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Suitable potato cultivars in non-traditional areas of north-western Rajasthan of India

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Abstract

Studies were conducted during 2015-17 at ICAR-Central Institute for Arid Horticulture, Bikaner in collaboration with ICAR-Central Potato Research Institute, Shimla to find out suitable potato cultivars for processing as well as for table purpose under North Western Rajasthan. Seven potato cultivars (Kufri Khyati, Kufri Garima, Kufri Chipsona-4, Kufri Pukhraj, Kufri Frysona, Kufri Surya and Kufri Jyoti) were raised under sprinkler irrigation as well as drip. Tuber yield varied significantly from variety to variety under both irrigation systems. Under sprinkler irrigation, Kufri Chipsona-4 gave higher yield (53.5 q/ ha) followed by Kufri Frysona (48.00 t/ ha) and Kufri Jyoti (46.5 t/ ha) while minimum yield was observed in Kufri Pukhraj (33.9 t/ ha) and Kufri Khyati (38.8 t/ ha). Kufri Garima and Kufri Surya gave intermediate yields (43.0 and 39.9 t/ ha), respectively. However, under drip irrigation, Kufri Frysona gave higher yield (43.5 t/ ha) followed by Kufri Chipsona-4 (42.9 t/ ha) and Kufri Garima (37.5 t/ ha) and minimum yield was observed in Kufri Pukhraj (20. 0 t/ ha). Kufri Frisona gave higher medium sized tuber yield (14.6 t/ ha) followed by Kufri Surya (11.2 t/ ha) and Kufri Chipsona-4 (9.30 t/ ha) under sprinkler irrigation while, under drip irrigation Kufri Jyoti produced the highest medium sized tuber yield (11.7 t/ ha) as compared to other. Thus, processing varieties Kufri Chipsona-4 and Kufri Frysona were found suitable and proved to possess high dry matter content and were the most efficient varieties in the arid region while for table purpose Kufri Garima and Kufri were found suitable for processing and table purpose, for cultivation in north western Rajasthan

Key words: Arid region, *Bikaner,* gronomic use efficiency, nitrogen, potato, yield, varieties

Introduction

India is the second largest potato producer in the world after China (FAOSTAT 2013). Potato is one of the most important food security crops in the country (Thiele et al. 2010; Singh and Rana 2013) and it plays a vital role in food security for ever increasing world population (Thiele *et al*., 2010**;** Scott and Sourez, 2011**;** Scott and Sourez, 2012). Presently, India is producing about 45-48 million tonnes of potato annually from about 2 million hectare of area The demand for potato has considerably increased during the last decade in India in response to economic development (Singh et al. 2014) and rapid growth of the processing industry (Keijbets 2008; Rana et al. 2010). Actually, 80% of potato is still grown in the Indo-Gangetic Plains in India during *rabi* (winter) season (Minhas et al. 2011) with more than half of the production being concentrated in the states of Uttar Pradesh and West Bengal. At present in India, about 68% of potato production is consumed as fresh while the rest is utilized as seed (8.5%) and processing purposes (7.5%) or the remaining goes as waste (16%) due to various reasons that includes rotting and wastage during the entire potato supply chain (Rana, 2015: Singh *et al.*, 2011, Singh and Rana, 2012 and Singh and Rana, 2013).

In Rajasthan, potato is supplied for consumption from neighbouring states like Punjab and Uttar Pradesh. The cold stored potato in North India, when transported to distant states in the western Rajasthan, undergoes serious quality deterioration. Augmentation of local potato supply is consequently the best way of facing the increase in demand and reducing the consumer price in the western Rajasthan. India aims to produce 125 million tonnes potatoes from 3.6 million hectare area in 2050 for ensuring food security (Singh *et al.* 2014). However, it is possible only if the cultivars of potato are extended to non-traditional areas. Rajasthan in general and Bikaner district in particular are dominated by the hot arid climate. The state in general and the study area in particular are not known for potato cultivation (Rana et al., 2017).

