

Original Research Article

<https://doi.org/10.20546/ijcmas.2021.1001.366>

Effect of Different Irrigation Method and Fertigation Level on Yield of Potato (*Solanum tuberosum* L.) under Western Rajasthan Condition

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ABSTRACT

Keywords

Irrigation method,
Fertigation level,
Drip irrigation,
Micro sprinkler

Article Info

Accepted:
20 December 2020
Available Online:
10 January 2021

A field experiment was carried out at Precision Farming Development Centre, Agricultural Research Station, S.K. Rajasthan Agricultural University, Bikaner, India during 2017-18 to 2019-20 in potato (*Solanum tuberosum* L.) crop. The experiment comprising two fertigation level (75 percent recommended dose of fertilizer and 100 per cent recommended dose of fertilizer) and three irrigation methods (drip irrigation, micro sprinkler and flood irrigation). The spacing of plants were maintained 45 x 30 cm. The 25 t ha⁻¹ FYM and NPK @ 150:100:100 kg/ha were applied in the crop. The experiment was laid out in a factorial randomized block design with three replications. Based on three year pooled data, it is found that the drip irrigation gave significantly higher yield (28.06 t ha⁻¹) followed by micro sprinkler and flood irrigation method and among fertigation levels 100 % RDF gave maximum yield of (25 t ha⁻¹) but it was at par with 75% RDF treatment.

Introduction

Potato (*Solanum tuberosum* L.) is one of the major food crops of the world. It belongs to family Solanaceae and the genus Solanum. It is a native of tropical South America regions where it grows wild in nature and presents the wider diversity of forms like tuber shape, size, colour, taste etc. It is believed that the cultivated potato originated from its wild ancestors near the lake Titicaca basin in Peru Bolivian region in high mountains. It can supplement the food needs of the country in a substantial way. It has proved its worth in

feeding the nation in emergency. It is an important crop for the high population areas of Asia because it produces more dry matter food, well balanced protein and more calories from unit area of land and time than other major food crops. The problem of malnutrition and under nutrition can be largely solved if potato is accepted as a major food and not merely as a vegetable in our country. Potato is a nutritious food and contains practically all the essential dietary constituents like cereals, carbohydrates, calcium, phosphorous, iron and vitamins (B₁, B₂, B₃ and C). About 50 percent of potato

produced in the world is utilized as human food in many of the countries especially in the West it is used as staple diet. Potato is grown in India in almost all the states. Uttar Pradesh, West Bengal and Bihar account for nearly ¾ of the area and 4/5 of the potato production in the country.

Fertigation ensures saving in fertilizer (40-60%), due to “better fertilizer use efficiency” and “reduction in leaching” (Kumar and Singh, 2002). Fertilizers applied through a drip irrigation system should improve efficiency, save labour and increase flexibility in scheduling of applications to fit crop needs (Rolston *et al.*, 1979). Fertilizer requirement can be reduced by 15-25 per cent with fertigation through drip without affecting the yield (Hongal and Nooli, 2007). It is the most effective and convenient means of maintaining optimum fertility level and water supply according to the specific requirement (Shirgure, 2000).

Now the farmers of western Rajasthan are also motivated to cultivation of potato due to large land holding, sandy soils and canal irrigation water. The areas are increasing day by day. Therefore, an experiment was undertaken at Precision Farming Development Station of Agricultural Research Station, SKRAU, Bikaner to assess the comparative performance of drip, micro sprinkler and flood irrigation on potato under different fertigation levels.

Materials and Methods

The experiment was conducted at Precision Farming Development Centre, Agricultural Research Station, S. K. Rajasthan Agricultural University, Bikaner, India (28° 01 'N latitude and 73° 22' E longitude at an altitude of 234.70 meters above mean sea level) during *Rabi* season of 2018, 2019 and 2020. The soil of experimental field was

loamy-sand, alkaline in reaction (pH 8.5) having 118 kg ha⁻¹ available N (Alkaline permanganate method), low level of available phosphorus (15.1 kg ha⁻¹, Olsen's method) and medium in available potassium (173.7 kg ha⁻¹, Flame photometric method) in 0-15 cm soil depth at the start of the experiment. The experiment was laid out in a factorial randomized block design with three replications. The experiment comprising two fertigation level (75 percent recommended dose of fertilizer and 100 per cent recommended dose of fertilizer) and three irrigation methods (drip irrigation, micro sprinkler and flood irrigation). The spacing of plants was maintained 45 x 30 cm. The 25 t ha⁻¹ FYM and NPK @150:100:100 kg ha⁻¹ was applied in the experiment. The fertigation was scheduled in three duration, first at establishment of crop stage applied NPK @ 64, 40, 26.15 kg ha⁻¹ in four split doses in weekly interval, second in stolen initiation & tuber formation stage (NPK@85,40,26.15 kg ha⁻¹) in six split doses at an interval of seven days and third at tuber development stage (PK@20, 47.7 kg ha⁻¹) in six split doses at an interval of seven days (Table 1).

The yield attributes and yields were recorded and data were statistically analyzed for estimation of analysis of variance as per method suggested by (Panse and Sukhatme, 1985). The critical differences between the observed values under different treatment combinations were also estimated to understand the significant effects of different irrigation method and fertigation level on potato.

