.80 to 9.09. The highest tuber number were recorded for the genotypes namely, CP1991 (9.09), CP3341 (9.0), Kufri Mohan (7.83), Kufri Chipsona 3 (7.38), CP1328 (7.29), Kufri Lalit (7.06), Lady Rossetta (7.00), Kufri Neelkanth (6.96), Kufri Garima (6.81), CP3273 (6.70), Kufri Sindauri (6.62), Kufri Ganga (6.58), Kufri Pukhraj (6.57), CP2382 (6.46), Kufri Arun (6.44), CP1931 (6.35), CP3495 and CP1312 (6.35), CP3319 (6.25), CP2101 (6.07), CP3005 (6.06), CP3473 (5.94), CP3325 (5.87), Atlantic (5.79), Kufri Lalima and CP4243 (5.78), CP3497 (5.75), Kufri Bahar, CP4238 and Kufri Surya (5.54).

The marketable tuber number ranged from 0.99 to 4.70. The highest tubers were recorded for CP3273 (4.70) followed by Kufri Garima (4.44), Kufri Ganga (4.37), Kufri Mohan (4.35), Kufri Neelkanth (4.23), Kufri Lalit (4.17), Kufri Lalima (4.09), Kufri Arun (4.04) Atlantic (3.94), CP2382 (3.89), CP4149 (3.83), CP1328 (3.81), CP3473 (3.77), Kufri Bahar (3.76), CP1637 (3.71), CP1526 (3.60), CP3005 (3.55), CP1931 and Kufri Lima (3.54) and CP3341 (3.50).

The incidence of hopper burn ranged from 0.00 to 80.00. Total 16 genotypes Kufri Lima, CP4149, Kufri Garima, Kufri Surya, CP3499, CP4238, CP1931, CP3470, CP3450, CP3319, CP3341, Lady Rossetta, Kufri Pukhraj, CP3322, Kufri Sindauri and CP3495 were found highly tolerant with 0% hopper burn incidence. The 47 genotypes were found highly tolerant with 0% mite damage incidence Kufri Lima, CP4149, Kufri Garima, Kufri Surya, CP3499, CP4238, CP1931, CP3470, CP3450, CP3319, Lady Rossetta, CP3322, Kufri Mohan, CP3282, Kufri Neelkanth, Kufri Ganga, CP3354, Kufri Lalit, Kufri Bahar, Kufri Lalima, CP1328, CP3383, CP 3005, CP1814, Kufri Chipsona-3, CP1637, CP3496, CP3291, CP1312, CP3497, CP2382, CP3273, CP4143, CP1326, CP1137, CP3368, CP2101, CP3473, CP1526, Atlantic, CP4243, CP3346, CP1991, CP4236, CP3325 and CP2135.

On pooled data basis, genotypes CP4149, CP3273, CP4143, Kufri Lima, Kufri Mohan, Kufri Garima and Kufri Neelkanth were found promising for total tuber yield and total tuber number and nil hopper burn.

SUMMARY

The potato genotypes CP4149, CP3273, CP4143, Kufri Lima, Kufri Mohan, Kufri Garima and Kufri Neelkanth were found suitable for heat stress condition.

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