ICAR-CIAH, Bikaner and ICAR-Central Potato Research Institute for past three years have made a systematic effort to introduce potato crop in the *Thar* deserts of Rajasthan by identifying locally adapted suitable varieties, which can produce economic yield under arid region. The south-west part of Rajasthan falls under arid region and known for

groundnut, pulse in *kharif* and wheat mustard, methi growing belt owing to well developed canal irrigation network. Agriculture of this region is completely dependent on canal water supply because groundwater is saline. In last few years, decline in water availability and irregular canal water supply associated with various pest problems caused reduction in their yield and subsequently farm income. Farmers are bound to shift to some other remunerative crops. Potato cultivation would be a possible alternate to increase the farm income, if efficient and reliable irrigation management strategies are adopted to maintain optimum moisture in the effective root zone. It can be achieved best with the use of modern irrigation system coupled with suitable irrigation scheduling under limited water resources, particularly in arid region.

Micro-irrigation (drip and sprinkler) is available with the farmer of Bikaner district which enables high frequency application of water in and around root zone of the plants (Arya et al, 2016 and Kumar et al., 2009). Potato has a sparse and shallow root system and nearly 70% of total water is used by the crop from upper 30 cm soil layer. It requires 400-600 mm of irrigation water depending on climatic conditions, soil type, length of growing season, duration of variety, purpose of crop and methods of irrigation etc. These micro-irrigation methods of irrigation/fertigation economise on water (about 30-50% saving) at the same time giving 15-30 higher yield with upto 25% saving on fertilizers.

Potato is not a new crop for the state of Rajasthan but mostly confined to the areas with better soil and good rainfall conditions like; Kota, Dholpur, Bharatpur, Sirohi, Jhalawar and Sri Ganganagar districts. As per the information available with us there is very negligible area under potato in western part of Rajasthan including Bikaner. The metrological database and ICAR-CPRI Simulation models have that Western Rajasthan has a good area suitable for potato cultivation. Area and production of groundnut in Bikaner district is 75626 ha and 135336 tonnes, respectively which was 22.52 and 25.49% area and production under Bikaner district of Rajasthan. Water requirement of groundnut and potato is almost same (400-700 mm) to meet the demands of metabolic activities of plants, evaporation and transpiration. Therefore, suitable potato varieties can be grown very well in Western Rajasthan.

In order to increase the area under potato, there is need to venture into non-traditional areas like hot arid zone under potato cultivation through better scientific management as per edaphoclimatic conditions. Keeping above facts in view, at attempt was made to assess the performance of potato varieties at ICAR-Central Institute for Arid Horticulture, Bikaner (Rajasthan) in collaboration with ICAR-Central Potato Research Institute, Shimla (Himachal Pradesh) to find out production potential of the popular and new potato varieties and their performance under different irrigation methods in North Western Rajasthan.

Materials and Methods

An investigation was carried out at Experimental Farm of ICAR-Central Institute for Arid Horticulture, Bikaner (Rajasthan) in the collaboration with ICAR-Central Potato Research Institute, Shimla (Himachal Pradesh) to assess the performance of potato cultivars for processing as well as for table purpose under hot arid region during two consecutive years *i.e*. 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 the 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 during experimental periods and depicted in Fig. 1. The experiment was laid out in factorial randomized block design and replicated six times. The analysis of variance was done based on pooled data of two consecutive years.

The healthy seeds of seven potato cultivars *viz.* Kufri Khyati, Kufri Garima, Kufri Chipsona-4, Kufri Pukhraj, Kufri Frysona, Kufri Surya and Kufri Jyoti were procured from ICAR-CPRI, Shimla. Well sprouted potato seed tubers were planted in the 2nd week of November during both the years under sprinkler and drip irrigation system with recommended management practices**.** In this experiment, 1/3rd of N was applied through neem coated urea and DAP in side-band along with a uniform dose of 80 kg P2O5 through di-ammonium phosphate and 100 kg/ ha K2O through muriate of potash during planting time while 1/3rd of N was applied as through neem coated urea at 35 days after planting *i.e*. at the time of earthing up and the remaining 1/3rd N was applied through neem coated urea at 50 days after planting *i.e*. at the time of bulking stage. The haulms were cut at 100 days and harvesting of tuber 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 growth parameters viz., plant height, number of branches/plant and number of compound leaves/ plant at 55 days were recorded. The yield and yield attributing characters of tubers were recorded after harvesting of the potato. Tubers after final harvesting were also classified into different grades viz., large, medium and small size of tubers.

