International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(3): 2771-2775

Received: 18-03-2020
Accepted: 22-04-2020

Nikhil Raghuvanshi
Research Scholar, Department of Agronomy, Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

BN Singh
Assistant Professor, Department of Agronomy, Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Corresponding Author:
Nikhil Raghuvanshi
Research Scholar, Department of Agronomy, Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Impact of sowing method and nitrogen management on growth of wheat (*Triticum aestivum* L.)

Nikhil Raghuvanshi and BN Singh

DOI: https://doi.org/10.22271/chemi.2020.v8.i3an.9632

Abstract
Wheat (*Triticum aestivum* L.) was planted for two consecutive seasons (2017-18 and 2018-19) at Agronomical research farm, Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, India situated at middle Gangetic plain region to determine the experiment obtained in split plot design and comprised of four sowing methods (A_1) Broadcasting method, (A_2) Line sowing method, (A_3) Furrow Irrigation Ridge Bed (FIRB) and (A_4) Criss cross sowing (20× 20 cm) and five nitrogen managements treatments (B_1) Control, (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation, (B_3) 50% N as basal + 50% N after first irrigation, (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal, (B_5) 25% N as basal + 75% through FYM as basal was laid out with three replication on crop growth, seed yield, yield components. Statistical analysis of the obtained data presented that the (A_3) Furrow Irrigation Ridge Bed (FIRB) sowing method and application of nitrogen (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation dominated other treatments for plant growth and economics. Current results suggested that (A_3) Furrow Irrigation Ridge Bed (FIRB) sowing method and (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation can be adopted as best treatments for wheat cultivation under semi-arid land conditions of India.

Keywords: Growth, yield, nitrogen, sowing method, wheat

Introduction
Wheat (*Triticum aestivum* L.) is the most important crop that excels all other cereals both in area and production and also known as king of cereals (Costa *et al.*, 2012) [3]. Wheat (*Triticum aestivum* L.) is the second most important cereal crop in India. It's one of the most nutritious cereals with higher protein and its contribution to human diet puts it in the first rank of plants that feed the world. Appropriate sowing method is one of important agronomic approaches that can be used to enhance wheat yield by optimizing tillering capacity and the efficient utilization of other available resources (Mehmood *et al.*, 2012) [10]. Sowing of wheat under FIRBS with 2 and 3 rows per bed was found to produce more yield compared to flat sowing and other methods (Kumar *et al.*, 2010) [7]. Row planting has many advantages over broadcasting, as it need less seed and facilitate field inspection and more yield (Pirzada *et al.*, 2018) [11]. Criss cross methods was observed maximum plant height and dry matter accumulation at successive growth over the line sowing but remained at par with FIRB system (Chouhan *et al.*, 2017) [2].
Nitrogen (N) is an essential elements for wheat production. Soils can supply a considerable amount of nitrogen to a wheat crop as a result of mineralization of nitrogen from the soil organic matter, a process that takes place both previous to and during the crop growth period (Sylvester-Bradley *et al.*, 2001) [12]. Optimum amount and time of fertilizer application is considered a key to the bumper crop of wheat. Time of fertilizer application can affect the N-utilization efficiency by wheat (Jan *et al.*, 2007) [4]. Nitrogen application at proper time is important to make sure profitable wheat production (Howard *et al.*, 2002) [5]. Several studies have shown that split application of nitrogen fertilizer results in higher nitrogen use efficiency and higher grain yield than under single applications (Khan *et al.*, 2011; López-Bellido *et al.*, 2012) [6, 9]. The present study was conducted to investigate the impact of sowing method and nitrogen management on growth of wheat (*Triticum aestivum* L.)

Materials and Methods

Materials (Experimental site, Materials)

Field experiments were carried out during rabi seasons of 2017-18 and 2018-19 at at the Agronomical research farm of the Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.), India, lies between latitude 26.47^0 North and at a longitude 82.12^0 East with an elevation of about 113 meters from sea level and is subjected to extremes of weather conditions., in Eastern Uttar Pradesh, India. In a semi-arid zone with maximum and mean temperature of 45 ^{0}C and 30 ^{0}C during summer, 25 ^{0}C and less than 5 ^{0}C during winter, the annual rainfall ranges from 750 mm to 1150 mm, with relative humidity ranging from 40 to 90 percent. The soil is a mixture of sand ≥ 25%, silt ≤ 50% and clay ≤ 25%. Materials used in the study were four sowing method, namely, (A_1) Broadcasting method, (A_2) Line sowing method, (A_3) Furrow Irrigation Ridge Bed (FIRB) and (A_4) Criss cross sowing (20× 20 cm) and five nitrogen managements treatments (B_1) Control, (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation, (B_3) 50% N as basal + 50% N after first irrigation, (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal, (B_5) 25% N as basal + 75% through FYM as basal as sub plot treatment.

