The Pharma Innovation Journal 2020; 9(2): 62-68

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; 9(2): 62-68

www.thepharmajournal.com
Received: 14-12-2019
Accepted: 18-01-2020

Tej Pratap
Department of Agrometeorology, Krishi Vigyan Kendra Kotwa Azamgarh, Uttar Pradesh, India

Mizanul Haque
Department of Agronomy, Bihar Agricultural University Sabour, Bhagalpur, Bihar, India

Arvind Bhai Patel
Department of Agronomy, Bihar Agricultural University Sabour, Bhagalpur, Bihar, India

Rajneesh Singh
Agronomy, ANDUA&T Kumargunj Ayodhya, Uttar Pradesh, India

Hanumant Singh
Soil & Land Use Survey of India, Ahmedabad, Gujarat, India

Corresponding Author:
Tej Pratap
Department of Agrometeorology, Krishi Vigyan Kendra Kotwa Azamgarh, Uttar Pradesh, India

Effect of precession nitrogen management and tillage practices on growth parameter of wheat (*Triticum aestivum* L.)

Tej Pratap, Mizanul Haque, Arvind Bhai Patel, Rajneesh Singh and Hanumant Singh

Abstract
A field experiment was conducted during *Rabi* 2014-15 and 2015-16 at BAC, Research Farm Sabour to access the effect of precession nitrogen management and tillage practices on growth parameter of wheat. The experiment was carried two tillage practices (conventional tillage, CT and Zero tillage, ZT) in main-plots and six different nutrient management practices [*viz*.N_1-Recommended dose of nutrients (150:60:40 kg NPK/ha, full P & K and ½ N at basal +1/2N in two splitting at 1st & 2nd irrigation- Top dressing after irrigation, N_2-Recommended dose of nutrients (150:60:40kg NPK/ ha, full P & K and ½ N at basal +½ N in two splitting at 1st & 2nd irrigation-Top dressing before irrigation, N_3-SSNM Based on Nutrient Expert (NE), N_4-70% N of SSNM based on NE+ remaining N as guided by Green Seeker, N_5 Nitrogen enriched plots (225:60:40Kg. NPK/ha.) and N_6-SPAD based nutrient management, (75Kg. N as basal +25Kg. N as 1st top dress +25Kg. N at 42 SPAD reading) in sub plots with 3 replications. The experimental results revealed that different tillage practices failed to exert any significant differences on growth parameter of wheat, while higher plant population were observed in conventional tillage (93.10 and 94.56m^{-2}). Different nutrient management practices failed to exert any remarkable effect on plant population of wheat at 25 days of sowing, while maximum plant population (94.21 and 95.90 m^{-2}) of wheat were recorded with treatment, N_5 (225kg N) during rabi 2014-15 and 2015-16. Tillage practices failed to exert any significant differences on plant height of wheat during Rabi 2014-15 and 2015-16. The tallest plant of wheat was recorded in conventional tillage practices at all the growth stages of wheat, while differences was non-significant. Precession nitrogen management practices showed significant differences on plant height of plant at 60 DAS, 90 DAS and at maturity, while differences were non-significant at 30 DAS. Tallest plant of wheat was recorded with treatment N5 (225kg N) at all the growth stages of wheat during Rabi 2014-15 and 2015-16. Similar trend also follows for leaf area index (LAI) of wheat. Maximum dry matter accumulation of wheat was recorded with treatment N5 (225kg N) at 30 DAS and 60 DAS during Rabi 2014-15 and 2015-16. Whereas, higher dry matter accumulation at 90 DAS and at maturity were recorded with treatment N4 (SSNM & Green Seeker) during Rabi 2014-15 and 2015-16. Different tillage practices failed to exert any significant difference on mean crop growth rate (CGR) of wheat during Rabi 2014-15 and 2015-16. In among precession nitrogen management practices significantly higher mean CGR were recorded with treatment, N5 (225kg N) at 30-60 DAS. Whereas, higher mean CGR at 60-90 DAS were recorded with treatment, N4 (SSNM & Green Seeker).