Results and Discussion

Growth parameters under non-traditional areas of north-western Rajasthan

Various growth parameters *viz.*, plant height (cm), number of branches/plant and number of compound leaves/ plant for all the varieties grown under sprinkler and drip system was recorded at 55 days after planting. Data presented in table 1 showed that growth parameters were increased irrespective of variety. There was wide variation in mean plant height of potato varieties under sprinkler (50.9 cm) and drip irrigation (37.1 cm). The other parameters like number of branches and number of compound leaves/ plant were slightly higher under drip system compared to sprinkler system. Thereby, dwarf and bushy plant growth was observed in drip system and sprinkler system of irrigation. Among different

cultivars, maximum plant height was recorded in Kufri Chipsona-4 (70.7 cm) followed by Kufri Frysona (59.1 cm), Kufri Surya (48.7 cm), Kufri Khyati (48.1 cm) and Kufri Pukhraj (46.7 cm) while minimum in Kufri Garima (37.2 cm) under sprinkler system. Similarly, under drip system maximum plant height at 55 days after planting was recorded in Kufri Chipsona-4 (51.9 cm) followed by Kufri Frysona (46.5 cm), Kufri Surya (39.8 cm), Kufri Jyoti (434.2 cm), Kufri Pukhraj 31.3 cm), Kufri Khyati (30.1 cm) while minmum in Kufri Garima (26.3 cm). The observations showed that Kufri Chipsona-4 is vigorous type while Kufri Garima is comparatively dwarf type. However, the 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 of the variety. Spieler (1994) also reported that microsprinkler protects crops from adverse climatic conditions which help in better growth and development of plant.

Yield of potato/plant under non-traditional areas of north-western Rajasthan

In case of yield/plant, K Chipsona-4 gave maximum yield (935.8 g/plant) followed by Kufri Frysona (839.5 g/plant) and Kufri Jyoti (813.9 g/plant) while, Kufri Pukhraj (593.0 g/plant) gave minimum yield followed by Kufri Khyati (678.4 g/plant) under sprinkler irrigation system (Table 2). Percent increase in yield/plant was 14.4, 27.17, 57.81, 41.57, 17.64, and 37.25 percent for Kufri Khyati, Kufri Garima, Kufri Chipsona, Kufri Frysona, Kufri Surya and Kufri Jyoti respectively as compared to K Pukhraj under sprinkler irrigation. In case of drip irrigation K Frysona (636.5 g/plant) gave higher tuber yield/plant followed by K Chipsona (626.7 g/plant) and K Jyoti (504.7 g/plant).

Yield and number of potato/plant under non-traditional areas of north-western Rajasthan

Average yield and number under different grades /plant varied due to variety and irrigation system (Table 3). Mean yield under small, medium, large grade was 49.7, 166.1, 543.1 g/plant under sprinkler, whereas under drip it was 28.4, 126.5, 348.9 g/plant. Similarly mean number of tuber under small, medium, large grade were 2.85, 2.74, 6.15 per plant under sprinkler whereas, 1.72, 2.10, 3.34 per plant was recorded under drip irrigation. Kufri Frysona (62 g/plant) gave higher small size tuber/plant followed by Kufri Chipsona-4 (59.9 g/plant) under sprinkler whereas under drip Kufri Chipsona-4 gave higher (66.1 g/plant) followed by Kufri Khyati (37.1 g/plant). In medium size maximum yield/plant were observed in Kufri Frysona (255.7 g/plant) followed by Kufri Surya (196.5 g/plant) under sprinkler whereas, under drip Kufri Jyoti (170.0 g/plant) gave maximum yield/plant followed by Kufri Garima (150.20 g/plant). In case of Large size tuber K Frysona gave higher yield per plant (712.6 g/plant)followed by Kufri Jyoti (617.4 g/plant) under sprinkler while, under drip Kufri Frysona gave higher large size of tuber per plant (508.9 g/plant) followed by (542.0 g/plant). Kufri Khyati, Kufri Frysona and Kufri Chipsona-4 gave higher number of small, medium and large sized tuber per plant (3.4, 3.99 and 9.32) respectively under sprinkler. While under drip irrigation Kufri Chipsona-4, Kufri Garima, Kufri Frysona gave higher number of tubers per plant (3.51, 2.71 and 4.46 tubers/plant, respectively).

