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Impact of Irrigation Systems and Dates of Planting on Growth Parameters of Potato (*Solanum tuberosum* L.)

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ABSTRACT: The present research titled "Impact of Irrigation Systems and Dates of Planting on Growth Parameters of Potato (*Solanum tuberosum* L.)" was conducted at Research farm of Department of Vegetable Science, CCS HAU, Hisar during the years 2017-18 and 2018-19. Among various irrigation systems, micro-sprinkler irrigation systems (I2) was significantly improve growth parameters i.e. Plant height (47.73 and 52.45 cm), number of stems hill^{-1} (1.77 & 1.82), Numbers of leaves stem^{-1} (24.91 and 26.86), Leaves weight (283.90 and 274.18 g) and Stem weight (65.46 g & 62.44) Harvested at 75 DAP and 90 DAP, respectively, of potato over furrow irrigation system, whereas, among various dates of sowing, (D4) 15th October had significant effects on potato growth metrics of potato i.e. Plant height (49.23 cm and 50.60 cm Harvested at 75 DAP and 90 DAP, respectively, number of stem hill^{-1} (1.95 and 2.15 Harvested at 75 DAP and 90 DAP), Numbers of leaves stem^{-1} (26.33 and 27.46 Harvested at 75 DAP and 90 DAP), Leaves weight (323.49 g and 315.37 Harvested at 75 DAP and 90 DAP) and Stem weight (79.10 g & 72.69 Harvested at 75 DAP and 90 DAP) over rest of the remainder dates of planting during 2017−19. So, in the future, I recommend that potato crops be sown on October 15th with a micro-sprinkler watering system and harvested at 75 and 90 dap, respectively, for better growth characteristics and maybe better yield.

Keywords: Dates of planting, growth parameters, furrow, irrigation, micro-sprinkler, potato.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is a native of the South American continent, where it grew as a wild plant between 7000 and 9000 years ago. In the 17th century, all the credit for bringing potatoes to India goes to Portuguese, after which the British carried it to North India. It is considered to be the only popular tuber grown in more than hundred natives in the world. (Nath *et al.*, 2008; Pandey and Sarkar 2005; Touseef, 2016). Potato is the most widely grown non-cereal crop on the world, as well as the fourth most significant food crop. (Zhang *et al*., 2017; Anonymous, 2017). Potato was documented as a safe food and crop for the world's poor as well as developing countries by Thiele *et al.* (2010); Singh and Rana (2013).

Presently, India is behind only China in potato production in the whole world. In 2017-18, India produced 525.89 lakh tonnes of potato on 21.84 million hectares, with a productivity of 24.08 t ha^{-1} (Anonymous, 2019). Potato is grown in almost all the states in India, yet seven of them (U.P., W.B., BR., GJ., M.P., PB. and HR) have 90% potato production (Anonymous, 2018). Haryana is one of the main potato producing states in India, whose productivity is more than the average productivity of India, along with potato is also one of the main crops here. Potato has the highest area among the crops grown in the state. The area, production and productivity of potato in Haryana has not improved as much as it should have, the area under potato crop during the year 2018-19 was 34738 hectare, production 8977846 tonne hectare and productivity 25 t/ha (Anonymous, 2020).

Potatoes are also rich in nutrients, which mainly contain vitamin C, potassium as well as dietary fiber (Weaver and Marr, 2013). If the nutrient value ratio of potato is compared with all other vegetables and fruits, then in this case it proves to be very economical, so it is included in the most economical nutritional food in the whole world. (Drewnowski and Rhem 2013). Animal and human research indicates that the nutrients in potatoes may positively affect a number of disease risk factors, including chronic disease, including blood pressure, blood lipids, and inflammation (Beals, 2019).

Soil temperature plays an important role in potato maturation, for example, 16-19°C temperature is important for tuber sprouting and initial growth, temperatures above 20°C reduce tuber development and if the temperature exceeds 30°C, then the growth of the tuber stops. More tubers are obtained from one plant if the temperature is low rather than high whereas at higher temperature the size of potato increases and the number decreases (Pandey *et al.*, 2008). In North and Central India, the temperature is favorable for sowing of potatoes after mid-October, only then potatoes are sown at the same time because if sowing is done early, then early planting can result in rotting of tubers in the post monsoon season. For balanced growth of tubers, it is necessary to have optimum level of moisture in the roots zone of the plant, which can be accomplished by using modern irrigation systems like drip and sprinkler (Pawar *et al.*, 2002).