Keywords: Nitrogen, wheat, leaf area index, crop growth rate and zero-tillage

Introduction
Wheat (*Triticum aestivum* L.) is one of the leading food crops of world farming and occupies significant position among the cultivated cereals. Cultivation of wheat has been the symbolic of green revolution that is why some times green revolution is also termed as Wheat revolution. Wheat forms the main source of protein and calories to a large section of the Indian population and contributes significantly for food and nutritional security to the people of the country. The story of green revolution in India is primarily a tale of wheat revolution. No other major crops in India have achieved as high rate of growth in production as wheat has done. Wheat production has increased significantly from 6.5million tonnes (1950-51) to more than 97.44 million tonnes (2016-17). This happened because of the spread of semi-dwarf Mexican wheat varieties along with spectacular increase in complementary dosages of inputs particularly fertilizers and irrigation. Wheat is the second largest important grain crop after rice and contribute significantly to the food security of the nation. India is the second largest producer of wheat next to China and occupying an area of about 30 million hectare and producing 94 million tonnes with a productivity of 31q/ha, which contributes to 37% of the

country's food grain production. In Bihar wheat is grown in 2.3mha area with a production of 6.5mt and productivity of 27q/ha. The productivity picture of wheat in Bihar is not quite encouraging hence, provide an opportunity to enhance production, productivity and profitability of wheat.

Need based nutrient management is a set of principles that aims to supply a crop's nutrient requirements tailored to a specific field or growing environment. Nutrient Expert (NE) is computer-based decision support system tool that helps crop advisers formulate fertilizer guidelines based on site specific nutrient management (SSNM) principles. Yet, NE does not require a lot of data nor very detailed information as in the case of many sophisticated nutrient decision support system tools, which could overwhelm the user. It allows users to draw the required information from their own experience, the farmer's knowledge of the local region, and the farmers' practices. NE (Nutrient expert) follows the SSNM guidelines for fertilizer application and split dressings to consider the crops nutrient demand at critical growth stages. In the absence of trial data for a specific location, NE estimates the attainable yield and yield response to fertilizer from site information using decision rules developed from on-farm trial data. Thus, fertilizer N recommendations must be based on the crop demand and supply capacity of the soil. Therefore, the difference between the nitrogen supply from the soil and crop need must be mitigated to increase the crop productivity as well as to maintain soil health. Crop growth indicates the N supply from all sources and N status of the crop at any given time is a good indicator of N availability. The chlorophyll content in leaves can indirectly measure the N status of the crop and thus helps in-season fertilizer N topdressing in accordance with need of the crop (Peng *et al*. 1996) [5]. Currently, 100mt of N per annum is applied as fertilizer for agricultural production worldwide, out of which 50% is consumed in production of three major crops like wheat, maize and rice. However, only 30-50% of this applied nitrogen is recovered by crop plants (Cassman *et al*. 2002). Thus, more than 50% of the N not assimilated by plants becomes a potential source of environmental pollution, groundwater contamination, eutrophication, acid rain, ammonia re-deposition, global warming and stratospheric ozone depletion (Ladha *et al*. 2005). While N losses cannot be avoided completely, there is certainly a scope to minimise losses with new and innovative precision N management techniques and technologies. Traditionally, N fertilizers have been applied uniformly across entire field while ignoring inherent spatial variation in crop N needs within crop fields (Khosla *et al*. 2010). This results in either too little or too much application of N in various parts of the fields. Too little N reduces yields while too much N reduces nitrogen use efficiency (NUE). Also, a large percentage of fertilizer (75%) is either applied prior to or at planting resulting in inadequate synchrony between supply and demand of N by crop plants (Cassman *et al*. 1998) [1]. In many developing countries, often a region-based single fertilizer recommendation is prescribed to farmers that do not take into account the variations in the indigenous N supply from their specific fields. To overcome the limitations of traditional N management practices, scientists all over the world have conducted research during the last 15-20 years to develop precision nitrogen management strategies (Raun *et al*. 2002 and Khurana *et al*. 2008) [7, 4].