Maximum large size tuber yield/plant (>75 g) recorded was 712.6, 617.4, 573.8 and 521.8 g/plant for Chipsona-4, Kufri Jyoti, Kufri Garima and Kufri Frysona, respectively. Whereas, maximum medium sized tuber/plant was observed under Kufri Frysona (255.7 g/plant) followed by Kufri Surya (196.5 g/plant) and Kufri Chipsona-4 (163.3g/plant) (Table-3) while maximum small sized tuber was obtained from Kufri Frysona (62.0 g/plant followed by Kufri Chipsona-4 (59.9 g/plant) Kufri Surya (48.8 g/plant) under sprikler irrigation.

Average weight of potato/plant under non-traditional areas of north-western Rajasthan

Average weight of small, medium and large size tubers varied under both the irrigation system (Table 4). Higher average weight of tubers under small, medium and large size tubers was 23.7, 72.9, 123.86 g obtained in Kufri Khyati, Kurfri Surya and Kufri Chipsona-4 respectively under sprinkler irrigation, while under drip average weight of tubers under small, medium and large size tubers was obtained in the Kufri Chipsona-4 (21.94 g), Kufri Frysona (64.05 g), Kufri Garima (113.07 g). Minimum average weight of tubers under small was 9.43 g under Kufri Frysona, while under average weight medium and large size tubers was 45.93 and 81.99 g obtained in K Pukhraj, under sprinkler irrigation. While under drip average weight of tubers under small, medium and large size tubers were obtained in the Kufri Khyati, Kufri Garima and Kufri Chipsona (10.99, 51.15 and 76.50 g), respectively.

Yield of potato/ha under non-traditional areas of north-western Rajasthan

Tuber yield varied significantly from variety to variety (Table 2) under sprinkler irrigation system. Maximum tuber yield, which was significantly higher over other varieties, was obtained from Kufri Chipsona-4 (53.48 t/ ha) followed by Kufri Frysona (47.97 q/ ha) and Kufri Jyoti (46.51q/ ha) while minimum yield was observed in Kufri Pukhraj (33.89 q/ ha) and Kufri Khyati (38.76 q/ ha). Kufri Garima and Kufri Surya gave intermediate yields (43.09 and 39.86 q/ha), respectively. Kufri Khyati, Kufri Garima, Kufri Chipsona, Kufri Frysona Kufri Surya and Kufri Jyoti gave 4.9, 9.2, 19.6, 14.1, 6.0 and 12.6 t/ha higher yield of potato as compared to Kufri Pukhraj. Tuber yield under drip irrigation, maximum yield was obtained from Kufri Frysona (43.5 t/ha) followed by Kufri Chipsona-4 (42.9 t/ha) and Kufri Garima (32.4 t/q/ha) and minimum yield was observed by Kufri Pukhraj (20.4 t/ha) and Kufri Khyati (33.3 t/ha). Percent increase in yield of Kufri Khyati, Kufri Garima, Kufri Chipsona, Kufri Frysona Kufri Surya and Kufri Jyoti was 163, 184, 210, 213, 167 and 169% as compared to Kufri Pukhraj.

Under sprinkler irrigation, maximum number of total

tubers (in thousands/ha) was recorded in Kufri Chipsona (883) followed by Kufri Garima (769) and Kufri Jyoti (887) while minimum number of total tubers was recorded under Kufri Pukhraj (499) and Kufri Garima (595), respectively. Whereas, under drip irrigation, Kufri Frysona (607), Kufri Garima (520), and Kufri Khyati (481) gave higher number of tubers, while Kufri Pukhraj (363) and Kufri Surya (388) in thousand/ha, respectively. The main reason of higher number of tuber in the presence of micro irrigation was the capacity of a genotype to use/ absorb more nutrients per unit from soil *i.e.* the ability of the root system of a genotype to acquire more nutrients from soil (Trehan, 2009)

The mean maximum temperature during crop season was 27.5°C and the average minimum temperature was 9.7°C. Therefore, potatoes grown here may be suitable for processing. Potatoes grown here can be expected to have higher dry matter and lower reducing sugar content due to hight night temperature. Therefore, these potatoes can be used for processing.

