Current Horticulture **11**(1): 22–25, January–April 2023

Introduction of potato *(Solanum tuberosum)* in hot arid region of north-western Rajasthan

M K Jatav[1], P L Saroj[2], S K Chakarbarti[3] and V K Dua[4]

https://doi.org/10.5958/2455-7560.2023.00004.3

ICAR-Central Institute for Arid Horticulture, Bikaner 334 006, Rajasthan, India

Received: 17 December 2020; **Accepted:** 15 January 2022

ABSTRACT

The experiment was conducted at ICAR-CIAH, Bikaner, (Rajasthan) to assess the performance of potato *(Solanum tuberosum)* cultivars in hot arid region during 2015-16 and 2016-17. Potato cultivars Kufri Khyati, Kufri Garima, Kufri Chipsona4, Kufri Pukhraj, Kufri Frysona, Kufri Surya and Kufri Jyoti, were grown under sprinkler and drip irrigation system with recommended management practices. Under sprinkler irrigation, Kufri Chipsona 4 gave highest yield (534.8 q/ha), followed by Kufri Frysona (479.7 q/ha) and Kufri Jyoti (465.1 q/ha), Kufri Garima (430.9 q/ha), Kufri Surya (398.6 q/ha) and Kufri Khyati (387.6 q/ha), while minimum yield was observed in Kufri Pukhraj (338.9 q/ha). In drip irrigation, Kufri Frysona gave highest yield (435.37 q/ha), followed by Kufri Chipsona4 (428.67 q/ha), Kufri Garima (374.45 q/ha) and Kufri Jyoti (344.58 q/ha) Kufri Pukhraj (203.99 q/ha). The tuber yield of all varieties was also classified into large (>75 g), medium (25-75 g) and small (<25 g) categories under both irrigation systems. On an average, >71.40% tubers were under large-sized category. Similarly, dry matter content was highest (22.22%) in Kufri Frysona and minimum in Kufri Khayati (15.09%) at 90 days of harvesting. The appearance of the tuber though varies with variety but it was very shining golden yellowish and was better than its recommended areas of Indo-gangetic plains. Based on tuber yield, size of tubers, dry matter content and appearance of tubers; it is recommended that Kufri Chipsona 4 and Kufri Frysona are suitable for processing types, while Kufri Garima and Kufri Jyoti as table types for cultivation under sprinkler system in hot arid region of Rajasthan.

Key Words: Agronomic-use efficiency (AUE), Net returns, Tuber yield, Hot arid region

Potato (*Solanum tuberosum* L.) plays a vital role in food security the world over. Considering more or less stagnant cultivable land and impending food insecurity threat in our country, increasing productivity and bringing additional area under potato cultivation is the need of the hour. Besides, tuber crops are used for food, medicines and raw materials for starch-based industries (Neducnchezhiyan *et al.*, 2022). The domestic demand of potato alone will be around 125 million tonnes (Paul *et al.* 2022). The main reasons of non-adoption of potato in hot arid region are; sandy soils with poor fertility and subjected to wind erosion, very low (average of about 213 mm/annum) and erratic rainfall, extremes of temperature and frost during winter, poor water resource, lack of situation specific knowledge about scientific cultivation of potato etc. Though, metrological database and ICAR-CPRI, Shimla, simulation models have indicated that western Rajasthan has good potential for potato cultivation. Therefore, there is a need to venture non-traditional areas like hot arid zone under potato cultivation through better scientific management.

*Corresponding author : mkjatav2008@gmail.com

MATERIALS AND METHODS

The experiment was conducted at Experimental Farm of ICAR-CIAH, Bikaner (Rajasthan) in collaboration with ICAR-CPRI, Shimla (Himachal Pradesh) to assess the performance of potato cultivars for processing as well as for table purpose, during 2015-16 and 2016-17. The surface soil samples taken before planting of potato crop were analyzed for their physico-chemical properties employing standard analytical techniques. The soil of experimental field was sandy in texture with low organic carbon (0.1%), pH (7.70), available N (90 kg/ha), available P (11.5 kg/ha) and available K (297.4 kg/ha). The climatic parameters were also recorded. The experiment was laid out in factorial randomized block design and

replicated six times. The analysis of variance was done based on pooled data.