The goal of site-specific management practices is to enable more efficient use of fertilizers, pesticides, fuel, and management and labour inputs. Most farming systems use spatial variability information related to crop status and soil characteristics to implement innovative management strategies to achieve a site-specific management. This new method of implementing agriculture is being bolstered by emerging cost-effective remote sensing techniques. Field crops must receive appropriate rates of N fertilizer to achieve optimal yields; both under fertilization and over fertilization can negatively affect the desired growth pattern of plants and reduce yields. Furthermore, repeated machinery passes for N applications increase driving distances, require more time, increase soil compaction, consume more farming inputs and increase the environmental load. Research in India on zero tillage (ZT) wheat started in the 1970s but was soon abandoned due to technical constraints. However, with the involvement of the Consultative Group for International Agricultural Development (CGIAR) in the South Asia region under the Rice-Wheat Consortium (RWC) programme of the IGP (Indo Gangetic plain zone), ZT technology gained momentum in the late 1990s in NW Indian states. Here, after the initial spread, the area under the technology stabilised at 20-25%. Bihar is an important wheat-growing state in the country and contributes significantly to the food security of the state. The major challenge to wheat production in the state is the enhancing of its productivity and profitability. In Bihar, many farmers grow late-maturing, fine-grained varieties of rice, causing late sowing of wheat. Therefore, to avoid delay in planting and reduce the cost of production, farmers have started adopting resource conserving technologies such as zero tillage and surface seeding in wheat production (Gupta and Seth, 2007) [2]. Farmers prefer this technology due to farm labour shortage and rising fuel prices. Hence, the present study was undertaken with one of the objectives of comparing the economics of wheat production with zero tillage and conventional methods and quantifying the contribution of technology and inputs into the estimated productivity differences due to zero tillage.

Method and Materials

The experiment was conducted in the experimental plot, situated in the Southern Section New Area (SSNA) of Research Farm Bihar Agricultural University, Sabour, during *rabi* season of two consecutive years 2014-15 and 2015-16, respectively. The Bihar Agricultural University, Research Farm, Sabour is located in south of the river Ganges, beyond the natural levees. It is situated at latitude of 25°15' 4" N and longitude 78°2' 45" E with an altitude of 37.19 meter above the mean sea level in Bhagalpur district of Bihar state under Gangetic plains of India. The experimental plots were provided with assured irrigation facility having uniform topography and proper drainage. Sabour, Bhagalpur has sub-tropical climate, characterized with hot and dry summer, cold winter and moderate annual rainfall. The average annual rainfall of this locality is 1167.0mm, about 75 to 80% of which precipitates during middle of June to middle of October (about 120 days) and there is very scanty rainfall during the remaining period (245 days). Late arrival and early cessation of monsoon are common features of this place. Westerly rain originating through Mediterranean Sea brings winter rain which is heavier in west and gradually weakens by the time it reaches Indo Gangetic plains of the eastern India. Pre-monsoon showers are usually received in the month of May. May is the hottest month when average monthly temperature touches heights around 36.0 °C while in winter monthly average temperature drops down below 10.0 °C in the month of January. Total rainfall was 1313.6mm & 1137.2mm received during the year 2014-15 and 2015-16, respectively). The average normal rainfall (30 years) of this locality is 1167.0mm, out of which 859.0mm (i.e.73.6%) rainfall is generally received during the month of November to April. During *rabi* season of 2014-15 (November to April) about 137.3 mm rainfall was received which was more than normal rainfall of 130.0mm, while during the same period in 2015-16, only 53.4mm was received. Cool and bright climate was prevailing at Sabour, Bhagalpur during the *Rabi* season of 2014-15, mean monthly maximum temperature varied from 21.5 °C to 32.5 °C while minimum temperature varied from 8.8 °C to 19.4 °C. During *Rabi* season of 2015-16 mean monthly maximum temperature varied from 23.0 °C to 35.8 °C, while minimum temperature varied from 7.0 °C to 19.8 °C. Minimum temperature was 1.0 °C lower than the normal in the month of January during 2015-16, while it was 0.8 °C higher than the normal during the same period in 2014-15. Similarly, it was 1.9 °C lower than the normal in the month of February during 2015-16, while it was 1.4 °C higher than the normal during the same period in 2014-15. Maximum temperature was 2.4 °C lower than the normal in February during 2015-16, while it was 0.5 °C higher during the same period in 2014-15. The temperature condition during experimentation remained conducive for the crop growth and development. Relative humidity during *Rabi* season of 2014-15 varied from 77% to 93% at 7.00AM and 49% to 67% at 2.00PM, while during *Rabi* season of 2015-16 it varied from 72% to 98% at 7.00AM and 41% to 66% at 2.00PM during both the years. The experiment was carried in split plot design with two tillage practices (conventional tillage, CT and Zero tillage, ZT) in main-plots and six different nutrient management practices [*viz*.N_1-Recommended dose of nutrients (150:60:40 kg NPK/ha, full P & K and ½ N at basal +1/2 N in two splitting at 1st & 2nd irrigation- Top dressing after irrigation, N_2-Recommended dose of nutrients (150:60:40kg NPK/ ha, full P & K and ½ N at basal +½ N in two splitting at 1st & 2nd irrigation-Top dressing before irrigation, N_3-SSNM Based on Nutrient Expert (NE), N_4-70% N of SSNM based on NE+ remaining N as guided by Green Seeker, N_5 Nitrogen enriched plots (225:60:40Kg. NPK/ha.) and N_6-SPAD based nutrient management, (75Kg. N as basal +25Kg. N as 1st top dress +25Kg. N at 42 SPAD reading) in sub plots with 3 replications.