Potato cultivars differ in their growth and yield potential; hence there is a differential response to agro climatic conditions and bulking rate even if they belong to same maturity group. Duynisveld *et al*., (1988) and Sharifi *et al*., (2007) have also reported that different cultivars behave different in term of yield and bulking rate. All the varieties gave higher yield as compared to their potential yield as reported by the ICAR-CPRI, Shimla. Kashyap and Panda (2002) also observed significantly higher potato yield under high frequency irrigation. Difference in tuber yield obtained under micro sprinkler and drip irrigation systems was higher than furrow irrigation method. The higher yield in microsprinkler and drip irrigation systems might be due to the fact that frequent watering resulted into higher water potential, thus minimizing fluctuation in soil moisture in effective root zone, which holds promise for increase in crop yield (Hanson *et al*. 1997). The better crop performance under microsprinkler could be attributed to minimum influence of frost, white fly and nutrient leaching. It was observed (visual observation) that whitefly attack was not so severe under microsprinkler regime as compared to drip and furrow irrigated crop. Frequent irrigation with microsprinkler washed the leaf canopy and minimized the whitefly infestation. Apart from this, microsprinkler irrigation might have created better microclimate, which facilitated better photosynthesis, root aeration and plant growth which resulted into higher yield (Dutta and Das, 2001). Findings are in accordance with

Table 1.Growth parameters of different potato cultivars after 55 days of planting under sprinkler and drip irrigation system.

Varieties	Sprinkler irrigation			Drip irrigation		
	Plant height (cm)	No. of branches/ plant	No. of compound leaves/ plant	Plant height (cm)	No. of branches/ plant	No. of compound leaves/ plant
Kufri Khyati	48.1	3.3	24.7	30.1	3.7	26.0
Kufri Garima	37.2	6.1	33.1	26.3	6.2	30.8
Kufri Chipsona-4	70.7	4.9	46.5	51.9	4.3	36.2
Kufri Pukhraj	46.7	3.1	22.8	31.3	3.1	23.3
Kufri Frysona	59.1	3.9	29.5	46.5	4.3	46.5
Kufri Surya	48.7	4.9	31.9	39.8	5.6	35.2
Kufri Jyoti	45.9	2.9	32.1	34.2	4.1	27.9
Mean	50.9	4.2	31.5	37.2	4.5	32.3
SEm±	3.33	0.27	2.14	1.80	0.22	1.60
CD (p=0.05)	10.2	0.8	6.3	5.0	0.7	4.8

Table 2.Yield and number of tuber obtained in different potato cultivars under sprinkler and drip irrigation system.

Treatment	Sprinkler irrigation			Drip irrigation		
	Yield /plant (g)	Yield (t/ha)	No. of tuber (000/ha.)	Yield /plant (g)	Yield (t/ha)	No. of tuber (000/ha.)
Kufri Khyati	678.4	38.8	673	487.3	33.3	481
Kufri Garima	754.1	43.08	595	474.3	32. 5	520
Kufri Chipsona	935.8	53.5	833	626.7	42.9	432
Kufri Pukhraj	593.0	33.9	499	298.2	20.4	363
Kufri Frysona	839.5	48.0	769	636.5	43.5	607
Kufri Surya	697.6	39.9	637	498.6	34.1	388
Kufri Jyoti	813.9	46.5	693	504.7	34.5	462
Mean	758.9	43.4	692	503.8	34.5	465
SEm±	37.89	2.1	34.54	25.18	1.7	23.48
CD at 5%	113.8	63.7	104	75.6	51.7	70

Table 3.Yield of tubers and number/ plant of different potato verities under both the irrigation system.

