

## Suitability of Elite Clones of Potato for Short Duration and Heat Tolerant Capabilities and their Characteristics

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### ABSTRACT

Collaborative studies were conducted at Potato Technology Centre, Shamgarh, Karnal, India and in different districts of Haryana during 2018-19 to identify suitable varieties for semi-arid, agro-ecology of Haryana. First experiment was conducted at Potato Technology Centre, Karnal during 2018-19 to evaluate the clones/ varieties at for short duration maturity possibilities. The treatments included seven clones of potato from CIP and five popular varieties CPRI. The experiment was laid out in randomized block design with three replications. Sowing was done on 24 October, 2018 at a spacing of 60 cm x 20 cm. Dehaulming of potato crop was done at 75 days after sowing (DAS). Second experiment was conducted with 7 most promising CIP clones along with five popular varieties of CPRI in five selected districts of Haryana (Karnal, Kurukshetra, Rohtak, Sirsa and Mahendergarh) was laid out to explore the location specific clones. The experiment was laid out in randomized block design with three replications at each location. Sowing was done in October, 2018 at Karnal, Kurukshetra and Rohtak, and in November, 2018 at Mahendergarh and Sirsa. Spacing was 60 cm x 20 cm. Dehaulming of potato crop was done at 90 DAS.

By dehaulming at 75 DAS, maximum tuber yield was recorded with Kufri Mohan (40.6 t/ha), followed by CP 4393 7008 and Kufri Khyati (31.6 t/ha), indicating their suitability for short duration maturity. When dehaulming of potato was done at 90 DAS, variety Kufri Mohan resulted in highest tuber yield and ranked one in Karnal, Kurukshetra and Sirsa (40.6-50.3 t/ha); Kufri Khyati in Mahendergarh (42 t/ha) and CP 4404 7015 in Rohtak (38.6 t/ha). The tuber yield of CP 4393 7008 and CP 4395 7010 was almost same in both the trials, indicating early maturity of these clones along with characteristics of late maturity. Highest dry matter (19%) was recorded in clones CP 4397 7011 and CP 4404 7015 with highest specific gravity (1.070) and total solid contents (19.2%), suggesting both the clones to be good as processing varieties. Characterization of elite clones of potato was also done.

**Keywords:** Potato, Clones, Varieties, Short duration,

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## INTRODUCTION

Potato is a major world food crop, next in production only to Maize, Rice & Wheat. In India potato is being cultivated on an area of 2.14 million ha with production of 51.3 million tons (IASRI, 2019), which is second only to China. Potato has wide flexibility in planting and harvesting time that help adjusting the crop in various intensive cropping systems without placing excessive pressure on scarce land and water resources. To meet the needs of the increasing population of the country, the production of potato in the country has to be increased to 122 million tons by 2050 and the productivity from 23 tons to 35 tons per hectare (CPRI, 2015). To meet this production target there are plenty of challenges ahead for India in general and Haryana in particular. These include seed potato production under climate change scenario, the development of climate smart cultivars for the changed climate and increase in productivity by making quality seed available to the farmers. Further, Haryana requires potato varieties of short duration, early heat tolerance and virus resistance, in order to fit in the rice-wheat crop system. The early harvest of short duration varieties would provide a productive window to produce an additional winter crop- such as wheat or cash crops (vegetables). The presently available short duration varieties have low storability due to high degeneration rate and poor keeping quality due to low dry matter. Hence, studies were initiated at Potato Technology Centre, Shamgarh, Karnal, India in collaboration with International Potato Centre (CIP), Central Potato Research Institute (CPRI) to identify suitable varieties for semi-arid, agro-ecology of Haryana for creating better income opportunities for the farmers. Genetic resources exchanged from CIP and CPRI were evaluated to develop improved short duration, early heat tolerant, salinity tolerant and virus resistant robust varieties to assist farmers in getting a remunerative price for their produce. Experiments were planned at PTC, Shamgarh with the objective to select robust, short duration, early heat tolerant and

virus resistant potato varieties for rice-wheat production systems; strengthen institutional capacity for quality seed production at farm-level and participatory multiple-environment selection of climate smart varieties.

## MATERIALS AND METHODS

Five districts namely Karnal, Kurukshetra (Potato growing belt) and Mahendergarh, Rohtak and Sirsa (non-potato growing belt) were selected for their suitability for seed potato production and growing of processing varieties. The clones from CIP were evaluated in the two experiments during 2018-19, the details of which are given below.

