



Soil fertility under different nitrogen irrigation methods in potato (*Solanum tuberosum*)

DEVA SHRI MAAN^{1*}, AMIT KUMAR¹, DAVINDER SINGH¹ and ANSUL DUHAN¹

Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana 125 004, India

Received: 16 August 2021; Accepted: 24 November 2021

Keywords: Fertility, Irrigation, Nitrogen, Nutrient, Soil

Potato (*Solanum tuberosum* L.) is the world's fifth-largest food crop, can be grown on alluvial, black, red and laterite soils having pH in the range of 5.5–8.0. Several agronomic practices like planting time, spacing, manurial and fertilizer requirements, and water management affect both quality and quantity of potato. The maximum area and production are from Uttar Pradesh followed by West Bengal and Bihar, while highest productivity comes from West Bengal followed by Gujarat (Bhardwaj and Sharma 2020). Among these cultural practices, the optimum dose of fertilizer is one of the most important factors. The drip irrigation system offers opportunity for the precise application of water, soluble fertilizers and other nutrients to soil at appropriate times in desired concentration. The major advantages of drip irrigation are better timing, uniform distribution, less damage to crop and soil, better recovery or utilization of fertilizer nutrients by the plant, minimum loss of plant nutrient due to leaching and the higher yield. Drip irrigation with adequate amount of fertilizer can increase size and quality of tubers with maintaining the soil health and without damaging soil fertility status.

The experiment comprising of two irrigation methods, i.e. drip irrigation (I_1) and furrow irrigation (I_2) and five levels of nitrogen, i.e. 60% of RDN (N_1), 80% of RDN (N_2), 100% of RDN (N_3), 120% of RDN (N_4) and 140% of RDN (N_5) was conducted at Research Farm of CCSHAU, Hisar during *rabi* 2015–16 and 2016–17. The treatments were laid out in split plot design with three replications. The net plot size was 3.60 m × 3.60 m. Farmyard manure (FYM) @50 t/ha was applied prior to field preparation and full dose of phosphorus and potash was applied as basal dose. Potato tubers of cv. Kufri Bahar were planted at 60 cm × 20 cm spacing in the last week of October. A common irrigation was applied immediately after planting in all the treatments through conventional furrow method

for uniform and rapid germination. The differential drip fertigation treatments were started 20 days after planting and different doses of nitrogen were applied in seven split doses through fertigation in drip irrigation and broadcast in furrow irrigation method. Soil samples were collected from each plot before and after digging of potato tubers to assess the variation in soil properties.

Available soil nitrogen (kg/ha): In potato, irrigation methods and nitrogen levels had played a significant role with soil nitrogen (Table 1). Among nitrogen levels, the significantly maximum soil nitrogen remained in the field under the treatment 60% of RDN (121.00 kg/ha), which was followed by 80% of RDN (115.33 kg/ha), whereas, the significantly minimum soil nitrogen remained in the field under 100% of RDN (106.50 kg/ha) in 2015–16. During 2016–17, maximum mean value for available soil nitrogen was recorded with 60% of RDN (124.00 kg/ha), which was followed by 80% of RDN (112.67 kg/ha), whereas, the minimum mean value for available soil nitrogen was obtained with 100% of RDN (107.50 kg/ha). In consonance with present findings that the interaction effect of irrigation method at same level of RDN and of RDN at same irrigation method was found significant for soil nutrients. The minimum soil nitrogen during both years (2015–16 and 2016–17) was recorded in treatment 100% of RDN with drip irrigation and maximum soil nitrogen was recorded in treatment 60% of RDN with furrow irrigation.

Available soil phosphorous (kg/ha): Significant difference on soil phosphorous due to irrigation methods and nitrogen levels was observed (Table 2). The maximum mean value for soil phosphorous was recorded with 60% of RDN (20.50 kg/ha), which was followed by 80% of RDN (14.50 kg/ha) and 120% of RDN (10.67 kg/ha) and the minimum mean value for soil phosphorous was obtained with 100% of RDN (10.34 kg/ha) in 2015–16. During, 2016–17, the highest mean value for soil phosphorous was observed with 60% of RDN (21.34 kg/ha), which was followed by 80% of RDN (14.50 kg/ha) and the lowest mean value for soil phosphorous was found with 100% of RDN (8.00 kg/ha).

The interaction effect of irrigation method at same level of RDN and of RDN at same irrigation method was

¹Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana. *Corresponding author email: devashrimaan4@gmail.com

Table 1 Effect of different nitrogen levels and irrigation methods in potato crop on available soil nitrogen (kg/ha)

Nitrogen level Irrigation method	2015–16			2016–17		
	Drip irrigation (I ₁)	Furrow irrigation (I ₂)	Mean	Drip irrigation (I ₁)	Furrow irrigation (I ₂)	Mean
60% of RDN (N ₁)	124.00	118.00	121.00	122.00	126.00	124.00
80% of RDN (N ₂)	115.33	115.33	115.33	110.67	114.67	112.67
100% of RDN (N ₃)	104.67	108.33	106.50	110.00	105.00	107.50
120% of RDN (N ₄)	107.33	106.00	106.67	109.33	108.67	109.00
140% of RDN (N ₅)	117.33	105.35	111.34	113.33	88.00	100.67
Mean	113.73	109.73		112.87	107.87	
CD at 5% level	N:2.08 I: 2.41			N:2.60 I:0.54		
	I at same level of N: 3.36 N at same level of I:3.46			I at same level of N: 3.31 N at same level of I: 3.70		