The healthy seeds of seven potato cultivars, *viz.* Kufri Khyati, Kufri Garima, Kufri Chipsona4, Kufri Pukhraj, Kufri Frysona, Kufri Surya and Kufri Jyoti, were procured from ICAR-CPRI, Shimla. Well sprouted potato seed tubers were planted in second week of November during both years under sprinkler and drip irrigation systems with recommended package of practices. One-third of N was applied through neem, coated urea and DAP in side-band along with a uniform dose of 80 kg P_2O_5 through di-ammonium phosphate and 100 kg / ha K_2O through muriate of potash during planting time, while one-third of N was applied through neem-coated urea 35 days after planting, *i.e.* at the time of earthing up and the remaining one-third N through neem-coated urea 50 days after planting, *i.e.* at the time of bulking stage.

The haulms were cut at 100 days and harvesting of tubers was done 15 days later. Irrigation was applied through on line drippers and low height sprinklers at weekly intervals before crop enters into wilting stage. The observation on plant height, number of branches / plant and number of compound leaves / plant at 45 and 75 days were recorded. The yield and yield-attributing characters of tubers were recorded after harvesting, while dry-matter content was recorded at 90 days. Tubers after final harvesting were also classified into, large, medium and small-sizes of tubers. The economics of potato cultivation was recorded based on prevailing rates of inputs and output in local market.

RESULTS AND DISCUSSION

The plant height, number of branches / plant and number of compound leaves / plant for all varieties grown under sprinkler and drip system was recorded at 45 and 75 days after planting. The data indicated that as days of planting advances from 45 to 75 days, vegetative growth increased irrespective of variety. There was wide variation in mean plant height of potato varieties under sprinkler and drip irrigation. The mean plant height at 75 days after planting under sprinkler was 60.38 cm, while it was only 43.46 cm under drip irrigation. Meanwhile, number of branches and number of compound leaves / plant were slightly higher under drip system compared to sprinkler system of irrigation. Thereby, dwarf and bushy plant growth were observed in drip and sprinkler systems,

Maximum plant height (80.80) was recorded 75 days after planting in Kufri Chipsona 4, followed by Kufri Frysona (67.60 cm), Kufri Surya (60.00 cm), Kufri Khyati (58.40 cm), Kufari Pukhraj (57.06 cm), while minmum in Kufri Garima (43.00 cm) under sprinkler system. Similarly, under drip system also maximum plant height (61.58 cm), was recorded 75 days after planting in Kufri Chipsona4, followed by Kufri Frysona (55.29 cm), Kufri Surya (46.58 cm), Kufri Jyoti (42.21 cm), Kufari Pukhraj (35.94 cm), Kufri Khyati (32.32 cm), and minmum in Kufri Garima (30.32 cm). Kufri Chipsona 4 was vigorous type, while Kufri Garima was comparatively dwarf type. However, number of branches and number of compound leaves / plant did not follow the same trend, which is obvious that these variations are due to their genetic nature.

The mean tuber yield / plant was 11.74q / ha irrespective of cultivars, though tuber yield / plant varied significantly, highest tubers / plant being in Kufri Chipsona 4 (14.57), followed by Kufri Frysona (13.45), Kufri Jyoti (12.13) lowest (Table 1) in Kufri Pukhraj (8.74). More than 62 g of tubers were obtained in all cultivars except Kufti Khyati (57.64 g). The main reason of higher number of tuber in microirrigation was the capacity of a genotype to use / absorb more nutrients per unit from soil, *i.e.* ability of root system of a genotype to acquire more nutrients from soil. The highest weight of tubers was recorded in Kufri Garima (72.42 g), followed by Kufri Pukhraj (67.87 g), Kufri Jyoti (67.12 g) and Kufri Chipsona 4 (64.23 g). The highest length of tuber was recorded in Kufri Pukhraj (4.44 cm), followed by Kufri Surya (4.43 cm), Kufri Frysona (4.37 cm) and Kufri Chipsona 4 (4.35 cm). The significantly lowest length of tubers was recorded in Kufri Jyoti (3.52 cm). Maximum tuber width (3.55 cm) was recorded in Kufri Chipsona4, followed by Kufri Pukhraj (3.35 cm) and Kufri Surya (2.32 cm).

