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Vipin Kumar Sagar
Department of Agronomy; Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, U.P., India

RK Naresh
Department of Agronomy; Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, U.P., India

Dinesh Kumar Sharma
Department of Agronomy; Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, U.P., India

Vineet Kumar
Department of Agronomy; Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, U.P., India

Thaneshwar
Department of Agronomy; Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, U.P., India

Praveen Kumar Sagar
Department of Agronomy, K.D. College Simbholi, Chaudary Charan Singh University, Meerut, U.P., India

Correspondence
Vipin Kumar Sagar
Department of Agronomy; Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, U.P., India

Furrow irrigated raised bed planting and irrigation schedules: Productivity, nutrient uptake and economics of irrigated wheat (*Triticum aestivum* L.) in Indo-Gangetic Plains

Vipin Kumar Sagar, RK Naresh, Dinesh Kumar Sharma, Vineet Kumar, Thaneshwar and Praveen Kumar Sagar

Abstract
A field experiment was conducted during 2014-15 and 2015-16 at Meerut, Uttar Pradesh., to assess the effects of furrow irrigated raised bed system and irrigation schedules on productivity, nutrient uptake and economics of wheat (*Triticum aestivum* L.) on sandy loam soil. In this experiment, 3 irrigation schedules in 6 land configuration including 5 bed configurations in furrow irrigated bed planting systems and 1 flat planting with row-to-row distance of 22.5 cm. In furrow irrigated bed planting systems, the crop was planted on the top of beds of 75 cm bed, 2 rows ($B_{75–2}$); 75 cm bed, 3 rows ($B_{75–3}$); 90 cm bed, 2 rows ($B_{90–2}$); 90 cm bed, 3 rows ($B_{90–3}$) and 90 cm bed, 4 rows ($B_{90–4}$). The bed configuration 90 cm bed, 4 rows ($B_{90–4}$) and irrigation schedules 4 cm irrigation at 0.8 IW/CPE registered significantly highest grain yield, straw yield, harvest index, net return, benefit: cost ratio, N, and K uptake. In case P uptake registered significantly highest under 90 cm bed, 3 rows ($B_{90–3}$) and 4 cm irrigation at 0.8 IW/CPE.

Keywords: Land configuration, irrigation schedules, economics, IW/CPE, Wheat

Introduction
Bread wheat (*Triticum aestivum* L.) is the most widely grown and consumed food crop and is the staple food for 35% of the world population. Wheat (*Triticum aestivum* L. emend. Fiori & Paol.) is very important and remunerative *rabi* crop of North India. It is the second most important cereal crop after rice, grown under diverse agro-climatic conditions. The irrigation efficiency of the border system has been found to be only 30-40% as compared to attainable level of 60-70%. The width of the bed and furrows commonly used are 40–45 and 25–30 cm, respectively, and the bed height is 15–20 cm. Inspired by the success of irrigated maize–wheat on permanent raised beds in Mexico, furrow irrigated raised bed planting system was introduced in Indo-Gangetic Plains in the mid 1990 for wheat Hobbs [1], Sayre and Hobbs [2]. Planting of crop on raised beds, usually 70 to 90 cm wide, with 2-3 rows on top of each bed, the furrows between the beds are used for irrigation water application. With this system, the emerging wheat plants form a solid stand in the space between the irrigation furrows. This system does allow the use of furrow for irrigation, which provides better water management and reduce seed rate than the conventional (flat bed) planting Jat [3]. Without water either through irrigation or rain, plant growth and development will be adversely affected. Water is essential for the maintenance to turgidity, absorption of nutrients and the metabolic process of the plants. Therefore, it becomes imperative to find out appropriate irrigation schedule in order to maintain the availability of soil moisture throughout the growing season for exploiting yield potential. Among the several recognized criteria of irrigation scheduling, the climatological approach is very scientific and has been identified widely among the scientists and research workers throughout the world. For many years, soil microbiologists have tended to differentiate soil microorganisms as beneficial or harmful according to their functions and how they affect soil quality, plant growth and yield, and plant health. Beneficial microorganisms are those that can fix atmospheric nitrogen, decompose organic wastes and residues, detoxify pesticides, suppress plant diseases and soil-borne pathogens, enhance nutrient. Irrigating wheat using this approach (IW/PAN-E = 0.9) saves 2 irrigation compared to 5-6 irrigations at fixed growth stages without any yield loss Prihar and Sandhu [4]. Being the prime natural resource for assured crop production, water has to be used judiciously and in scientific manner. To increase availability of irrigation water there is need to quantify the irrigation water by using improved irrigation method and proper scheduling of irrigation to obtain more yield and

economic returns. The objective of this research was to evaluate the effects of irrigation schedules on wheat productivity, nutrient uptake, and economics under different planting methods.