Methods

The land was properly cleaned, ploughed, harrowed, leveled, ridged and divided into three blocks running perpendicular to the gradient. Each block contained 4 plots randomized with four sowing method and each plot was further divided into five subplots randomized with nitrogen management treatments. The design used was split plot design with three replicates. Sowing was done 7th and 5th December during 2017-18 and 2018-19, respectively. Nitrogen fertilizer in form of urea at rate of 120 Kg/ha was applied as per the treatments. Phosphorus and potassium were applied at the rate of 60 and 40 kg/ha as basal application, uniformly to all plots and gravitational 6 irrigation was applied according to the temperature, and all other agronomic practices. Planting depth, weeding and harvesting etc. were kept constant for all treatments. The observations were recorded for germination percentage, plant height, leaf area index, number of tillers. All the data were processed by using EXCEL and further analyzed with the Date Processing System (DPS).

Result and Discussion

Plant height

The data presented in Table. 1 showed that in general plant height (cm) increased with the age and was maximum at 90 DAS. The plant height significantly varied due to different planting methods and nitrogen management. The results revealed that the maximum plant height of wheat was recorded under (A_3) FIRB (furrow irrigation and ridge bed) as compared to (A_2) line sowing method and (A_4) Criss cross sowing (20× 20 cm) of planting at all the growth stages at 60 DAS and 90 DAS. Significantly the smallest plants were observed under (A_1) broadcasting method of planting irrespective of growth stages and years of experimentation. Same finding suggest by Chauhdary *et al.* (2016) [1] who concluded that wheat sowing under bed planting showed better results with highest plant height, numbers of tillers, while lower plant height was observed as the lowest under broadcasting among all treatments.

Nitrogen management significantly influenced the plant height of wheat and the tallest plants were recorded under (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation treatment at 60 and 90 DAS during both the years. However, at 60 and 90 DAS, it was found to be at par with (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal treatment during both the years of experimentation. (B_1) Control treatment that was 0 kg N produced significantly the smallest plants of wheat in both the years and at all the stages of crop growth. Same work suggest by Jan *et al.* (2007) [4] who observed that nitrogen application in 3 splits displayed greater height and no. of tillers in wheat plants it may be due to split application during early growth phase improves growth pattern. Another reason may be split doses provided the chance to plants to uptake more N during whole plant period. Concerning a splitting of the same N rate in three amendments, the late N application was totally assimilated by plants, increasing the biomass of leaf, root, and ear. This indicates that a late N application may accumulation the growth and grain yield. (Zahedi *et al.*, 2004) [13].

Number of tillers per running meter

The data presented in Table.1 revealed that the number of tillers per running meter of increased sharply from 30 DAS to 60 DAS in comparison to 60 DAS to 90 DAS and at harvest. The number of tillers per running meter significantly highest under (A_3) FIRB (furrow irrigation and ridge bed) of planting at 60 and 90 DAS and that was found at par with (A_2) line sowing method for both years 2017-18 and 2018-19. Significantly the least number of tillers were observed under (A_1) broadcasting method of planting irrespective of growth stages and years of experimentation. Same finding suggest by Chauhdary *et al.* (2016) [1] who reported that wheat sowing under bed planting showed better results with highest numbers of tillers, while lower plant height was observed as the lowest under broadcasting among all treatments.

Nitrogen management significantly influenced number of tillers of wheat and the maximum number of tillers per running meter was recorded under treatment (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation than other treatments at 60 and 90 DAS followed by (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal during both the years 2017-18 and 2018-19. However, (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation significantly influenced at 60 and 90 DAS and it was at par with (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal during both the years 2017-18 and 2018-19. Significantly the least number of tillers were observed under (B_1) control treatment of nitrogen management irrespective of all growth stages and years of experimentation.