Results and Discussion

Irrigation method

Irrigation method viz., drip irrigation, micro sprinkler and flood irrigation significantly influence the yield of potato plants. In flood

irrigation method, 23.14 tones/ha potato yield was obtained which was increase 25.39 tones/ha in micro sprinkler. While highest yield 28.06 tones/ ha was recorded in drip irrigation system (Table 2).

The yield of potato was increased in drip irrigation system may be due to the efficiency of this method in reducing water loss through evaporation and increase water use efficiency. The increasing of water amounts in the soil may increase the length and the density of roots through the optimal regulation of soil water, in addition to maintain a high water potential in the root zone (Wang *et al.*, 2006), which increase the water absorption, and total water content in leaves as well as the

absorption of nutrients as a result of increasing its availability in the soil reflecting the efficiency of the biological processes in the plant. These results are in agreement with data reported by Shae *et al.*, (1999) and, Al-Janaby, (2012). Swarajyalakshmi *et al.*, (2005) reported that the highest green chilli yield (21.56 t ha⁻¹) was recorded through drip method scheduled at 0.8 ET under black polythene mulch. This increase was accounted to 34 per cent over conventional method of irrigation practiced. Ngouajio *et al.*, (2007) showed that drip irrigation along with fertigation at flowering and fruit development stage increased tomato yield by 8–15%, fruit number by 12–14% over control treatment.

Table1 Schedules for fertilizers application in potato crop

Crop Stage	Fertigation Schedule	Basal dose (t/ha)	Nutrients through Fertigation (kg/ha)			Fertilizers for fertigation (Kg/ha)		
		FYM	N	P ₂ O ₅	K ₂ O	Urea	P ₂ O ₅ (0:52:34)	K ₂ O (0:0:50)
Establishment	full dose of FYM as basal and N,P,K @ 64,40,26.15 kg/ha in 4 split doses weekly interval	25	65	40	26.15	141.30	76.92	0
Stolen initiation & tuber formation	NPK@ 85, 40, 26.15 Kg/ha in six spilt doses at an interval of 7 days		85	40	26.15	184.78	76.92	0
Tuber development	PK @ 20, 47.7 kg/ha in six spilt doses at an interval of 7 days		0	20	47.7	0	38.46	69.16
	Total		150	100	100	326.08	192.30	69.16

Table.2 Effect of irrigation method on potato under different fertigation levels

Treatment	Yield (tones/ha)			
	2017-18	2018-19	2019-20	Pooled
Irrigation method				
Drip irrigation	26.88	27.90	29.40	28.06
Micro sprinkler	24.00	25.60	26.56	25.39
Flood method	21.92	22.83	24.66	23.14
S.Em.±	0.83	0.79	0.91	0.46
C.D. (p=5%)	2.61	2.48	2.76	1.35
Fertigation level				
75% RDF	21.92	23.64	27.20	24.25
100% RDF	24.00	24.79	26.20	25.00
S.Em.±	0.90	0.79	0.83	0.44
C.D. (p=5%)	2.72	2.38	2.44	1.28

Fertigation levels

Fertigation allows nutrient placement directly into the plant root zone during critical periods in the required dose (Singandhupe *et al.*, 2003; Jat, *et al.*, 2011). Three year pool data revealed that application of 100 per cent recommended dose of fertilizers (NPK @ 150: 100:100 kg/ha) through fertigation gave maximum yield (25 tones/ha) of potato. However, it was at par with 75 percent recommended dose of fertilizers (Table 2).

In fertigation upto 90% of the applied nutrients were absorbed, while in traditional fertilizer application only 10 to 40% were absorbed. It lower the wastage of water and chemical fertilizers, optimizes the nutrient use by applying them at critical stages and at proper place and time, which finally increase water and nutrient use efficiency. Darwish *et al.*, (2003) studied the impact of N fertigation in potato and reported that fertigation with continuous N feeding through drip system based on actual N demand and available N in the soil resulted in 55 per cent N recovery; and for spring potato crop in this treatment, 44.8 per cent N need was met from the soil N and 21.8 per cent from the irrigation water.

Higher N input increased not only the N derived from fertilizers, but also the residual soil N.

A similar finding was recounted in tomato by Prabhakar and Hebbar, 1996. They reported that 45.7 t ha⁻¹ fruit yield was obtained with application of recommended dose of fertilizers using polyfeed (19:19:19), MAP (12:60:0) and urea through fertigation, which was 22-27 per cent higher compared to the crop which was provided with ordinary fertilizers through soil application.

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How to cite this article:

Rathore, R. S., A. K. Singh, Ashok Chaudhary, Ramesh Kumar, P. S. Chauhan, Durga Singh Rathore, Shri Rakesh and Dependra Singh. 2021. Effect of Different Irrigation Method and Fertigation Level on Yield of Potato (*Solanum tuberosum* L.) under Western Rajasthan Condition. *Int.J.Curr.Microbiol.App.Sci*. 10(01): 3146-3150.
doi: <https://doi.org/10.20546/ijcmas.2021.1001.366>