Difference in tuber yield obtained under micro sprinkler and drip irrigation systems was higher than furrow irrigation. The higher yield in micro sprinkler and drip irrigation systems might be due to that frequent watering resulted into higher water potential, minimizing fluctuation in soil moisture in effective root zone, which holds promise to increase crop yield. Better crop performance under micro sprinkler could be attributed to minimum influence of frost, white fly and nutrient leaching; besides micro sprinkler irrigation might have created better microclimate, which facilitated better photosynthesis, root aeration and plant growth. Further, during tuberization (in December) minimum temperature was as low as 5-12°C for few days. Micro sprinkler irrigation system might have protected the crop from adverse effect of low temperature by sprinkling water droplets on leaves which, helped in better growth, early maturity and higher yield as compared to traditional method.

The tuber yield was classified into three grades, *viz.* small- sized tubers (< 25 g), medium -sized tubers (25-75 g) and large- sized tubers (> 75 g). For better understanding, grading was done both for 1000 tubers

Table 1. Grade-wise tuber yield of potato varieties under sprinkler and drip irrigation systems

Variety	Sprinkler system						Drip system					
	Yield (q/ha)			No. of tubers (000)			Yield (q/ha)			No. of tubers (000)		
	Small (<25 g)	Medium (25-75 g)	Large (>75 g)	Small (<25 g)	Medium (25-75 g)	Large (>75 g)	Small (<25 g)	Medium (25-75 g)	Large (>75 g)	Small (<25 g)	Medium (25-75 g)	Large (>75 g)
Kufri Khyati	21.3 (5.50)*	68.0 (17.54)	298.3 (76.96)	194 (28.84)	124 (18.37)	355 (52.78)	25.39 (7.62)	82.19 (24.66)	225.76 (67.73)	107 (22.24)	118 (24.44)	257 (53.41)
Kufri Garima	27.8 (6.45)	75.2 (17.45)	327.9 (76.10)	158 (26.55)	147 (24.71)	290 (48.74)	16.70 (5.15)	102.76 (31.67)	204.99 (63.18)	128 (24.59)	185 (35.58)	207 (39.83)
Kufri Chipsona 4	34.2 (6.40)	93.3 (17.45)	407.2 (76.15)	156 (18.74)	144 (17.33)	532 (63.93)	45.18 (10.54)	74.31 (17.34)	309.17 (72.12)	240 (55.60)	118 (27.39)	250 (57.82)
Kufri Pukhraj	26.8 (7.90)	82.5 (24.35)	229.6 (67.75)	126 (25.29)	132 (26.46)	241 (48.25)	11.78 (5.78)	65.28 (32.00)	126.92 (62.22)	66 (18.16)	142 (39.17)	155 (42.66)
Kufri Frysona	35.4 (7.38)	146.1 (30.46)	298.2 (62.16)	186 (24.16)	228 (29.68)	355 (46.16)	15.18 (3.49)	72.07 (16.55)	348.12 (79.96)	161 (26.53)	141 (23.24)	305 (50.26)
Kufri Surya	27.9 (7.00)	112.3 (28.17)	258.4 (64.83)	180 (28.24)	177 (27.78)	280 (43.99)	5.41 (1.59)	92.63 (27.16)	243.02 (71.25)	31 (8.07)	127 (32.76)	230 (59.17)
Kufri Jyoti	25.4 (5.46)	86.9 (18.69)	352.8 (75.86)	141 (20.31)	145 (20.86)	408 (58.83)	16.23 (4.70)	116.60 (33.78)	212.35 (61.52)	91 (19.60)	175 (37.96)	196 (42.44)
Mean	28.4	94.9	310.3	154.1	157.3	381	19.41	86.55	238.62	117.6	143.82	228.48
SEm (±)	1.47	5.87	16.53	7.54	7.88	19.78	0.92	4.38	11.83	5.92	7.13	11.49
CD (p=0.05)	4.68	17.78	49.47	23	24	57	2.91	12.98	35.79	17.65	21.57	34.27