Dry matter accumulation (DMA), g running per meter

The significant result was found at 60 and 90 DAS for both the years. The significantly maximum dry matter accumulation at 60 and 90 DAS was found under FIRB (furrow irrigation and ridge bed) planting method. However, it was at par with line sowing method in both year2017-18 and 2018-19. Same finding suggest by Chouhan *et al.* (2017) [2] who reported that the different sowing methods maximum plant height and dry matter accumulation at successive growth stages was recorded with criss-cross method which ultimately increase the yield of wheat over line sowing but remained at par with FIRB system.

Under nitrogen management treatments, the maximum dry matter accumulation was found with (B_2) 50% N as basal +

25% N after first irrigation + 25% N after second irrigation during both the years and at all the stages of growth. At 60 and 90 DAS the maximum DMA significantly found with (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation and it was at par with (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal for both year 2017-18 and 2018-19.

Leaf area index (LAI)

Leaf area index was estimated at 30, 60 and 90 DAS in (Table 2). The data clearly show that the LAI increased during crop growth period and recorded maximum at 60 DAS. The rate of increase in LAI was recorded maximum between the stages of 30 to 60 days indicating the grand growth period of the crop. The highest leaf area index was found in FIRB (furrow irrigation and ridge bed) planting method at 30 and 60 DAS in the both years 2017-18 and 2018-19 and it was at par with (A_2) Line sowing method at 30 DAS of sowing followed by (A_4) Criss cross sowing (20× 20 cm). Where lowest LAI recorded with (A_1) broadcasting method of planting at all stage for both year 2017-18 and 2018-19. Researcher reported sowing of wheat under FIRBS with 2 and 3 rows per bed was found to produce more yield compared to flat sowing and other methods (Kumar *et al.*, 2010) [7].

Under nitrogen management, significantly maximum LAI was recorded under (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation at 60 DAS. However, it was at par with (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal followed by (B_3) 50% N as basal + 50% N after first irrigation. Where lowest LAI recorded with without nitrogen application plot for both year of experiment. At 30 DAS, the highest LAI significantly recorded with (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation followed by (B_3) 50% N as basal + 50% N after first irrigation during both the years.

Leaf area duration

The leaf area duration (LAD) was calculated for the period between 30-60 DAS and 60-90 DAS. The values at 30-60 DAS was showed slightly higher value with (A_3) FIRB (furrow irrigation and ridge bed) planting method in comparison to other three methods during both the years.

The different nitrogen management treatment influenced LAD during both the years. The LAD between 30-60 DAS was maximum under (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation in both the years. The lowest leaf area duration was recorded under without nitrogen application (control) irrespective of years and stages of observation.

Number of leaves

In this chapter we also records the number of green leaves per running meter at 30, 60 and 90 DAS. Leaves is the main accumulation part of plant and it play a vital role in terms of growth, more leaf absorbed more sun light and produce more food for plant and it enhance the plant growth in terms of plant height, tillers, Dry matter accumulation etc. The highest number of leaves per running meter at 60 DAS found with (A_3) FIRB (furrow irrigation and ridge bed) planting method followed by (A_2) line sowing method than (A_4) Criss cross sowing (20× 20 cm). The lowest number of leaves found with (A_1) broadcasting method at whole growth period and during both of the years. At 30 DAS, number of tillers did not statistically effected due to treatments during the both of year experiments. Significantly the lover number of leaves were observed under (A_1) broadcasting method of planting irrespective of growth stages and years of experimentation.

In both the years of study, the number of leaves per running meter in wheat was greatly influenced by all nitrogen management treatments. They influenced the number of leaves significantly as compared to control (B_1). The highest values of number of leaves were noticed in treatment (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation and it was at par with (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal at 60 DAS stages of crop growth as compared to all other treatments. The next best treatments were found to be (B_3) 50% N as basal + 50% N after first irrigation followed by (B_5) 50%RDN through Urea and 50% through FYM as basal. Where lowest number of leaves recorded with without nitrogen application plot (control) for both year of experiment. At 30 DAS, the no significantly affect found of treatments on number of leaves for both the year.