Results and Discussion

Plant population (m^2)

The plant population was measured at initial stage for both the years and it was recorded that tillage method and nutrient management did not affect the population significantly at 25 days after sowing (DAS) and the interaction effect also found non- significant among the treatments (Table: 1). No-significant differences were observed in plant population of wheat with different tillage practices. (Pirjo *et al*. 2010)

Table 1: Effect of tillage and nutrient management practices on plant population at 25 days after sowing of wheat crop during 2014-2016

Treatment	**2014-15**	**2015-16**
Tillage Practices	**Plant Population m^{-2}**	
ZT	92.3	93.47
CT	93.1	94.26
S.Em (±)	0.51	0.50
CD (P=0.05)	NS	NS
Nutrient management		
N_1	92.06	92.41
N_2	91.16	92.10
N_3	92.70	93.07
N_4	93.33	94.99
N_5	94.21	95.90
N_6	92.93	94.97
S.Em (±)	1.16	1.05
CD (P=0.05)	NS	NS
Interaction	NS	NS

ZT= Zero tillage; CT= Conventional tillage; N_1= 150kg N (after irrigation); N_2= 150 kg N (before irrigation); N_3= 125 kg N (Nutrient expert); N_4= SSNM & Green Seeker; N_5= 225 kg N; N_6= 150kgN. (SPAD based); DAS= Days after sowing; S.Em (±) = Standard error of mean; CD= Critical difference

Plant height (cm)

The plant height at different growth stages from 30 DAS to maturity of crop was measured and presented in Table (2). The plant did not very significantly between zero tillage and conventional tillage over the growth stages; but nitrogen management practices exerted significant effect in wheat crop during both the year studies. Treatment N_5 (nitrogen enriched plot) recorded highest plant height all the growth significantly superior when compare with other nitrogen management practices during the studies. The maximum plant observed at 90 DAS sowing (116cm and 117cm 2014-15, 2015-16 respectively). N_4 (nutrient expert and Green Seeker based nitrogen management practices) had recorded the lowest plant height at all the growth stage of the crop. The N_1 and N_2 treatments i.e. nitrogen top dressing before and after irrigation, respectively did not differ significantly between themselves and remained at par with N_3 during the study. The interaction effect was found non-significant during the study. These above lines also supported by (Iqbal *et al*. 2012) [3].