### *Experiment 1: Evaluation of potato clones dehaulmed at 75 days*

The experiment was conducted at PTC, Karnal during 2018-19 to evaluate the clones/ varieties at for short duration maturity possibilities. The treatments included seven clones of potato from CIP (CP 4388 7003, CP4393 7008, CP 4395 7010, CP 4397 7011, CP 4404 7015, CP 4406 7017, CP 4197 7019) and five popular varieties (Kufri Pukhraj, Kufri Khyati, Kufri Mohan, Kufri Chipsona 1, Kufri Lima) from CIPRI. The experiment was laid out in randomized block design with three replications. Sowing was done on 24 October, 2018 at a spacing of 60 cm x 20 cm. Whole tubers were used as seed for sowing. The plot size was 2.4 m x 3.0 m. Dehauling of potato crop was done at 75 days after sowing (DAS), and tubers were excavated 2 weeks after dehauling. The data on number of tubers, number of marketable tubers, tuber yield and marketable tuber yield were recorded from harvested plot area and converted to per hectare basis.

The dry matter (%), specific gravity (g/cc) and total solid content (%) of CIP clones was done through Goodrich Factory from Karnal for the Karnal harvested samples in year 2018-19, for characterization of the clones.

### *Experiment 2. Evaluation of potato clones dehaulmed at 90 DAS*

The trial with 7 most promising CIP clones (CP 4388 7003, CP 4393 7008, CP 4395 7010,

CP 4397 7011, CP 4404 7015, CP 4406 7017, CP 4197 7019) along with five popular varieties of CPRI (Kufri Pukhraj, Kufri Khyati, Kufri Mohan, Kufri Chipsona 1, Kufri Lima) at five selected districts of Haryana (Karnal, Kurukshetra, Rohtak, Sirsa and Mahendergarh) was laid out to explore the location specific clones.

The experiment was laid out in randomized block design with three replications at each location. Sowing was done in October, 2018 at Karnal, Kurukshetra and Rohtak, and in November, 2018 at Mahendergarh and Sirsa due to conditions of high temperature and sandy soils in these districts. Spacing was 60 cm x 20 cm with use of whole tubers as seed. The gross plot size was 2.4 m x 3.0 m. Dehaulming of potato crop was done at 90 DAS, and tubers were excavated 2 weeks after dehaulming. The data on number of tubers, number of marketable tubers, tuber yield and marketable tuber yield were recorded from net plot area and concerted to per hectare basis.

The data were subjected to the analysis of variance (ANOVA). The significant treatment effect was judged with the help of 'F' test at the 5% level of significance, and the significant treatment effect was judged with the help of 'F' test at the 5% level of significance (Cochran & Cox, 1957).

## RESULTS AND DISCUSSION

### *Experiment 1: Evaluation of potato clones dehaulmed at 75 days*

By dehaulming at 75 DAS, maximum tuber yield was recorded with Kufri Mohan (40.6 t/ha), followed by CP 4393 7008 (31.6 Mt/ha) and Kufri Khyati (31.6 t/ha) in succession (Table 1). This indicated their suitability for short duration maturity. Among the above clones/ varieties, the number of tubers/ha were highest in clone CP 4393 7008 (525/ha), indicating smaller tuber size which is a desirable character. The lowest tuber yield was recorded with Kufri Chipsona-1 indicating its long duration maturity. The highest marketable yield was recorded under Kufri Mohan (40.3

t/ha) and CP 4393 7008 (35.0 t/ha). The number of marketable tubers were highest in Kufri Mohan (428.7/ha), CP 4395 7010 (400/ha), Kufri Pukhraj (382.3/ha) and CP 4393 7008 (374/ha). The results indicated suitability of new clone CP 4393 7008 along with variety Kufri Mohan in terms of marketable and total number of tubers and tuber yield.