Chlorophyll content (SPAD value) of flag leaf and 3rd leaf

Chlorophyll content of 3rd leaf at 30 DAS did not vary significantly over all planting method for during both year. Chlorophyll content at 60 DAS for planting method found significantly effected and maximum chlorophyll content at 60 DAS was found with (A_3) FIRB (furrow irrigation and ridge bed) planting method of sowing and it was at par with (A_2) Line sowing method during 2018-19. Whereas the lowest chlorophyll content recorded with (A_1) broadcasting method of planting at all stage for both year 2017-18 and 2018-19. Same related work done by Kumar *et al.* (2017) [8] whose results revealed that growth and productivity were recorded significantly higher under zero tillage wheat with rice residue retention as compared to conventional method of broadcasting but it was statistically at par with zero tillage without residue and conventional method of line sowing. In both the years of study, chlorophyll content (SPAD value) of 3rd leaf in wheat was significantly influenced by all nitrogen management treatments. The maximum chlorophyll content (SPAD value) found with (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation and least found with control (B_1). The highest values of chlorophyll content (SPAD value) were noticed in treatment (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation and that was at par with (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal at 60 DAS stages of crop growth as compared to all other treatments. The next best treatments were found to be (B_3) 50% N as basal + 50% N after first irrigation followed by (B_5) 50%RDN through Urea and 50% through FYM as basal. Where lowest chlorophyll content (SPAD value) recorded with without nitrogen application plot (control) for both year of experimentation. At 30 DAS, the highest chlorophyll content (SPAD value) found with (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation and that was statistically at par with (B_3) 50% N as basal + 50% N after first irrigation and (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal and the no significantly affect found of treatments on chlorophyll content (SPAD value) for second year of experimentation.

Chlorophyll content of flag leaf at 60 DAS for planting method found significantly effected and maximum chlorophyll content at 60 DAS was found with (A_3) FIRB (furrow irrigation and ridge bed) planting method of sowing and that was at par with (A_2) Line sowing method and (A_4)

criss cross sowing (20× 20 cm) during both year of experimentation. Where lowest chlorophyll content recorded with (A_1) broadcasting method of planting at all stage for both year 2017-18 and 2018-19.

In both the years of study, chlorophyll content (SPAD value) of flag leaf in wheat was significantly influenced by all nitrogen management treatments. The maximum chlorophyll content (SPAD value) found with (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation and least found with control (B_1). The highest values of chlorophyll content (SPAD value) were noticed in treatment (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation and that was at par with (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal at 60 DAS stages of crop growth as compared to all other treatments. The next best treatments were found to be (B_3) 50% N as basal + 50% N after first irrigation followed by (B_5) 50%RDN through Urea and 50% through FYM as basal. Where lowest chlorophyll content (SPAD value) recorded with without nitrogen application plot (control) for both year of experimentation.

Table 1: Effect of sowing methods and nitrogen management on growth parameters of wheat *(Triticum astivum* L.) during 2017-18 and 2018-19

Treatment	Plant Height (cm)				Number of tillers				Dry matter accumulation				Number of leaves			
	60 DAS		90 DAS		60 DAS		90 DAS		60 DAS		90 DAS		30 DAS		60 DAS	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Sowing methods																
A_1	48.92	52.76	70.69	70.75	70.84	74.49	66.97	77.12	42.32	46.54	83.35	78.81	78.13	77.67	208.35	224.61
A_2	62.23	58.61	101.52	109.41	91.59	87.55	100.35	95.85	52.58	56.61	120.80	114.18	82.40	79.40	268.13	292.15
A_3	69.23	63.91	109.80	114.62	98.74	94.60	104.57	100.50	59.44	63.88	130.60	126.55	85.87	80.80	311.53	322.20
A_4	56.77	56.16	90.69	81.68	75.42	77.05	75.38	80.51	50.12	54.59	98.05	92.40	79.87	78.53	256.20	268.40
SEm ±	1.23	1.64	3.34	1.72	2.43	2.66	2.35	3.13	2.00	1.74	6.90	4.97	1.85	2.79	9.62	10.69
LSD	4.26	5.67	11.56	5.96	8.42	9.19	8.14	10.83	6.94	6.03	23.88	17.20	NS	NS	33.27	37.00
Nitrogen managements																
B_1	47.45	47.59	72.26	70.16	73.04	72.32	72.27	76.99	35.83	40.14	79.84	77.01	72.17	76.08	185.75	203.92
B_2	68.84	67.78	113.22	110.38	94.46	95.43	101.68	103.31	62.69	68.35	131.55	123.65	88.17	83.17	315.50	335.52
B_3	58.45	57.94	93.87	102.56	83.41	79.91	84.85	83.98	49.99	53.92	106.05	102.71	84.67	79.00	268.67	279.85
B_4	67.43	63.50	105.05	106.41	90.14	92.00	97.87	97.68	59.57	64.08	123.08	115.72	82.75	76.33	300.50	323.67
B_5	54.26	52.48	81.44	81.08	79.70	77.45	77.41	80.50	47.50	50.52	100.47	95.82	80.08	70.92	234.85	241.25
SEm ±	1.94	1.71	3.22	1.70	2.10	2.13	1.61	2.13	1.73	1.44	4.86	4.71	2.245	2.105	9.06	6.51
LSD	5.58	4.93	9.29	4.89	6.05	6.15	4.65	6.13	4.99	4.14	13.99	13.57	6.47	NS	26.10	18.75

