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Performance of CIP potato (*Solanum tuberosum*) clones for early maturity in subtropical region of Haryana

POOJA PANDEY[1]*, SUSHMA ARYA[1], M S KADIAN[1] DEEPA RANI[1] and S K YADAV[2]

International Potato Center (CIP), NASC Complex, Indian Agricultural Research Institute Campus, New Delhi 110 012, India

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Potato (*Solanum tuberosum* L.) has made its place in high yielding cash crops in certain districts of Haryana such as Karnal, Kurukshetra, Ambala and Yamunanagar having subtropical climate. The state is a part of Indo-Gangetic plain and produces 897.58 thousand tonnes of tubers from 34.72 thousand hectare area (Anonymous 2018). The crop is grown in winter (*rabi*) season from October–March. Selection and identification of short duration potato varieties provides farmers a productive window to produce an additional winter crop such as late wheat or any vegetables and improves the overall productivity of the cropping system. Apart from high yielding varieties, area specific short duration varieties and quality planting material is the most important part for the successful cultivation of the crop (Addis *et al*. 2017, Poudel *et al*. 2018). Development of heat tolerant cultivars and adjustment in production system management has made high productivity possible, even in subtropical and warmer climates (Malhotra and Srivastava 2014).

The present study was carried out in a randomized block design with three replications at Potato Technology Center, Karnal, Haryana during winter (*rabi)* season of 2018–19 and 2019–20 for evaluating six elite clones of CIP for yield and early maturity. Six elite CIP genotypes (CIP302498.7, CIP392797.22, CIP304368.46, CIP304387.17, CIP396311.1, CIP397079.6) and four recommended CPRI varieties (K Sinduri, K Pukhraj, K Chipsona-1 and K Lima) were planted in third week of October. Plot size was 3.0 m × 2.4 m having 5 ridges spaced at 60 cm. The seed sized (35–50 g) tubers were planted at 20 cm distance from each other within each ridge. The recommended dose of fertilizers (180 N :80 P_2O_5 :100 K_2O kg/ha) as prescribed by Haryana Agriculture University, Hisar was applied. The entire dose of P_2O_5 and K_2O was given as basal whereas, nitrogen was given in two split doses, first as basal and second at 30 days after planting followed by earthing up. All the cultural practices were carried out as per the recommended package of practices. Data on vegetative growth, viz. germination per cent at 30 days after planting, plant height, number of haulms, plant vigour, plant habit at 60 days and senescence at 75 days after planting was recorded. Dehaulming was done at 75 days after planting to find out early maturing candidate varieties. Quantitative traits, viz. marketable, non-marketable, and total tuber yield at the time of harvesting were recorded in both the years, pooled and analyzed by using OPSTAT software designed and developed by Haryana Agricultural University, Hisar (Sheoran 1998).

Morphological characters of tuber: Detail of the physical characters of tubers such as skin and flesh colour, eye depth of different genotypes were recorded (Table 1). The tubers of most of the clones were oval in shape except CIP392797.22 (7008) and CIP304387.17 (7011) which had oblong tubers. Clones CIP392797.22 (7008), CIP396311.1 (7015) and variety K Sindhuri had red skin tubers however, rest of the clones were white in skin colour. The flesh colour of all the clones was yellow except CIP397079.6 (7017) which had white flesh. All the clones had shallow eyes which is one of the required criteria except K Sindhuri having deep eyed tubers. These characters are stable over the environments and therefore, might be governed by the genetic constitution of genotype. These are the distinctive quality parameters that influence consumer's choice (Pandey *et al*. 2000).

Growth and yield characters: The analysis of variance on potato genotypes (Table 2) revealed statistically significant differences among the genotypes for all the characters except germination per cent indicating prevalence of genetic variability under climatic conditions of the state. Wide variation was observed among the varieties in respect of plant height. The tallest (71.7 cm) plant was observed in the variety Kufri, Pukhraj and the shortest plants (35.0 cm) were observed in the clone CIP304387.17. The variation

[1]International Potato Center (CIP), NASC Complex, Indian Agricultural Research Institute Campus, New Delhi; [2]Potato Technology Center Shamgarh, Karnal, Haryana. *Corresponding author email: p.pandey@cgiar.org

Table 1 Morphological character of genotypes

Genotype	Tuber shape	Skin colour	Flesh colour	Eyes	Tuber size
CIP302498.7 (7003)	Oval	White	Yellow	Shallow	Medium
CIP392797.22 (7008)	Oblong	Red	Yellow	Shallow	Extra-large
CIP304368.46 (7010)	Round	White	Yellow	Shallow with pink colour	Large tubers
CIP304387.17 (7011)	Obong	White	Yellow	Shallow	Long large
CIP396311.1 (7015)	Oval	Red	Yellow	Shallow	Medium
CIP397079.6 (7017)	Oval	White	White	Shallow	Medium
K Pukhraj	Ovoid	White	White	Shallow	Medium
K Sindhuri	Round	Red	Cream	Deep	Medium
K Lima	Ovoid	White	Light yellow	Shallow medium	Large
K Chipsona-1	Ovoid	White	White	Shallow	Medium