Materials and Methods

Site description

The field experiment was established in 2014 at Sardar Vallabhbhai Patel University of Agriculture &Technology, Meerut research farm (29^0 04', N latitude and77^0 42' 'E longitude a height of 237m above mean sea level) U.P., India. The region has a semi-arid sub-tropical climate with an average annual temperature of 16.8^0C. The highest mean monthly temperature (38.9^0C) is recorded in May, and the lowest mean monthly temperature (4.5^0C) is recorded in January. The average annual rainfall is about 665 to 726 mm (constituting 44% of pan evaporation) of which about 80% is received during the monsoon period. The predominant soil at the experimental site is classified as Typic Ustochrept. Wheat cultivar DBW-17 was shown on November 2014 and 2015 using 80 kg ha^{-1} for raised beds and 100 kg seed ha^{-1} for flat planting were done using zero till cum raised beds planter with inclined plate metering device. Soil samples for 0–20 cm depth at the site were collected and tested prior to applying treatments and the basic properties were non-saline (EC 0.42 dS m^{-1}) but mild alkaline in reaction (pH 7.98). The soil initially had 4.1 g kg^{-1} of SOC and 1.29 g kg^{-1} of total N (TN), 1.23 g kg^{-1} of total phosphorus, 17.63 g kg^{-1} of total potassium, 224 mg kg^{-1} of available N, 4.0 mg kg^{-1} of available phosphorus, and 97 mg kg^{-1} of available potassium.

A detailed description of crop establishment methods are necessary to compare the influence of land configuration practices on environmental performance (Derpsch *et al*., 2014).Six crop establishment methods, viz 75 cm bed, 2 rows (B_{75-2}); 75 cm bed, 3 rows (B_{75-3}) ; 90 cm bed, 2 rows (B_{90-2}); 90 cm bed, 3 rows (B_{90-3}); 90 cm bed, 4 rows (B_{90-4}); Flat planting, rows 22.5 cm apart in main plots and three irrigation schedule practices were viz 4 cm irrigation at IW/CPE 0.8**;** 5 cm irrigation at IW/CPE 1.0 ; 6 cm irrigation at IW/CPE 1.2 allotted to sub-plots in a split-plot design and replicated thrice. The gross and net plot sizes were 7.0 m×4.5 m and 6.0 m×3.5 m, respectively and treatments were superimposed in the same plot every year to study the cumulative effect of treatments. The dimension of the raised beds were 45 and 60 cm wide (top of the bed) x 18 cm height x 30 cm furrow width (at top) and the spacing from center of the furrow to another center of the furrow was kept at 75 and 90 cm. In furrow irrigated raised bed planting system, the crop was planted on the top of beds in bed configurations of 45 cm bed and 60 cm bed.

Data collection

Observations on grain yield, straw yield, biological yield, harvest index were recorded at harvest stage. The yield was estimated at 14% moisture at harvest by the produce obtained from net plot area, treatment wise. Plant nutrients were applied as per the state recommendations for wheat (N_{120}+ P_{60} + K_{40}). The remaining N was broadcasted with dry urea in two equal splits of 30 kg N ha^{-1}, (N_{30}) at crown root initiation (CRI) and the flag leaf initiation (FLI) crop growth stages. The nutrient uptake by wheat at harvest had been worked out by using the following equation:

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient Concentration (\%)}}{100} \times \text{Biomass (kg ha}^{-1}\text{)}$$

Nutrients Uptake

The total nutrient uptake was computed by adding of seed and straw determined separately taking into account their respective yield and nutrient content determined by using following methods:

- Nitrogen content of wheat seed and straw was determined by modified Micro Kjeldals's method [5].
- Phosphorus content was determined by vando-molybdophosphoric yellow colour method [5].
- Potassium was estimated by flame photometry method [5].