Furthermore, sprinkler irrigation technologies allow for more efficient resource utilization and increased agricultural output (Singh *et al.*, 2001). The main reasons for increasing productive capacity of tuber crop with micro-sprinklers can be attributed to mitigation of effect of white fly, nutrient leaching and soil moisture fluctuations in effective root zone. When comparing drip and furrow watered crops to micro-sprinkler irrigated crops, it was clearly seen that whitefly infestation was less severe. The leaf canopy was cleansed and the whitefly infestation was controlled by frequent irrigation with a micro-sprinkler. Aside from that, micro-sprinkler irrigation may have provided a better microclimate, allowing for enhanced photosynthesis, root aeration, and plant growth, resulting in increased yields. (Holzapfel *et al.*, 2000).

MATERIALS AND METHODS

The research work, titled "Impact of Irrigation Systems and Dates of Planting on Growth Parameters of Potato (*Solanum tuberosum* L.)" was carried out at the Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during winter (*rabi*) seasons during 2017-19.

The following are the details of the materials and methods used in this study:

A. Location of the experiment, climate, and meteorological circumstances

Hisar is located at latitude of 29º10′N, longitude of 75º46′E and at the elevation of 215.2 m above mean sea level and falls in semi-arid and sub-tropical region with hot and dry summer and severe cold in winters. Fig. 1 and 2 show the monthly mean meteorological data (maximum and minimum temperature, relative humidity, sunshine, and rainfall) collected by the Department of Agricultural Meteorology, CCS HAU, Hisar, during the crop growing season.

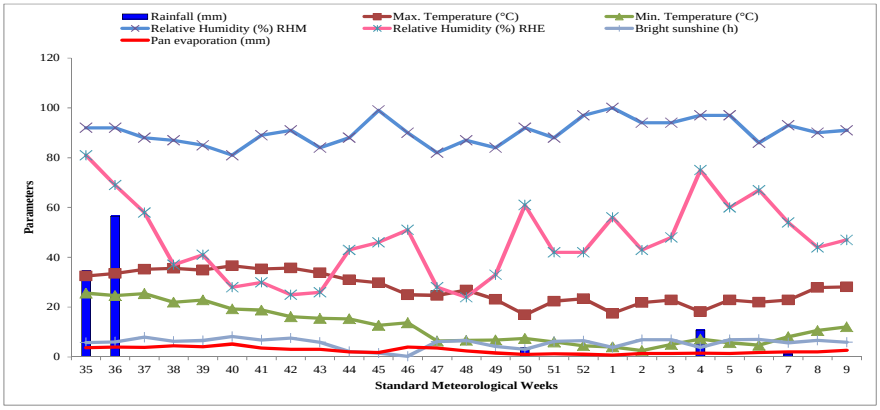

Fig. 1. Mean of weekly meteorological data of Hisar district from August, 2017-March, 2018.

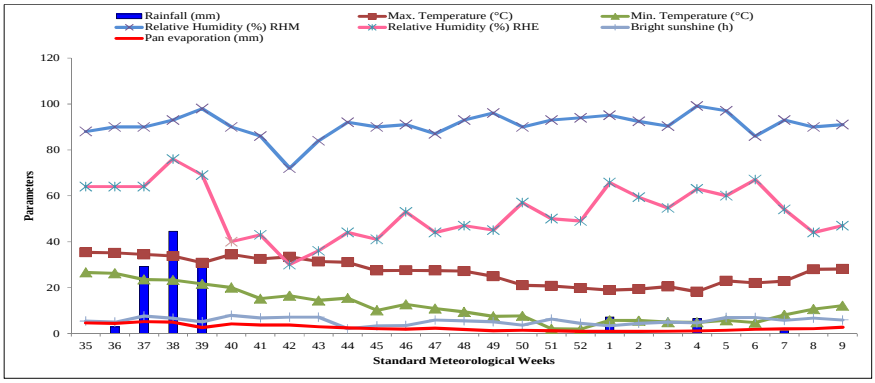

Fig. 2. Mean of weekly meteorological data of Hisar district from August, 2018-March, 2019.

Characteristics of the soil. The composite soil samples were gathered from the experimental field up to a depth of 15 cm before the experiment. Before applying treatments, these samples were analyzed to determine the original state of the soil. The physico-chemical properties of the samples were investigated.