### *Experiment 2. Evaluation of potato clones dehaulmed at 90 DAS*

When dehaulming of potato was done at 90 DAS, variety Kufri Mohan resulted in highest tuber yield and ranked one in Karnal, Kurukshetra and Sirsa (40.6-50.3 t/ha); Kufri Khyati in Mahendergarh (42 t/ha) and CP 4404 7015 in Rohtak (38.6 t/ha) (Table 2). Second rank was attained by Kufri Lima in Karnal (45.9 t/ha), CP 4388 7003 in Kurukshetra (47 t/ha) and Mahendergarh (41 t/ha), CP 4393 7008 in Sirsa (39.8 t/ha) and CP 4397 7011 in Rohtak (33.9 t/ha). Kufri Khyati, Kufri Lima, CP 4395 7010 and Kufri Mohan were at third rank in terms of tuber yield in Karnal, Kurukshetra, Sirsa, and Mahendergarh & Rohtak districts. Overall, Kufri Mohan gave highest tuber yield (41.9 t/ha) followed by Kufri Lima (40.2 t/ha) and CP 4388 7003 (36.9 t/ha) based on means of districts in which these clones/ varieties were grown. This indicated suitability of Kufri Mohan, Kufri Khyati, Kufri Lima for long duration maturity among varieties. Among elite clones, CP 4388 7003, CP 4393 7008, CP 4397 7011 and CP 4404 7015 showed suitability for long duration maturity.

The results are in agreement with other researchers that tuber yield varies with variety, location and genotypes x environment interaction (Pandey et al. 2004; Kumar et al., 2007; Elfinesh, 2008; Gebreselassie et al., 2016; Preetham et al., 2018).

### *Comparison of 75- and 90-days dehaulmed potato*

The tuber yield of CP 4393 7008 and CP 4395 7010 was almost same in both the trials, indicating early maturity of these clones along with characteristics of late maturity (Fig. 1). However, the short duration popular variety

Kufri Pukhraj showed increase in the yield by late dehauling including Kufri Mohan to be suitable as late maturity cultivar. Therefore, these two clones CP 4393 7008 and CP 4395 7010 could be suitable candidates for short duration maturity situations.

#### **Dry matter accumulation and physical properties of potato clones**

Highest dry matter (19%) was recorded in two clones CP 4397 7011 and CP

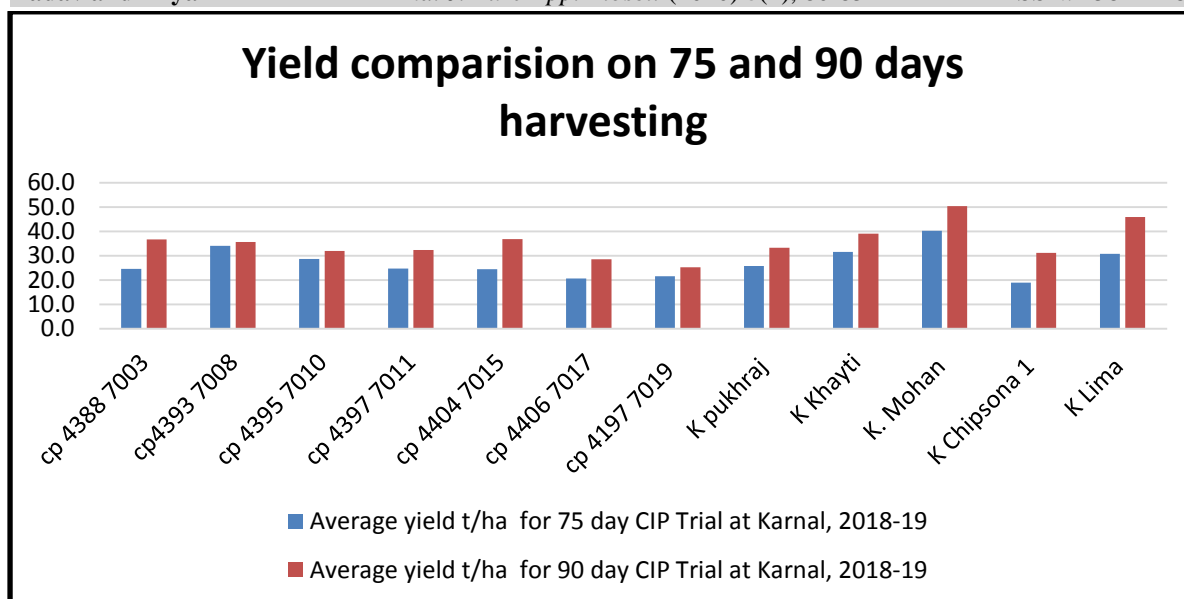
4404 7015 which had highest specific gravity (1.070) and total solid contents (19.2%) (Table 3). It suggested that both the clones were good as processing varieties. Other physical properties of different elite clones of potato are given in Table 4, which could guide in selection of these clones for need based specific purpose.