Irrigation water was applied using polyvinyl chloride pipes of 15-cm diameter and the amount of water applied to each plot was measured using a water meter (Dasmesh Co., India). The quantity of water applied and the depth of irrigation was computed using the following equations:

Quantity of water applied (L) = $F \times t$----- (1)

Depth of water applied (cm) = L /A /1000 ----- (2)

Where F is flow rate (L/s), t is time (s) taken during each irrigation and A is area of the plot (m^2). Rainfall data was recorded using a rain gauge installed within the meteorological station. The total amount of water (input water) applied was computed as the sum of water received through irrigation (I) and rainfall (R).Water productivity (WP_{I+R}) (kg/m^3) was computed as follows Humphreys *et al.*[6]**.** Irrigation through tube-well of discharge 8 litre/second was given to each plot and measured with the help of Parshall flume.

Grain yield was determined at maturity and the cost of cultivation of wheat was worked out. Cost of labour, tractor for tillage and sowing, weeding, fertilizer application, harvesting and threshing were calculated as per prevailing market rates during the period of experimentation. Gross return was worked out at the prevailing market prices. Benefit: cost ratio was calculated dividing net returns by the cost of cultivation of individual treatment.

Statistical analysis

The data on yield, oil content and protein content as well as their yield were recorded as per the standard procedure. The treatment differences were tested by using "F" test and critical differences at 5% probability.

Results and Discussion

Nutrient uptake

Nitrogen: Total (grain + straw) uptake of nutrients (N, P, K) analyzed at crop maturity varied significantly due to land configuration and irrigation schedules. Land configuration 90 cm bed, 4 rows (B_{90-4}) was recorded significantly maximum total nitrogen uptake [Table 1] as compared to all other treatments except 90 cm bed, 3 rows (B_{90-3}) during both the year of study.

Table 1: Effect of land configuration and irrigation schedules on N uptake

Treatment	N Uptake (Kg ha^{-1})				Total N uptake (Kg ha^{-1})	
	Grain		Straw			
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Land configuration						
75 cm bed, 2 rows	67.25	69.16	29.56	30.78	96.82	99.94
75 cm bed, 3 rows	66.82	68.88	28.36	28.81	95.19	97.69
90 cm bed, 2 rows	66.64	68.53	30.20	31.85	96.84	100.38
90 cm bed, 3 rows	75.60	77.96	31.32	32.78	106.92	110.75
90 cm bed, 4 rows	79.53	81.55	31.15	31.78	110.68	113.33
Flat planting	70.47	71.97	28.01	29.05	98.49	101.03
SEm(±)	0.96	1.00	0.41	0.45	1.36	1.45
C.D. (P=0.05)	*3.02*	*3.16*	1.32	1.42	*4.27*	4.58
Irrigation schedules						
4 cm irrigation at IW/CPE 0.8	77.09	79.50	32.10	33.60	109.19	113.09
5 cm irrigation at IW/CPE 1.0	73.54	75.54	31.05	32.11	104.59	107.65
6 cm irrigation at IW/CPE 1.2	62.53	63.00	26.16	26.83	88.69	90.82
SEm(±)	0.31	0.32	*0.17*	*0.18*	*0.46*	*0.51*
C.D. (P=0.05)	*0.91*	*0.92*	*0.49*	*0.52*	*1.34*	*1.47*
Interaction I ×B	Sig	Sig	Sig	Sig	Sig	Sig

The significant maximum total nitrogen uptake (109.19 and 113.09 kg N ha^{-1}) was recorded with the application of irrigation at 4 cm irrigation at 0.8 IW/CPE to all other treatments. However, treatment 5 cm irrigation at 1.0 IW/CPE was significantly superior over 6 cm irrigation at 1.2 IW/CPE which recorded minimum total nitrogen uptake during the years of experimentation.
These results are in line with the findings of Talukder *et al*. [7] and Hossain *et al*. [8].

Phosphorus: The data pertaining to total phosphorus uptake (kg ha^{-1}) by grain and straw (kg ha^{-1}) after crop harvest was affected significantly by land configuration and treatment 90 cm bed, 3 rows (B_{90-3}) performed superior over all other treatments during both the year of study.