B. Experimental details

The research was completed at Research Farm of the Department of Vegetable Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar during *Rabi* season of 2017−19. Two experiments were conducted during the research, the other details of the experimental material, design and treatments are given as under:

Experiment 1: Impact of Irrigation Systems and Dates of Planting on Growth Parameters potato harvested at 75 days after planting

Experiment 2: Impact of Irrigation Systems and Dates of Planting on Growth Parameters of potato harvested at 90 days after planting

design of Experimental : Split plot design
Variety of potato : Kufri Lima
Replications Numbers: 4
Dimensions of the net plot (m^2): 3×2 m (6 m^2)
Spacing between rows : 60 cm
Plant-to-plant distance : 20 cm

C. Experiment design and layout

Split-plot Design (SPD) was used to set up the experiment, which was then reproduced four times. Figure 3 depicts the experiment's plan of action. With the use of a random number table, the 8 treatments were randomized.

Experimental materials. The Department of Vegetable Science, CCS Haryana Agricultural University, Hisar (Haryana) provided the seed tubers of potato variety Kufri Lima used in this study. Following are the specifics of the treatment:

(a)Main plot.
Irrigation methods - 2
1. I1: Furrow irrigation (30 mm CPE)
2. I2: Micro-sprinkler (10 mm CPE)

(b) Sub-plot
Planting dates - 4
1. 1st September
2. 15th September
3. 30th September
4. 15th October

Details of the treatments and notations used		
Sr. No.	**Notation**	**Description**
1.	$D_1 I_1$	Planted on 1st September under furrow irrigation method
2.	$D_2 I_1$	Planted on 15th September under furrow irrigation method
3.	$D_3 I_1$	Planted on 30th September under furrow irrigation method
4.	$D_4 I_1$	Planted on 15th October under furrow irrigation method
5.	$D_1 I_2$	Planted on 1st September under micro-sprinkler irrigation method
6.	$D_2 I_2$	Planted on 15th September under micro-sprinkler irrigation method
7.	$D_3 I_2$	Planted on 30th September under micro-sprinkler irrigation method
8.	$D_4 I_2$	Planted on 15th October under micro-sprinkler irrigation method

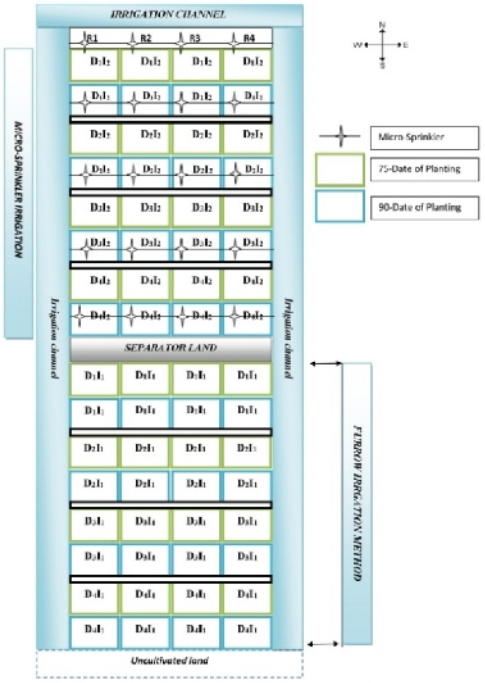

Fig. 3. Layout of experimental field.

D. Cultural operations

The following are the cultural operations that were used during the experiment:

Field preparation and application of fertilizer. During both years, the experimental field was appropriately prepared in the last week of August. To smash clods, the field was ploughed twice using a tractor-drawn cultivator after the previous crop was harvested. The field was ploughed by cross harrowing followed by the cultivator twice and in the final planking to bring the soil to a fine tilth before sowing.

Seed rate and sowing. In the 1st September, 15th September, 30th September, and 15th October in 2017 and 2018, a potato planter planted seeds of the potato crop @ 3 qha^{-1} on a well-prepared field.

E. Details of collection of experimental data

The following are the details of the different observations made, as well as the procedures to be used:

Plant height (cm) at 45, 60, 75 and 90 DAP. Five plants were chosen at random from each plot and their height was measured in centimeters. At 45, 60, 75, and 90 days following planting, the height of the tallest shoot was measured from the base of the plant to the apex of the last leaf, and the average was calculated.