in plant height among different potato genotypes may be due to the genetic and inherent character of the genotypes which is in accordance with the findings of Enujeke (2013) and Sadawarti *et al.* (2018). Similar variation in plant height of different genotypes were recorded in Hoogly, West Bengal (Das *et al.* 2014) and in other countries such as Iran (Mohammadi *et al.* 2010) and Nepal (Luitel *et al.* 2015). Significant differences were recorded among the varieties for number of haulms/plant. The highest number of haulms was recorded in clone CIP392797.22 (8) followed by K Chipsona-1 (7), K Lima (6) and K Pukhraj (6). Number of haulms per plant is affected by number of eyes per seed tuber as suggested by Arsenault *et al.* (2004). Pooled data over the years showed significant difference among genotypes for plant's vigour and plant habit. Both the characters were observed visually and rated in the scale of 1–5. Genotypes having dispersed plant habit ranked 1 and compact plant habit ranked 5. Pooled data related to plant habit indicates K Lima (5) and clone CIP396311.1 (4) showed compact type plant habit. However, clone CIP304387.17 showed dispersed growth. Similar variations in the plant's vigour were recorded by Hasan *et al.* (2013) under Bangladesh conditions. Another character senescence was also recorded on a scale of 1–5 which indicated very green to totally dry foliage. It was recorded at 75 days after planting. Genotypes having more senescence indicate early maturity. Pooled year data revealed maximum senescence with clone CIP392797.22 followed by K Chipsona-1. Mihovilovich *et al*. (2014) were of the view that leaf senescence is an indicator of tuber bulking cessation and maturity.

Statistical analysis of the pooled data (Table 2) revealed significant difference among different genotypes with respect to marketable, non-marketable and total tuber yield per hectare. Clone CIP392797.22 (30.9), K Pukhraj (26.5) and K Lima (25.9) recorded significant higher marketable tuber yield as compared to other genotypes. Highest non-

Table 2 Growth and tuber yield characters of different potato genotypes (Pooled over 2018–19 and 2019–20)

Clone	Germination (%)	Plant height (cm)	Number of haulms	Plant vigour	Plant habit	Senescence	Marketable tuber yield (tonnes/ha)	Non-marketable tuber yield (tonnes/ha)	Tuber yield (tonnes/ha)
CIP302498.7	98.30	38.0	4	3.0	3.3	2.7	19.4	3.1	22.5
CIP392797.22	91.13	49.0	8	2.7	3.0	4.0	30.9	4.0	34.9
CIP304368.46	93.90	47.3	4	3.0	3.3	2.3	22.6	2.9	25.5
CIP304387.17	90.53	35.0	3	2.3	3.7	2.7	19.9	2.9	22.7
CIP396311.1	91.67	48.7	4	3.3	4.0	2.0	22.1	2.7	24.8
CIP397079.6	88.90	48.3	3	3.3	2.7	2.0	19.1	1.8	20.8
K Sinduri	89.43	45.0	3	2.7	3.3	2.3	17.4	4.4	21.8
K Pukhraj	89.97	71.7	6	3.3	3.7	2.7	25.9	4.1	30.0
K Chipsona-1	95.00	58.3	7	2.7	2.7	3.3	17.0	3.8	20.7
K Lima	93.90	51.3	6	5.0	5.0	1.0	26.5	2.3	28.8
CD(P=0.05)	NS	10.3	3	1.1	1.0	1.0	5.8	0.8	5.8
SEm±	2.51	3.5	1	0.4	0.4	0.3	1.9	0.3	1.9
CV	4.71	12.1	1	20.2	17.5	23.5	15.1	15.2	13.2

Plant vigour: 1, less vigor; 2–3, intermediate; 5, vigorous; Plant habit: 1, disperse; 2–3, intermediate; 5, compact; Senescence: 1, totally green; 2–3, intermediate; and 5, totally dry.

marketable tuber yield per hectare was recorded in cultivar K Sindhuri (4.4 tonnes) followed by K Pukhraj (4.1 tonnes), clone CIP392797.22 (4 tonnes) and K Chipsona-1 (3.8 tonnes). Clone CIP392797.22 (34.9 tonnes/ha) gave highest tuber yield which was at par to K Pukhraj (30.0 tonnes/ha). Tuber yield depends upon number and weight of tubers. Both genetic and environmental factors play a vital role in stolon development and tuberization process (Dutt *et al*. 2017). These results are in agreement with the findings of Gebreselassie *et al.* (2016) and Preetham and Pavan (2018).

Based on both year's experiment, it was concluded that among all the genotypes, clone CIP392797.22 (7008) was found promising for subtropical regions of Haryana with the characters of early maturity, higher yield and attractive red colour. It may be recommended to the farmers to get additional profit by early market and increased crop intensity by taking an additional winter crop after potato.

SUMMARY

Research experiments were carried out with six promising potato clones of International Potato Center (CIP) compared with four recommended varieties of Central Potato Research Institute (CPRI) as checks with the objective to identify high yielding, short duration variety suitable for rice-wheat cropping system of subtropical region of Haryana. The trials were conducted at Potato Technology Center, Karnal during *rabi* season of two consecutive years, viz. 2018–19 and 2019–20 under Rastriya Krishi Vikas Yojna Project. The experiments were laid out in randomized block design with three replications. All the cultural practices were followed with scientific management. Dehaulming was done after 75 days of planting. Physical characters of tubers like skin colour, flesh colour, tuber shape and eye depth were observed. Data related to vegetative growth and yield was recorded, pooled and statistically analyzed. It was observed from the data that the maximum plant vigour was recorded in cultivar Kufri Lima however, highest marketable and total tuber yield was recorded in a red skinned CIP clone CIP392797.22. This variety might be selected as a candidate variety fit for rice-wheat cropping system.

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