Table 2: Effect of land configuration and irrigation schedules on P uptake

Treatment	P Uptake (Kg ha^{-1})				Total P uptake (Kg ha^{-1})	
	Grain		Straw			
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Land configuration						
75 cm bed, 2 rows	12.74	13.83	8.33	8.50	21.07	22.33
75 cm bed, 3 rows	12.65	13.46	7.95	8.05	20.59	21.51
90 cm bed, 2 rows	13.50	14.56	9.31	9.80	22.81	24.36
90 cm bed, 3 rows	14.82	16.17	9.86	10.28	24.68	26.45
90 cm bed, 4 rows	14.62	15.49	7.91	8.07	22.53	23.54
Flat planting	13.60	14.24	7.98	8.10	21.58	22.34
SEm(±)	*0.29*	0.39	*0.18*	*0.23*	*0.47*	*0.59*
C.D. (P=0.05)	*0.96*	1.24	*0.56*	*0.72*	*1.48*	*1.84*
Irrigation schedules						
4 cm irrigation at IW/CPE 0.8	15.23	16.57	9.42	9.70	24.65	26.27
5 cm irrigation at IW/CPE 1.0	13.93	14.83	9.36	9.69	23.29	24.52
6 cm irrigation at IW/CPE 1.2	11.81	12.46	6.90	7.02	18.70	19.48
SEm(±)	0.23	0.27	0.15	0.18	0.39	0.42
C.D. (P=0.05)	0.67	0.78	0.45	0.54	1.13	1.24
Interaction I ×B	N.S	N.S	N.S	N.S	N.S	N.S

Treatment 75 cm bed, 3 rows (B_{75-3}) was recorded the minimum phosphorous uptake during both the year of study [Table 2]. Among irrigation schedules was significantly higher (24.65 and 26.27 kg ha^{-1}) with 4 cm irrigation at 0.8 IW/CPE than 5 cm irrigation at 1.0 IW/CPE and 6 cm irrigation at 1.2 IW/CPE 1.2 during study of experimentation Sepat *et al*. [9] and Idnani and Kumar [10].

Potassium: It is evident from the data in [Table 3] the 90 cm bed, 4 rows (B_{90-4}) land configuration registered was significantly higher in total potassium uptake (kg ha^{-1}) (119.18 and 121.70 kg ha^{-1}) as compared to all other land configuration practices. The total uptake of potassium increased with the increasing moisture content. Highest total potassium uptake (119.76 and 123.63 kg ha^{-1}) was recorded with 4 cm irrigation at 0.8 IW/CPE, which differed significantly from 5 cm irrigation at 1.0 IW/CPE and 6 cm irrigation at 1.2 IW/CPE in both the years.
The interaction, irrigation schedules and land configuration inrespect to total nitrogen and potassium uptake was significant (Table 1 and 3). Maximum total nitrogen and potassium uptake was observed in 4 cm irrigation at 0.8 IW/CPE to 90 cm bed, 4 rows (B_{90-4}) land configurationas compare to 5 cm irrigation at 1.0 IW/CPE and 6 cm irrigation at 1.2 IW/CPE, during both years.

Table 3: Effect of land configuration and irrigation schedules on K uptake

Treatment	K Uptake (Kg ha-1)				Total K uptake (Kg ha-1)	
	Grain		Straw			
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Land configuration						
75 cm bed, 2 rows	17.74	19.01	92.65	95.73	110.39	114.74
75 cm bed, 3 rows	16.20	17.12	93.24	94.53	109.44	111.65
90 cm bed, 2 rows	17.84	19.42	93.45	95.88	111.29	115.29
90 cm bed, 3 rows	19.80	21.07	97.70	99.98	117.49	121.20
90 cm bed, 4 rows	19.79	20.33	99.39	101.37	119.18	121.70
Flat planting	17.29	18.03	92.33	94.15	109.62	112.17
SEm(±)	*0.25*	*0.29*	*1.27*	*1.39*	*1.51*	*1.68*
C.D. (P=0.05)	*0.79*	*0.92*	*3.99*	*4.37*	*4.75*	*5.28*
Irrigation schedules						
4 cm irrigation at IW/CPE 0.8	20.35	21.70	99.40	101.93	119.76	123.63
5 cm irrigation at IW/CPE 1.0	18.31	19.40	97.99	100.18	116.30	119.57
6 cm irrigation at IW/CPE 1.2	15.67	16.46	86.99	88.71	102.66	105.17
SEm(±)	*0.09*	*0.10*	*0.49*	*0.50*	*0.56*	*0.58*
C.D. (P=0.05)	*0.26*	*0.28*	*1.42*	*1.45*	*1.62*	*1.68*
Interaction I ×B	Sig	Sig	Sig	Sig	Sig	Sig

The higher uptake of NPK in grain and straw under furrow irrigated raised beds plots was because of more availability of these nutrients, which encouraged the crop growth and finally higher grain and biomass yield. The nutrient status of the plant tissue being the genetic character affected less by the environment but, higher growth require higher uptake. However the K uptake through grain and straw was due to variation in grain and straw yield recorded under different land configuration techniques. Similar result have been reported by; Jat *et al.* [11] and Naresh *et al.* [12].