Number of stems hill^{-1} at final harvest. The average number of stems hill^{-1} was estimated by counting the stems of 5 plants (hills) at randomly.

Numbers of leaves stem^{-1} at final harvest. The average number of leave hill^{-1} was estimated by counting the leave of 5 plants (hills) at randomly.

Leaves weight hill^{-1} at final harvest (g). The average leaf weight hill^{-1} was estimated by counting the leaf weight of 5 plants (hills) at randomly.

Stem weight hill^{-1} at final harvest (g). At final harvest, the weight of stem hill-1 was recorded for the plants chosen for the number of stem parameter, their stems without leaf were weighed, and an average was calculated.

F. Statistical analysis

The data observed for the various characters during the study were statistically analyzed following the technique of analysis of variance (ANOVA). The significance of difference between mean of two treatments were judge with the critical difference (CD) worked out using following formula:

$$CD = \sqrt{\frac{2 \times \text{Mean square error}}{n}} \times 't' \quad (1)$$

Where, CD = Critical difference

N = Number of replications of the factor for which C.D. is to be calculated.

t = The value from fisher table for error degree of freedom at 5% level of significance.

RESULTS AND DISCUSSION

The results of field research work entitled "impact of irrigation systems and dates of planting on growth parameters of potato (*Solanum tuberosum* L.)" carried out at the Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during winter (*rabi*) seasons of the years 2017-18 and 2018-19 are being presented in this article. During both years, data referring to a trend of increase in potato growth parameters was seen in timely planted potatoes over early planted potatoes and under the micro-sprinkler over furrow irrigation method.

A. Plant height (cm) at 75 DAP

Table 1 demonstrates that significantly highest plant at 75 DAP & 90 DAP (47.73 cm at 75 DAP & 52.45 cm, respectively throughout 2017-19) were measured using the micro-sprinkler irrigation method (I2) instead of the furrow irrigation technique (I_1). The frequent irrigation and optimal soil moisture provided by drip and micro sprinkler irrigation may have resulted in excellent nutrient absorption and utilization and Root proliferation is improved, resulting in faster canopy expansion (Ayotamuno *et al.*, 2007), which would have expedited the production of growth regulators like as auxins (IAA) and cytokinins, resulting in enhanced plant height by stimulating cell elongation and division (Anittafanish *et al.*, 2011), Among various planting dates, significantly highest plant of potato at 75 DAP (49.23 cm at 75 DAP & 50.60 cm at 90 DAP during 2017-19) were observed in potato planted on 15th October (D_4) over the remainder planting dates, Similar trend of increased in plant height in timely planted potato was observed by Rab *et al.* (2013); Singh and Sood, (2013); Haile *et al*. (2015); Anittafanish *et al.* (2017); Thongam *et al.* (2017); Mustafa *et al.* (2017).

Table 1: Impact of irrigation systems and dates of planting on plant height (cm) at 75 DAP in potato.

Irrigation methods / Planting dates	Harvested at 75 DAP 2017–19 (Pooled)			Harvested at 90 DAP 2017–19 (Pooled)		
	Furrow (I_1)	Micro-sprinkler (I_2)	Mean	Furrow (I_1)	Micro-sprinkler (I_2)	Mean
1st September (D_1)	39.62	44.10	41.86	37.85	42.60	40.22
15th September (D_2)	41.21	46.82	44.02	40.90	46.75	43.82
30th September (D_3)	44.45	49.35	46.90	44.96	50.15	47.56
15th October (D_4)	47.82	50.63	49.23	48.75	52.15	50.60
Mean	43.28	47.73		43.11	52.45	
CD at significance level 5%	Irrigation (I) : 3.78 Planting Date (D) : 1.32 Factor (D) at same level of (I) : N/A Factor (I) at same level of (D) : N/A			Irrigation (I) : 1.53 Planting Date (D) : 0.97 Factor D at same level of (I) : N/A Factor I at same level of (D) : N/A		

While analyzing the combinations of various planting dates with various Systems of irrigation, highest plant at 75 DAP (50.63 cm at 75 DAP & 52.15 cm at 90 DAP during 2017-19) were observed in treatment D_4I_2 (on the 15th of October, potatoes were planted under micro-sprinkler irrigation). Lowest plant height of potato at 75 DAP were recorded in treatment D_1I_1 (On September 1st, potatoes were planted under furrow irrigation) followed by D_1I_2 (On September 1st, potatoes were planted and irrigated with micro-sprinkler.). It could be attributed to the optimization of temperature suitable to potato plant emergence in a timely planted condition as opposed to a high temperature in a potato crop planted one month earlier.