*Values in parentheses are in percentage

Table 2. Yield and yield-attributing characters of potato varieties under sprinkler and drip irrigation systems

Variety	Sprinkler system						Drip system					
	No. of tubers/ plant	Av. Wt. of tuber (g)	Av. length of tuber (cm)	Av. width of tuber (cm)	Tuber yield/plant (g)	Tuber yield (q/ha)	No. of tubers/ plant	Av. Wt. of tuber (g)	Av. length of tuber (cm)	Av. width of tuber (cm)	Tuber yield/plant (g)	Tuber yield (q/ha)
Kufri Khyati	11.77	57.64	3.54	2.42	678.4	387.6	7.04	69.27	3.68	2.54	487.3	333.34
Kufri Garima	10.41	72.42	3.67	2.91	754.1	430.9	7.61	62.35	3.86	3.05	474.3	324.45
Kufri Chipsona4	14.57	64.23	4.35	3.55	935.8	534.8	6.31	99.30	4.52	3.72	626.7	428.67
Kufri Pukhraj	8.74	67.87	4.44	3.35	593.0	338.9	5.31	56.22	4.60	3.55	298.2	203.99
Kufri Frysona	13.45	62.40	4.37	2.51	839.5	479.7	8.87	71.75	4.54	2.67	636.5	435.37
Kufri Surya	11.14	62.62	4.43	2.32	697.6	398.6	5.67	87.92	4.69	2.54	498.6	341.06
Kufri Jyoti	12.13	67.12	3.52	2.72	813.9	465.1	6.76	74.67	3.65	2.83	504.7	345.18
Mean	11.74	62.66	4.05	2.83	758.9	433.7	6.79	74.15	4.22	2.99	503.8	344.58
SEm (±)	0.51	2.48	0.22	0.24	37.89	21.35	037	24.79	0.25	0.17	25.18	17.27
CD (p=0.05)	1.76	7.56	0.81	0.57	113.8	63.71	1.02	74.15	0.63	0.45	75.6	51.69

and total yield and also expressed in percentage for all cultivars grown under both systems. The yield under large- sized tuber was more than medium- sized and small - sized tubers. Mean data of tuber yield shown that out of total yield / ha (433.7 q), large sized tubers were 310.3 q, medium-size 94.4 q and small size were only 28.4 q under sprinkler system (Table 2). Whereas, under drip system, out of total yield / ha (344.58 q), large- sized tuber were (238.62 q), medium-size (86.55 q) and small-size was only 9.41 q. The grading distribution on percentage basis ranges from 62.16 to 76.16%, 17.45 to 30.46% and 5.46 to 7.9% as large, medium and small categories respectively under sprinkler system.

Similarly, under drip system, percentage of tuber grades ranges from 61.52 to 79.96%, 16.55 to 33.78% and 3.49 to 10.54% as large, medium and small categories respectively. The number of tubers in small grade category was some time either equal or higher than medium grade category but always less than large category irrespective of cultivars under both irrigation systems. Thereby yield (q / ha) in a specific grade is more reliable parameters than number of tubers. Overall, large to medium size grade tubers were produced under irrigated conditions, which is good indication for realizing higher return under hot arid region.

The flesh colour of Kufri Khyati and Kufri Pukhraj was cream, Kufri Frysona and Kufri Jyoti white and Kufri Garima whitish cream and Kufri Surya light yellow colour in both irrigation systems. As far as number of eyes / tuber is concerned, maximum number of eyes was recorded in Kufri Garima, *i.e.* 10.25 and 11.05, followed by Kufri Surya 8.92 and 9.15 and Kufri Pukhraj 8.