(A1) Broadcasting method, (A2) Line sowing method, (A3) Furrow Irrigation Ridge Bed (FIRB) and (A4) Criss cross sowing (20× 20 cm) and (B1) Control, (B2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation, (B3) 50% N as basal + 50% N after first irrigation, (B4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal, (B5) 25% N as basal + 75% through FYM as basal

Table 2: Effect of sowing methods and nitrogen management on growth parameters of wheat *(Triticum astivum* L.) during 2017-18 and 2018-19

Treatment	LAI				Chlorophyll 3rd leaf				Chlorophyll flag leaf		Leaf area duration		Leaf Area Ratio			
	60 DAS		90 DAS		60 DAS		90 DAS		60 DAS		30-60 DAS		30 DAS		60 DAS	
	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Sowing method																
A_1	0.33	0.35	3.13	3.05	29.89	32.23	32.03	32.59	37.815	37.133	51.83	51.06	49.25	54.59	36.70	32.35
A_2	0.34	0.36	4.35	4.19	30.19	32.77	42.44	37.83	44.088	43.505	70.37	68.26	46.63	51.12	41.84	37.31
A_3	0.37	0.39	4.53	4.35	30.93	33.67	43.85	40.28	45.700	44.559	73.48	71.07	45.61	49.63	38.53	34.10
A_4	0.32	0.35	3.78	3.62	30.87	32.79	35.17	35.95	43.052	42.238	61.56	59.61	45.67	50.58	38.30	33.35
SEm ±	0.01	0.01	0.22	0.17	1.03	1.45	1.10	0.95	1.122	1.506	3.24	2.45	2.81	2.68	1.07	1.25
LSD	0.03	0.02	0.75	0.57	NS	NS	3.81	3.28	3.881	5.212	11.23	8.48	NS	NS	NS	NS
Nitrogen management																
B_1	0.29	0.31	2.60	2.47	28.21	30.56	34.99	29.26	38.067	37.475	43.43	41.66	42.60	46.62	36.95	30.91
B_2	0.37	0.40	4.75	4.60	32.58	34.65	41.98	40.47	46.475	45.617	76.25	74.27	42.48	45.72	38.19	33.75
B_3	0.36	0.39	4.15	4.01	31.80	33.82	38.01	38.44	43.198	42.410	67.72	66.23	52.17	58.76	41.52	37.32
B_4	0.34	0.37	4.65	4.50	30.14	33.26	39.63	39.50	45.049	43.930	75.30	73.31	49.89	53.34	39.09	35.23
B_5	0.33	0.35	3.59	3.43	29.33	32.04	37.24	35.63	40.530	39.863	58.84	57.04	46.81	52.97	38.45	34.17
SEm ±	0.013	0.013	0.15	0.12	1.016	1.05	1.04	1.00	0.892	1.041	2.17	1.81	2.52	2.49	1.89	1.49
LSD	0.04	0.04	0.42	0.34	2.926	NS	2.99	2.88	2.569	2.999	6.24	5.20	7.27	7.18	NS	NS