B. Plant height (cm) at 90 DAP

Table 2 shows that when comparing micro-sprinkler irrigation system (I2) to furrow irrigation system (I1), the highest plant at 90 DAP (48.59 cm at 90 DAP from 2017-19) was seen under micro-sprinkler irrigation system (I2). Among the various planting dates, the tallest plant of potato at 90 DAP (51.47 cm at 90 DAP from 2017-19) was seen in potatoes planted on October 15th (D4) compared to the other planting dates. The highest plant at 90 DAP (52.95 cm at 90 DAP during 2017-18 to 2018-19) was reported in treatment D4I2 when analyzing the collaboration of various planting dates with different systems of irrigation (On the 15th of October, potatoes were planted under micro-sprinkler irrigation). Treatment D_1I_1 (where potatoes were planted via furrow irrigation on September 1st) had the lowest plant height at 90 DAP, followed by D_1I_2 (where potatoes were planted on September 1st and irrigated with micro-sprinkler).

Table 2: Impact of irrigation systems and dates of planting on plant height (cm) at 90 DAP in potato.

Irrigation methods / Planting dates	Harvested at 75 DAP			Harvested at 90 DAP		
	2017–19 (Pooled)			2017-19 (Pooled)		
	Furrow (I_1)	Micro-sprinkler (I_2)	Mean	Furrow (I_1)	Micro-sprinkler (I_2)	Mean
1st September (D_1)				37.37	42.32	39.85
15th September (D_2)		CROP		41.77	48.10	44.94
30th September (D_3)		HARVEST		45.71	50.97	48.34
15th October (D_4)		AT 75		50.00	52.95	51.47
Mean		DAYS		43.72	48.59	
CD at significance level 5%				Irrigation (I) : 1.39 Planting Date (D) : 1.62 Factor (D) at same level of (I) : N/A Factor (I) at same level of (D) : N/A		

C. Number of stems hill^{-1} at final harvest

Table 3 shows that the micro-sprinkler irrigation technology (I2) produced considerably more stems hill-1 at harvest (1.77 at 75 DAP & 1.82 at 90 DAP from 2017-19) than the furrow irrigation method (I1). It was possible that the lower number of stems hill-1 is related to a lack of soil moisture under furrow compared to micro-sprinkler irrigation. The findings are consistent with Singh and Sood's findings (2013). The potato planted on October 15th (D4) had the highest number of stems hill-1 at harvest (1.95 at 75 DAP and 2.15 at 90 DAP from 2017 to 2018).

Table 3: Impact of irrigation systems and planting dates on number of stem hill^{-1} at final harvest in potato.

Irrigation methods / Planting dates	Harvested at 75 DAP			Harvested at 90 DAP		
	2017–19 (Pooled)			2017–19 (Pooled)		
	Furrow (I_1)	Micro-sprinkler (I_2)	Mean	Furrow (I_1)	Micro-sprinkler (I_2)	Mean
1st September (D_1)	1.20	1.40	1.30	1.17	1.42	1.30
15th September (D_2)	1.47	1.72	1.60	1.45	1.70	1.57
30th September (D_3)	1.70	1.90	1.80	1.67	1.92	1.80
15th October (D_4)	1.87	2.07	1.97	2.12	2.22	2.15
Mean	1.56	1.77		1.60	1.82	
CD at significance level 5%	Irrigation (I) : 0.12 Planting Date (D) :0.15 Factor (D) at same level of (I) : N/A Factor (I) at same level of (D) : N/A			Irrigation (I) : 0.11 Planting Date (D) : 0.19 Factor (D) at same level of (I) : N/A Factor (I) at same level of (D) : N/A		

(Potatoes were planted on October 15th under micro-sprinkler watering). Treatment D_1I_1 (where potatoes were planted via furrow irrigation on September 1st) had the fewest stems hill-1 at harvest, followed by D_1I_2 (On September 1st, potatoes were planted and irrigated with a micro-sprinkler).

Table 4: Impact of irrigation systems and dates of planting on numbers of leaves stem^{-1} at final harvest in potato.