Table 2 Effect of different nitrogen levels and irrigation methods in potato crop on available soil phosphorous (kg/ha)

Nitrogen level Irrigation method	2015–16			2016–17		
	Drip irrigation (I ₁)	Furrow irrigation (I ₂)	Mean	Drip irrigation (I ₁)	Furrow irrigation (I ₂)	Mean
60% of RDN (N ₁)	22.00	19.00	20.50	23.00	19.67	21.34
80% of RDN (N ₂)	13.33	15.67	14.50	11.00	18.00	14.50
100% of RDN (N ₃)	8.00	12.67	10.34	6.33	12.33	9.33
120% of RDN (N ₄)	10.33	11.00	10.67	7.00	9.00	8.00
140% of RDN (N ₅)	15.00	7.67	11.34	16.33	5.67	11.00
Mean	13.73	13.20		12.73	12.93	
CD at 5% level	N: 1.31 I: 0.03			N: 1.97 I: 0.04		
	I at same level of N: 2.44 N at same level of I: 2.37			I at same level of N: 3.54 N at same level of I: 3.48		

found significant for soil phosphorous. The maximum soil phosphorous (22.00 kg/ha) was recorded in 60% of RDN with drip irrigation, which was followed by 60% of RDN (19.00 kg/ha) with furrow irrigation and 80% of RDN (15.67 kg/ha) under furrow irrigation method, while minimum soil phosphorous during 2015–16 (8.00 kg/ha) was recorded in 100% of RDN with drip irrigation, which was followed by 80% of RDN (10.33 kg/ha) under drip irrigation method and the maximum phosphorous uptake by foliage during 2016–17 (23.00 kg/ha) was found in 60% of RDN under drip irrigation, which was followed by 60% of RDN (19.67 kg/ha) under furrow irrigation method, whereas, 100% of RDN (6.32 kg/ha) under drip irrigation had minimum available soil phosphorous. The maximum soil phosphorous was found in 60 % of RDN with furrow irrigation, and the treatment 100% of RDN with drip irrigation had minimum soil phosphorous. Kang *et al.* (2014) observed strong relationship between soil available N, P, and K and tuber N, P, and K concentration suggesting that potato crop can take up more N, P, and K than it is required. Similarly Pinochet *et al.* (2018) observed that higher rates of N fertilization increased the amount of mineral N remaining by 21.5% from the initial mineral N found in

the soil (control) to the maximum rate applied, 300 kg N/ha. Based on the present experimental results, it is concluded that the irrigation method and nitrogen levels affect the growth, yield and soil fertility status. In both years 2015–16 and 2016–17 minimum soil nitrogen, phosphorous and potassium found in drip irrigation with 100% of RDN and maximum soil nutrients that is nitrogen and phosphorous found in furrow irrigation with 60% of RDN.

SUMMARY

A field experiment was conducted during *rabi* 2015–16 and 2016–17 to assess influence of nitrogen levels and irrigation methods on soil nutrients under potato cultivation at Hisar, Haryana. The treatments comprising of irrigation methods (drip and furrow) and five doses of nitrogen (60, 80, 100, 120 and 140% of RDN) were laid out in split plot design replicated thrice. Among nitrogen levels, the mean maximum available soil nitrogen (N) was recorded in 60% of RDN (121.00; 124.00 kg/ha) during 2015–16 and 2016–17, respectively. With respect to irrigation methods, the mean maximum available soil N was recorded under drip irrigation (113.73; 112.87 kg/ha) 2015–16 and 2016–17,

respectively. Considering the available soil phosphorous during 2015–16, minimum was recorded in the treatment 100% of RDN (10.34 kg/ha) and maximum was recorded in 60% of RDN (20.50 kg/ha). The interaction effect of irrigation method at same level of RDN and of RDN at same irrigation method was found significant for soil nutrients. The minimum available soil N (104.67 kg/ha) and P (8.00 kg/ha) were obtained with drip irrigation at 100% RDN during 2015–16. Similar interaction effects were observed regarding available N and P during 2016–17. Hence, 100% of RDN with drip irrigation condition proved the best treatment.

REFERENCES

- Bhardwaj S and Sharma R. 2020. An introduction to mechanization in potato farming. *International Journal of Farm Sciences* **10**(2): 52–59.
- Kang W, Fan M, Ma Z, Shi X and Zheng H. 2014. Luxury absorption of potassium by potato plants. *American Journal of Potato Research* **91**(4): 573–78.
- Kashyap P S and Panda R K. 2002. Effect of irrigation scheduling on potato crop parameters under water stress conditions. *Agricultural Water Management* **71**(2): 1–18.
- Pinochet D, Clunes J, Gauna C and Contreras A. 2018. Reasoned fertilization of potato in response to nitrogen supply in Andisols. *Journal of Soil Science and Plant Nutrition* **18**(3): 790–803.