Varieties	Sprinkler irrigation						Drip irrigation					
	Yield under different grades per plant (g)			Number of tuber in different grades			Yield under different grades per plant (g)			Number of tuber in different grades		
	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	37.3	119.0	522.1	3.40	2.16	6.21	37.1	120.2	330.1	1.56	1.72	3.76
Kufri Garima	48.7	131.6	573.8	2.77	2.57	5.08	24.4	150.2	299.7	1.87	2.71	3.03
Kufri Chipsona	59.9	163.3	712.6	2.73	2.53	9.32	66.1	108.6	452.0	3.51	1.73	3.65
Kufri Pukhraj	46.9	144.4	401.8	2.21	2.31	4.22	17.2	95.4	185.6	0.96	2.08	2.26
Kufri Frysona	62.0	255.7	521.8	3.25	3.99	6.21	22.2	105.4	508.9	2.35	2.06	4.46
Kufri Surya	48.8	196.5	452.2	3.15	3.09	4.90	7.9	135.4	355.3	0.46	1.86	3.36
Kufri Jyoti	44.4	152.1	617.4	2.46	2.53	7.13	23.7	170.5	310.5	1.32	2.57	2.87
Mean	49.7	166.1	543.1	2.85	2.74	6.15	28.4	126.5	348.9	1.72	2.10	3.34
SEm±	2.43	8.37	27.31	0.19	0.17	0.27	1.38	6..27	17.52	0.13	0.13	0.15
CD at 5%	7.5	24.9	81.5	0.43	0.41	0.92	4.3	19.0	52.3	0.26	0.32	0.50

Table 4.Average weight of tubers/plant of different potato verities under both the irrigation system

Treatments	Sprinkler irrigation			Drip irrigation		
	Average weight of tubers under different grades per plant (g) Under Sprinkler			Average weight of tubers under different grades per plant (g) Under Drip Irrigation		
	Small (<25 g)	Medium (25-75 g)	Large (>75 g)	Small (<25 g)	Medium (25-75 g)	Large (>75 g)
Kufri Khyati	23.73	69.87	87.84	10.99	55.02	84.04
Kufri Garima	13.05	55.49	98.90	17.60	51.15	113.07
Kufri Chipsona	18.83	62.86	123.86	21.94	64.66	76.50
Kufri Pukhraj	17.88	45.93	81.99	21.21	62.46	95.29
Kufri Frysona	9.43	51.12	114.14	19.07	64.05	84.02
Kufri Surya	17.27	72.89	105.89	15.52	63.52	92.29
Kufri Jyoti	17.92	66.44	108.24	18.03	60.12	86.54
Mean	16.49	60.18	104.44	18.43	60.34	81.51
SEm±	5.12	19.26	35.21	6.45	19.78	27.35
CD at 5%	16.49	60.18	104.44	18.43	60.34	81.51

Holzapfel *et al.* (2000) who reported better soil aeration in root zone of Kiwi crop under microsprinkler irrigation as compared to drip irrigation system, and recorded higher yield. Further, during tuberization (in December) minimum temperature was as low as 512 °C for few days. Microsprinkler irrigation system might have protected the crop from adverse effect of low temperature by sprinkling water droplets on the leaves of the plant, helped in better growth, early maturity and higher potato yield as compared to traditional method. Spieler (1994) also reported that microsprinkler protects crops from adverse climatic conditions which help in better growth and development of plant. Superiority of drip irrigation or sprinkler irrigation over traditional irrigation methods in terms of yield and economics is now well established fact (Narayanamoorthi 1997, Pawar *et al.* 2002). It is imperative to evolve efficient, economical and reliable irrigation management strategies for successful early potato cultivation and to increase productivity and profitability of existing bio-production system for canal irrigated area of arid environment.

From the present study, 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 agronomically most efficient in resource poor conditions and had given high yield, better quality tuber and good return. In fact, potato has great potential in the state as the green vegetables are not availability is poor in the arid region of Rajasthan throughout the year. If good quality seed, proper marketing system, sufficient cold storage and irrigation facilities are made available, definitely the prospect of potato will be bright in this region. It is therefore necessary to educate the farmers through front line demonstrations as well as imparting training on good agricultural practices for potato cultivation. Also, western Rajasthan is the most suitable area for the establishment of processing units. This will increase the demand and will further motivate the farmers to grow potatoes in this region.