The higher NPK uptake was mainly because of higher grain and straw yield in 4 cm irrigation at 0.8 IW/CPE compared to 5 cm irrigation at 1.0 IW/CPE and 6 cm irrigation at1.2 IW/CPE during both the years. As the NPK content in grain and straw was affected by the irrigation scheduling during both the years. The higher NPK uptake was mainly because of higher grain and straw yield in 4 cm irrigation at 0.8 IW/CPE followed by 5 cm irrigation at 1.0 IW/CPE compared to 6 cm irrigation at1.2 IW/CPE during both the years. Similar trend have been observed by Ingle *et al.* [13].

The higher amount of uptake of nutrients under furrow irrigated raised bed planting techniques and irrigation schedules was associated with higher bio-mass accumulation under these treatments, which led to higher amount of uptake of these nutrients. The higher nutrient uptake in 4 cm irrigation at 0.8 IW/CPE with furrow irrigated raised beds is mainly due to less leaching loss of nutrients and avail-ability of sufficient moisture for mineralization of native as well as applied nutrients. The higher uptake efficiency of nutrients depends on a myriod of factors including nutrient availability due to favorable soil biota 4 cm irrigation at 0.8 IW/CPE with furrow irrigated raised beds compared to precision leveling with flat beds.

Yield

The number of spike m^{-1}, number of grains $spike^{-1}$, and test weight higher with B_{90-2} as compare to rest of treatments. The number of grains $pike^{-1}$ was higher in 90 cm than 75 cm beds and flat planting. The irrigation scheduling 4 cm irrigation at 0.8 IW/CPE recorded significantly values for all the above yield attributes as compare to other irrigation schedules.

The grain yield (46.52, 47.63 q ha^{-1}), significantly higher [Table 4] were recorded with B_{90-4} land configuration the as compared to all other treatments during experimentation. The grain yield increased 11.00 and 12.02%, straw yield 7.0 and 7.3% with B_{90-4} land configuration over flat planting during first and second year, respectively. Treatments B_{75-4} and flat planting were at par with each other during both the year of study. Higher grain yield with bed planting of wheat has been also reported by Bhahma *et al.* [14], Kumar *et al.* [15] and Thind *et al.* [16].

Table 4: Yield attributing characters and yield as influenced by land configuration method and irrigation schedule

Treatment	Spike m-1		No. of Spikelet's spike-1		No. of grains spike-1		Grain yield (q ha-1)	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Land configuration								
75 cm bed, 2 rows	115	118	54.7	56.8	43.46	43.80	39.33	40.18
75 cm bed, 3 rows	97	100	51.0	53.0	41.40	41.67	40.28	41.39
90 cm bed, 2 rows	134	140	55.9	58.6	44.15	44.67	37.80	38.57
90 cm bed, 3 rows	128	133	55.4	57.8	44.01	44.41	43.06	44.12
90 cm bed, 4 rows	110	115	52.8	54.4	43.51	43.87	46.52	47.63
Flat planting	81	84	50.0	52.3	42.74	42.95	41.92	42.52
SEm(±)	*2.03*	*1.96*	*0.35*	*0.45*	*0.14*	*0.15*	*0.57*	*0.54*
C.D. (P=0.05)	*6.40*	*6.16*	*1.11*	*1.41*	*0.45*	*0.46*	*1.79*	*1.70*
irrigation schedules								
4 cm irrigation at IW/CPE 0.8	119	123	55.0	57.7	44.17	44.58	44.01	44.88
5 cm irrigation at IW/CPE 1.0	112	117	53.0	55.4	43.72	43.23	42.92	43.97
6 cm irrigation at IW/CPE 1.2	101	105	46.8	47.9	40.75	40.87	37.53	38.35
SEm(±)	*0.73*	*0.76*	*0.20*	*0.20*	*0.10*	*0.12*	*0.18*	*0.18*
C.D. (P=0.05)	*2.14*	*2.22*	*0.57*	*0.58*	*0.29*	*0.34*	*0.51*	*0.53*
Interaction I × B	Sig	Sig	Sig	Sig	NS	NS	Sig	Sig

The results have clearly shown that the grain yield in land configurations B_{75-2}, B_{75-3}, B_{90-2} and B_{90-3} was lower than that in flat planting due to low plant density, but the yield was higher in B_{90-4} than flat planting. The irrigation schedules having good tillering and higher rates of photosynthesis, had high biomass production and therefore was more suited for furrow irrigated raised bed planting system than flat planting.