(A1) Broadcasting method, (A2) Line sowing method, (A3) Furrow Irrigation Ridge Bed (FIRB) and (A4) Criss cross sowing (20× 20 cm) and (B1) Control, (B2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation, (B3) 50% N as basal + 50% N after first irrigation, (B4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal, (B5) 25% N as basal + 75% through FYM as basal

Conclusion

On the basis of result of the experiment, it may be concluded that (A_3) FIRB (furrow irrigation and ridge bed) followed by (A_2) Line sowing method seems to be suitable for growth of late sown wheat and application of and (B_2) 50% N as basal + 25% N after first irrigation + 25% N after second irrigation followed by (B_4) 25% N as basal + 25% N after second irrigation + 50% through FYM as basal proved to be more remunerative for growth of late sown wheat in middle Gangetic Plain. Non-significant difference was detected between sowing methods and nitrogen management for all growth parameters.

References

1. Chauhdary JN, Khan UD, Shah SHH, Shahid MA, Arsalan M. Effect of sowing methods and seed rates on wheat yield and water productivity. Quality Assurance and Safety of Crops & Foods. 2016; 8(2):267-272.
2. Chouhan BS, Kaushik MK, Napelia V, Solanki NS, Singh B, Devra NS *et al*. Effect of sowing methods, scheduling of irrigation based on IW/CPE ratio and chemical weed control on plant height, dry matter accumulation and yield of wheat. Journal of Pharmacognosy and Phytochemistry. 2017; 6(3):169-172.
3. Costa R, Pinheiro N, Ameida AS, Gomes C, Coutinho J, Coco J *et al*. Effect of Sowing Date and Seeding Rate on Bread Wheat Yield and Test Weight under Mediterranean Conditions. Emir. J Food Agric. 2013; 25:951- 961.
4. Jan T, Jan MT, Arif M, Akbar H, Ali S. Response of wheat to source, type and time of nitrogen application. Sarhad J Agric. 2007; 23(4):871-879.
5. Howard DD, Newman MA, Essington ME, Percell WM. Nitrogen fertilization of conservation-tilled wheat. I. Sources and application rates. J Plant Nutr., 2002; 25(6):1315–1328.
6. Khan MI, Jan A, Hussain N, Jan MT, Qadoos M. Rainfed wheat response to tillage and nitrogen. Sarhad J Agric. 2011; 27(4):519–523.
7. Kumar M, Parvender S, Yadav A. Productivity potential of wheat in relation to different planting methods and nitrogen management strategies. Indian J Agri. Sci. 2010; 80(5):427-429.
8. Kumar N, Kamboj BR, Thakral SK, Singh M. Growth Parameters and Productivity of Wheat as Influenced by Crop Establishment Methods and Different Seed Rate, Int. J Pure App. Biosci. 2017; 5(4):2134-2140. doi: http://dx.doi.org/10.18782/2320-7051.2933
9. López-Bellido L, Mùnoz-Romero V, Benítez-Vega J, Fernández-García P, Redondo R, López-Bellido, RJ. Wheat response to nitrogen splitting applied to a Vertisols in different tillage systems and cropping rotations under typical Mediterranean climatic conditions. Europ. J Agronomy. 2012; 43:24–32.
10. Mehmood Z, Hussain M, Khan MB, Farooq S, Lee DJ, Farooq M. Narrow row spacing ensures higher productivity of low tillering wheat cultivars. Int. J Agric. Biol. 2012; 14:413-418.
11. Pirzada R, Chandio MA, Khaskheli N, Magsi NH, Perzada AA, Siyal M. Effect of varietal cum sowing methods trait on growth and yield of wheat (*Triticum aestivum* L.). National Journal of Advanced Research. 2018; 4(3):68-73.
12. Sylvester-Bradley R, Stokes DT, Scott RK. Dynamics of nitrogen capture without fertilizer: the baseline for fertilizing winter wheat in the UK. The Journal of Agricultural Science, Cambridge. 2001; 136:15–33.
13. Zheng H, Xiao HL, Dong ZBL, Rong S, Wang G. Combined effect of nitrogen, phosphorous, potassium fertilizer and water on spring wheat yield in an arid desert region. Communications in Soil Sci., and Plant Analysis. 2004; 35(1 &2):161-175.