Irrigation methods / Planting dates	Harvested at 75 DAP			Harvested at 90 DAP		
	2017–19 (Pooled)			2017–19 (Pooled)		
	Furrow (I_1)	Micro-sprinkler (I_2)	Mean	Furrow (I_1)	Micro-sprinkler (I_2)	Mean
1st September (D_1)	21.49	23.51	22.50	22.64	24.41	23.52
15th September (D_2)	22.39	24.09	23.24	23.91	27.18	25.55
30th September (D_3)	23.99	25.40	24.69	25.75	27.88	26.82
15th October (D_4)	26.02	26.63	26.33	26.95	27.97	27.46
Mean	23.47	24.91		24.81	26.86	
CD at significance level 5%	Irrigation (I) : 0.36 Planting Date (D) : 0.62 Factor (D) at same level of (I) : N/A Factor (I) at same level of (D) : N/A			Irrigation (I) : 0.93 Planting Date (D) : 0.15 Factor D at same level of (I) : N/A Factor I at same level of (D) : N/A		

When comparing the number of stems hill-1 at harvest (2.07 at 75 DAP & 2.22 at 90 DAP from 2017 to 2018), treatment D4I2 had the highest number of stems hill-1 at harvest (2.07 at 75 DAP & 2.22 at 90 DAP from 2017 to 2018). In punctually planted potato, a similar trend of a higher average number of stem hill-1 was seen by Rab *et al.* (2013); Haile *et al*. (2015); Thongam *et al*. (2017).

D. Numbers of leaves stem^{-1} at final harvest

Table 4 shows that under micro-sprinkler irrigation method (I2), the maximum number of leaves stem^{-1} at harvest of potato (24.91 at 75 DAP & 26.86 at 90 DAP during 2017-19) was recorded significantly higher than under furrow irrigation method (I1), the current findings are consistent with Singh and Sood (2013); Mustafa *et al*. (2017). Among the various planting dates, the potato planted on October 15th (D4) had the significantly higher number of leaves stem-1 at harvest (26.33 at 75 DAP & 27.46 at 90 DAP throughout 2017-18 and 2018-19) than the other planting dates. Similar trend of increased in plant height in timely planted potato was observed by Rab *et al.* (2013); Thongam *et al.* (2017); Dash *et al.* (2018). It could be correlated to optimizing temperature for the emergence of a bigger number of leaves at a timely sowing condition, as contrary to a warmer temperature at a potato crop planted one month earlier. When comparing the results of different planting dates with different irrigation methods, the treatment D4I2 (On the 15th of October, potatoes were planted under micro-sprinkler irrigation) had the highest number of leaves stem^{-1} at harvest (27.97 at 90 DAP from 2017 to 2018), which was significantly affected by different interactions. Treatment D_1I_1 (where potatoes were planted via furrow irrigation on September 1st) had the lowest number of leaves stem-1 at harvest, followed by D_1I_2 (where potatoes were planted on September 1st and irrigated with a micro-sprinkler).

E. Leaves weight hill^{-1} at final harvest (g)

Table 5 shows that with micro-sprinkler irrigation method (I2), maximum leaves weight hill-1 of potato at harvest (283.90 g at 75 DAP & 274.18 g at 90 DAP throughout 2017-19) was significantly higher than furrow irrigation method (I1). The present results are in conformity with the findings of Nunes, *et al.* (2006) found more leaf dry weight plant^{-1} of potato under micro-sprinkler irrigation as compared to drip irrigation.

Table 5: Impact of irrigation methods and dates of planting on leaf weight hill-1 (g) at final harvest in potato.

Irrigation methods / Planting dates	Harvested at 75 DAP			Harvested at 90 DAP		
	2017–19 (Pooled)			2017–19 (Pooled)		
	Furrow (I_1)	Micro-sprinkler (I_2)	Mean	Furrow (I_1)	Micro-sprinkler (I_2)	Mean
1st September (D_1)	187.52	230.83	208.84	173.82	214.75	194.29
15th September (D_2)	209.42	266.15	237.79	198.40	253.00	225.70
30th September (D_3)	266.60	294.25	280.42	265.07	298.47	281.77
15th October (D_4)	301.92	345.05	323.49	300.25	330.50	315.37
Mean	241.36	283.90		234.39	274.18	
CD at significance level 5%	Irrigation (I) : 13.23 Planting Date (D) : 13.08 Factor (D) at same level of (I) : N/A Factor(I) at same level of (D) : N/A			Irrigation (I) : 12.89 Planting Date (D) : 8.47 Factor D at same level of (I) : 14.47 Factor I at same level of (D) : 16.14		