The interaction, Irrigation schedules × land configuration was significant for the number of spikes m^{-1}, number of Spikelet's $spike^{-1}$and grain yield. The number of spikes m^{-1} was significantly higher in B_{90-2} and B_{90-3} as compared to B_{90-4}, B_{75-3}, B_{75-2} and flat planting. No significant differences were found for the number of grain $spike^{-1}$ between irrigation schedules '4 cm irrigation at 0.8 IW/CPE' and '5 cm irrigation at 1.0 IW/CPE' but the 2 irrigation schedules produced higher number of grain $spike^{-1}$ than 6 cm irrigation at 1.2 IW/CPE except in B_{75-3} and flat planting. Highest number of grain $spike^{-1}$was produced by the irrigation schedules in B_{90-2}. The crop produced significantly higher grain yield in B_{90-4} and B_{90-3} as compared to flat planting, followed by B_{75-3}, B_{75-2} and B_{90-2} land configuration system same trend found next year. In cereals such as wheat grain yield is a function of number of spikes m^{-1}, number of grains $spike^{-1}$ and seed size, and the latter two traits are decided by the current rates of photosynthesis (depending on leaf area index) and remobilization of stored assimilates, ie, crop biomass by Grover *et al.* [17], Maurya and Singh [18] and Idnani and Kumar [19].

Economics

Grain and straw yield were major outputs, which cause differences in net return. The crop gave highest gross return of Rs. 85625 and Rs. 90606 ha^{-1} with 90 cm bed, 4 rows (B_{90-4}) land configuration [Table 5]. The 4 cm irrigation at 0.8 IW: CPE cm also recorded maximum gross return Rs. 81485 and Rs. 86055 ha^{-1}. The net returns and net returns invested because of more increase in grain yield and gross income in comparison to increase in cost of cultivation and highest net profit and B: C ratio was recorded in 90 cm bed, 4 rows (B_{90-4}) land configuration pattern. In case irrigation schedules, B: C ratio of 1.89 and 1.94 were recorded under 4 cm irrigation at 0.8 IW: CPE. This was due to the proportionately higher in output in comparison to almost similar input. Thus economically the 90 cm bed, 4 rows (B_{90-4}) land configuration and 4 cm irrigation at 0.8 IW/CPE proved superior over all the treatments combination under present investigation

Table 5: Effect of land configuration and irrigation schedules on profitability

Treatment	Cost of cultivation (Rs. ha^{-1})		Gross income (Rs. ha^{-1})		Net return (Rs. ha^{-1})		B:C ratio	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Land configuration								
75 cm bed, 2 rows	28520	29343	73628	78008	45108	48065	1.58	1.64
75 cm bed, 3 rows	28520	29343	75347	80036	46827	50093	1.64	1.71
90 cm bed, 2 rows	27820	28643	71199	75303	43379	46060	1.56	1.61
90 cm bed, 3 rows	27820	28643	79774	84390	51954	55147	1.87	1.93
90 cm bed, 4 rows	27820	28643	85625	90606	57805	61363	2.08	2.14
Flat planting	28740	29630	77590	81727	49950	52764	1.74	1.78
Irrigation schedules								
4 cm irrigation at IW/CPE 0.8	28490	29380	81485	86055	53762	57059	1.89	1.94
5 cm irrigation at IW/CPE 1.0	28206	28930	79775	84571	51752	55075	1.83	1.90
6 cm irrigation at IW/CPE 1.2	27923	28813	70331	74445	42008	44649	1.50	1.55

Similar result was reported by Naresh *et al.* [20], Tanwar *et al.* [21] jat and singh [22].

Conclusion

The B_{90-4} land configuration increased N uptake while B_{90-3} improved P and K uptake up to 12.37; 12.17% and 14.18; 18.40% and 8.72; 8.50% over flat planting tillage practices. Land configuration B_{90-4} was recorded maximum net profit of Rs 57805 and Rs 61363 ha^{-1} and B: C ratio were registered 2.08 and 2.14 over rest of the treatments. The irrigation schedules 4 cm irrigation at 0.8 IW/CPE were recorded significant higher N, P and K uptake over other treatments during 2014-15 and 2015-16, respectively. The highest net returns Rs. 53762 and Rs. 57059 ha^{-1} with B: C ratio of 1.89 and 1.94 were recorded under 4 cm irrigation at 0.8 IW/CPE irrigation schedules.

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