**Table 1: Performance of potato clones and varieties dehaulked at 75 DAS at PTC, Karnal (2018-19)**

Potato clones	Tuber yield (t/ha)	Number of tubers/H ha	Marketable tuber yield (t/ha)	Number of marketable tubers/ha
CP 4388 7003	24.6	468.7	23.1	296.0
CP 4393 7008	36.8	525.0	35.0	374.0
CP 4395 7010	28.7	536.0	27.1	400.0
CP 4397 7011	24.7	439.0	23.2	306.3
CP 4404 7015	24.4	351.0	22.9	236.0
CP 4406 7017	21.9	348.0	20.7	173.0
CP 4197 7019	21.5	395.0	21.4	211.0
Kufri Pukhraj	29.8	496.0	25.8	382.3
Kufri Khyati	31.6	442.0	29.9	344.3
Kufri Mohan	40.6	443.7	40.3	428.7
Kufri Chipsona 1	19.0	362.7	17.3	253.7
Kufri Lima	30.8	394.3	29.2	283.7
C.D. at 5%	3.9	57.3	6.1	96.1

**Table 2: Tuber yield (t/Ha) of potato dehaulked at 90 DAS at different locations in Haryana (2018-19)**

Clone/Variety	Karnal	Kurukshetra	Sirsa	Mahendergarh
CP 4388 7003	36.7	47.0	31.5	41.0
CP 4393 7008	35.6	39.3	39.8	37.3
CP 4395 7010	32.0	32.3	35.0	31.8
CP 4397 7011	32.4	35.6	28.8	24.9
CP 4404 7015	36.8	41.7	31.3	28.4
CP 4406 7017	28.5	41.5	28.6	23.9
CP 4197 7019	25.3	31.0	-	-
Kufri Pukhraj	33.3	40.3	-	37.3
Kufri Khyati	39.1	34.5	-	42.0
Kufri Mohan	50.3	47.6	40.6	38.9
Kufri Chipsona 1	31.2	28.9	-	29.3
Kufri Lima	45.9	46.2	28.6	-
C.D. at 5%	5.5	8.3	4.0	7.9



**Figure 1: Yield comparison on 75- and 90-day dehauling of potato at PTC, Karnal to assess the early maturing clones (2018-19)**

**Table 3: Dry Matter parameters of elite clones of potato grown at PTC, Karnal (2018-19)**

Clones	Specific gravity (g/cc)	Total solid content (%)	Dry Matter (%)
CP 4388 7003	1.064	18.2	18.6
CP 4393 7008	1.064	18.2	18.5
CP 4395 7010	1.064	18.2	18.5
CP 4397 7011	1.070	19.2	19.0
CP 4404 7015	1.070	19.2	19.0
CP 4406 7017	1.058	17.0	17.1

**Table 4: Physical characteristics of elite clones of potato (2018-19)**

Clones	Vigor	Senescence	Plant morphology	Tuber Shape	Skin Colour	Flesh colour	Overall Rating	Eyes	Tuber size	General observation on yield
CP 4388 7003	4	1	Tuberosum type-spreading	Oval	Yellow	Yellow	4	Fleet	Medium	Medium
CP 4393 7008	5	1	Tuberosum type	Oblong	Red	Yellow	5	Fleet	Extra-large	High
CP 4395 7010	5	1	Tuberosum type, broad leaf	Oval	Yellow	Yellow	5	Fleet picked	Large tubers	Very good
CP 4397 7011	5	1	Tuberosum type, green	Long	Yellow	Yellow	5	Fleet	Long - large	Excellent
CP 4404 7015	5	1	Tuberosum, red tuber	Oval	Red	Yellow	4	Fleet	Medium	Medium
CP 4406 7017	4	1	Tuberosum type, good growth	Oval	Yellow	White	4	Fleet	Medium	Less
CP 4197 7019	5	1	Tuberosum type	Oval	White	White	5	Fleet	Medium	Good

## CONCLUSION

Among varieties Kufri Mohan and Kufri Khyati were found suitable for early maturity and among the new elite clones CP 4393 7008 and CP 4395 7010 were found suitable for short duration maturity. Farmers could invest their earnings into a second winter harvest, helping them to improve the overall productivity of the cropping system. The clones (CP 4397 7011, CP 4404 7015) having higher dry matter and low sugar content were suitable for processing. Thus new elite clones of potato could help in increasing farmers' income.

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