Maximum leaves weight hill-1 of potato at harvest (323.49 g at 75 DAP & 315.37 g at 90 DAP from 2017 to 2018) was recorded in potato planted on October 15th (D4), which was statistically significant with D3 (268.48 g) at 90 DAP and others. It could be due to temperature optimization conducive to higher leaf growth at timely sown conditions as opposed to warmer temperatures at one month early planted potato crop.

When analyzing the effects of different planting dates and irrigation methods on potato leaves weight hill-1 at harvest (330.50 g at 90 DAP from 2017 to 2018), treatment D4I2 had the greatest leaves weight hill-1 at harvest (330.50 g at 90 DAP from 2017 to 2018). On the 15th of October, potatoes were planted under micro-sprinkler irrigation) during both the years. Lowest leaf weight hill^{-1} of potato at harvest was found in treatment D_1I_1 (where potatoes were planted via furrow irrigation on September 1st) followed by D_1I_2 (where potatoes were planted on September 1st and irrigated with micro-sprinkler).

F. Stem weight hill^{-1} at final harvest (g)

Table 6 shows that the significantly highest stem weight hill^{-1} of potato at harvest (65.46 g at 75 DAP and 62.44 g at 90 DAP from 2017-19) was obtained using micro-sprinkler irrigation system (I_2) over furrow irrigation system (I_1). The findings are in consistent with the findings of Nunes et al. (2006) found more stem dry weight of potato under micro-sprinkler irrigation as compared to drip irrigation. Among different dates of planting, significantly highest stem weight hill^{-1} of potato at harvest (79.10g at 75 DAP & 72.69 g at 90 DAP from 2017-19) was recorded in potato planted on 15th October (D_4) from 2017-19, over rest of the other planting dates.

While evaluating the collaboration of different planting dates with various system of irrigation, significantly maximum weight of stem hill^{-1} of potato at harvest (82.77 g at 75 DAP & 75.87 g at 90 DAP during 2017-18 and 2018-19, respectively) was recorded in treatment D_4I_2 (On the 15th of October, potatoes were planted under micro-sprinkler irrigation.) than rest of the other interactions. Minimum weight of stem hill^{-1} of potato at harvest was recorded in treatment D_1I_1 (where potatoes were planted via furrow irrigation on September 1st) followed by D_1I_2 (where potatoes were planted on September 1st and irrigated with a micro-sprinkler).

Table 6: Effect of irrigation methods and planting dates on stem weight hill^{-1} (g) at final harvest in potato.

Irrigation methods / Planting dates	Harvested at 75 DAP 2017–19 (Pooled)			Harvested at 90 DAP 2017–19 (Pooled)		
	Furrow (I_1)	Micro-sprinkler (I_2)	Mean	Furrow (I_1)	Micro-sprinkler (I_2)	Mean
1st September (D_1)	45.32	50.42	47.87	43.67	48.82	46.25
15th September (D_2)	50.45	58.45	54.34	47.65	57.62	52.63
30th September (D_3)	59.22	70.20	64.70	57.55	67.45	62.50
15th October (D_4)	75.42	82.77	79.10	59.50	75.87	72.69
Mean	57.54	65.46		54.59	62.44	
CD at significance level 5%	Irrigation (I) : 1.47 Planting Date (D) : 0.86 Factor (D) at same level of (I) : 1.53 Factor (I) at same level of (D) : 1.77			Irrigation (I) : 0.72 Planting Date (D) : 1.37 Factor (D) at same level of (I) : 2.02 Factor (I) at same level of (D) : 1.81		

CONCLUSION

As per observation of this research, Micro-sprinkler irrigation with Kufri-Lima found superior to increase growth parameters from 6.09 to 17.62 % significantly more were harvested at 75 DAP and 90 DAP, respectively, which was comparatively higher than furrow irrigation method. Finally, by following the conclusion, it is suggested that potato (Kufri-Lima) planted on 15th October and harvested at 75 DAP under micro-sprinkler irrigation method to be a good for growth parameters and yield of potato crop under Hisar conditions.

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