The dry-matter content of tubers was slightly higher in drip system of irrigation than sprinkler system of irrigation, probably due to high dry- matter accumulation in tubers under drip system the wetting zone in drip system was confined. The cultivar-wise dry-matter content varied significantly giving highest dry-matter in Kufri Frysona (22.22% and 22.58%), followed by Kufri Chipsona4 (20.54% and 21.56%) in sprinkler and drip system of irrigation respectively 90 days after planting. This further increased with advancing date of harvesting. Both cultivars (Kufri Chipsona 4 and Kufri Frysona) qualify the requisite value of dry-matter content for processing. Other cultivars also possess good amount of dry-matter content (15.09% to 18.78%) 90 days after planting. In general, Kufri Khyati has given lowest dry-matter content (15.09% and 15.79%) under both sprinkler and drip irrigation system respectively.

The highest net return was obtained by cultivation of Kufri Chipsona 4 under sprinkler system (₹ 1,17,664 / ha), followed by Kufri Frysona (₹ 98,403 / ha) and Kufri Jyoti (₹ 93,271 / ha) and minimum Kufri Khyati (₹ 66,172 / ha). Whereas, under drip system, highest net return was obtained by Kufri Frysona (₹ 82878 / ha), followed by Kufri Chipsona 4 (₹ 80,536 / ha) and Kufri Khyati (₹ 47,149 / ha). The highest B:C ratio was recorded in Kufri Chipsona 4 (2.69), followed by Kufri Fysona (2.42), under sprinkler system and Kufri Frysona (2.19), followed by Kufri Chipsona 4 (2.16) under drip irrigation system. The economic analysis of data reveals that potato cultivation under hot arid ecosystem is economically viable.

CONCLUSION

Thus it can be concluded that there is a good scope for cultivation of potato cultivars like Kufri Chipsona 4 and Kufri Frysona in hot arid region of north-western Rajasthan. These cultivars are most efficient in resource-poor conditions. The western Rajasthan is also most suitable area for establishment of processing units.

REFERENCES

Kushwah V S and Singh S P 2011. Relative performance of low input and high input technology for potato production in India. *Potato Journal* **38**(1): 56-60

Nedunchezhiyan, M., Suja, G. and Ravi, V. 2022. Tropical root-and tuber crops-based cropping systems - a review. *Current Horticulture* **10**(1): 14-22, 2022.

Paul, Vijay, Buckseth, Tanuja, Singh, Rajesh Kumar, Ravichandran, G., Lal, Milan Kumar, Singh, Brajesh and Tiwari, Jagesh K. 2022. Alternative methods of seed potato *(Solanum tuberosum)* production: Indian perspective - a review. *Current Horticulture* **10**(2): 3-11, 2022.

Rajesh K. 2011. The Indian Potato Processing Industry-Global comparison and business prospects. *Outlook on Agriculture (UK)* **40**: 237-243.

Satyendra Kumar, Ram Asrey, G Mandal and Rajbir singh Microsprinkler. 2009. Drip and furrow irrigation for potato Solanum tuberosum) cultivation in a semi-arid environment. *Indian Journal of Agricultural Sciences* **79**(3): 165-9.

Scott G J and Suarez V 2011. Growth rates for potato in India and their implications for industry. *Potato Journal* **36**(3-4): 121-35.

Scott G J and Suarez V. 2012 the rise of asia as the centre of global potato production and some implications for industry. *Potato Journal* **39**(3-4): 1-22

Singh, B P and Rajesh K Rana. 2012. Indian potato processing sector: analysis and prospects. *In: Agriculture Today-Year Book-20.* **12**: 58-61.

Singh B P and Rajesh K Rana. 2013. Potato for food and nutritional security in India. *Indian Farming* **63**: 37-43.

Singh B P, Rajesh K Rana and M Kumar. 2011. Technology infusion through contact farming: success story of potato. *Indian Horticulture* **56**: 49-51.

Thiele G, K Theisen, M Bonierbale and T Walker 2010. Targeting the poor and hungry with potato science. *Potato Journal* **37**(3-4): 75-86.