References

Arya, Sushma, Kadian, Mohinder, Rawal, Sanjay, Luthra, Satish, Rana, Rajesh and Quiroz Roberto. 2016. Cultivation of potato in dryland system of Western Rajasthan for improving food security and income generation. *International Journal of Tropical Agriculture*, 34 (8) : 2433-2439.

Dutta, Dibyendu, Das, D.K. 2001. Water requirement of some crops grown under shallow perched water-table at

Indira Gandhi canal command, western Rajasthan. *Journal of the Indian Society of Soil Science*, 49: 1-6

Duynisveld, WHM, Strebel, O and Bottcher, J .1988. Are nitrate leaching from arable land and nitrate pollution of ground water avoidable. *Ecol.Bull.*, 39: 116-25.

FAOSTAT.2013.FAO, statistical databases FAOSTAT. http://faostat.fao.org/site/567/default.

Hanson, B. R., Schwanki, L. J., Schulbach, K. F. and Pettygove, G. S. 1997. A Comparison of furrow, surface drip and subsurface drip irrigation on lettuce yield and applied water. *Agricultural Water Management*, 33: 139-57.

Holzapfel, E. A., Merino, R., Marino, M. A. and Matta, R. 2000. Water production functions in kiwi. *Irrigation Science*, 19: 739.

Kashyap, P. S. and Panda, R. K. 2002. Effect of irrigation scheduling on potato crop parameters under water stressed conditions. *Agricultural Water Management*, 71:118.

Keijbets, M.J.H. 2008. Potato processing for the consumer: developments and future challenges. *Potato Res*., 51(3):271-281

Kumar, Satyendra, Asrey, Ram, Mandal, G and Singh Rajbir. 2009.Microsprinkler, drip and furrow irrigation for potato (*Solanum tuberosum*) cultivation in a semi-arid environment *Indian Journal of Agricultural Sciences*, 79 (3): 16-59,.

Minhas, J.S., Rawat, S., Govindakrishnan, P.M., Kumar, D. 2011. Possibilities of enhancing potato production in non-traditional areas. *Potato J.*, 38(1):14-17

Narayanamoorthi, A. 1997. Economic viability of drip irrigation: an empirical analysis from Mahrastra. *Indian Journal of Agricultural Economics*, 52(4): 728-39.

Pawar, D. D., Bhoi, P. G. and Shinde, S. H. 2002. Effect of irrigation methods and fertilizer levels on yield of potato. *Indian Journalof Agricultural Sciences*, 72 (2): 80-83.

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

Rana, R.K., Pandit, A., Pandey, N.K. 2010. Demand for processed potato products and processing quality potato tubers in India. *Potato Res*., 53:181-197

Rana, Rajesh K., Arya, Sushma, Kumar, Sanjay, Singh, Dhiraj K, Cecilia, T, Mares, V, Quiroz, R. and Kadian, M. S. 2017. SWOT analysis of potato cultivation under arid conditions in western Rajasthan (India) *Indian Journal of Agricultural Sciences*, 87 (12): 168-794.

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

Sharifi, M., Bernie, J. Z. And Coleman, W. 2007. Screening for nitrogen-use efficiency in potato with a recirculating hydroponic system. Commun Soil Sci Plan, 38: 359-70.

Singh, B. P., Rana, Rajesh K. and Govindakrishnan, P. M. 2014. *Vision 2050*. ICAR-Central Potato Research Institute, Shimla, 26 p.

Singh, B.P. and Rana, R.K. 2013. Potato for food and nutritional security in India. *Indian Farming*, 63(7):37-43

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

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

Singh, Brajesh, Raigond, Pinky, Joshi, Alka, Mehta, Ashiv and Singh, B.P. 2016. A Manual on Potato Processing in India. CPRI Technical Bulletin No. 48 (Revised).

Spieler, G. 1994. Microsprinklers and microclimates. *International Water and Irrigation Review*, 14 (4): 14-17.

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

Trehan, S.P. 2009. Improving nutrient use efficiency by exploiting genetic diversity of potato. *Potato J*., 36(3-4): 121-35