Table 2: Effect of tillage and nutrient management practices on plant height at various growth stages of wheat crop during 2014-2016

Treatment	30 DAS		60 DAS		90 DAS		At Maturity	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Tillage Practices Plant Height (cm)								
ZT	23.7	25.2	57.8	60.1	104.8	106.5	103.4	104.5
CT	25.6	27.1	61.5	63.4	108.3	109.8	106.7	107.3
S.Em(±)	0.39	0.39	0.98	1.19	0.76	0.86	1.26	0.68
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
Nutrient management								
N_1	25.2	26.7	60.9	62.9	107.9	109.9	106.4	107.9
N_2	24.4	25.9	59.2	61.1	105.7	106.8	104.2	104.9
N_3	23.9	25.4	57.1	59.1	102.9	104.7	102.1	102.8
N_4	22.7	24.2	55.7	57.9	101.8	103.8	100.0	101.8
N_5	27.4	28.9	68.0	70.0	116.2	117.0	114.0	113.4
N_6	24.2	25.7	57.2	59.6	104.6	106.2	103.2	104.7
S.Em(±)	1.00	1.00	1.56	1.62	1.34	1.34	1.34	1.55
CD (P=0.05)	NS	NS	4.92	5.10	4.23	4.21	4.21	4.87
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

ZT= Zero tillage; CT= Conventional tillage; N_1= 150kg N (after irrigation); N_2= 150kg N (before irrigation); N_3= 125 kg N (Nutrient expert); N_4= SSNM & Green Seeker; N_5= 225 kg N; N_6= 150kgN (SPAD based); DAS= Days after sowing; S.Em(±)= Standard error of mean; CD= Critical difference

Dry matter accumulation (g m^{-2})

The dry matter accumulation recorded at 30, 60 and 90 DAS were statistically analysed presented in Table 3 and Fig. 1. At initial stage (30 DAS) the biomass accumulation was founded non-significant between tillage options and nutrient management practices. The tillage options did not very significantly in relation to biomass accumulation at all the growth stages in both the years during the study. However, the N management practices exerted significant effect at 60 and 90 DAS on dry matter accumulation (Fig. 2). The N enrich treatment (N_5) recorded the maximum dry matter accumulation at 60 DAS in both the years which was significantly superior than the treatment N_3 and N_4 due to high application of N. Whereas, in 90 DAS the high dose of N application didn't contribute much to dry matter partitioning and significantly dropped in total biomass than in treatment N_4. The nutrient expert-based N management treatment (N_4) recorded significantly higher dry matter accumulation than the other treatments in both the years at 90 DAS against the lower dose of N application (103kg ha^{-1}). At maturity treatment N_4 recorded the highest dry matter accumulation among the N management treatments which was significantly superior than all other treatments except SPAD based N management (N_6). Treatment N6 maintained the similar biomass with N_4 indicated the use of that the smart technologies are to be better than the conventional recommendation. Here in the study it was noted that high dose of N application (N_5) failed to maintain the total biomass and recorded the significantly lower value than the treatment N_1, N_2 & N_4 in both the years of the study. The interaction effect was found non-significant during the study. These results are in close conformity with the statement of Zemichael *et al*. (2017) [9]

Leaf area index (LAI)

The leaf area index (LAI) was estimated at the different growth stages were statistically analysed and presented in Table 3 and Fig. 2. The result showed that the LAI was remained at par between the tillage options and among the N management practices at 30 DAS. The maximum LAI was recorded at 60 DAS in treatment N_5 (2.71 and 2.91 in 1st year and 2nd year, respectively) which was significantly superior than the other treatments N_3 and N_4. The LAI, thereafter decreased the as crop progress toward its maturity. There is no significant effect was noticed against N topdressing at before and after irrigation (N_1 and N_2) in both the years of the study.

Crop growth rate (CGR)

The crop growth rate (CGR) of wheat crop was estimated at 30-60 and 60-90 DAS and were statically analysed the Table 4 and Fig. 3. The CGR was not varied significantly between the tillage practices in all the cases during the study. The maximum CGR was found in N enrich plot against 225 kg N ha^{-1}(N_5) in both the years during 30-60 DAS and it was significantly superior to all other treatments in the first year of study.

Table 3: Effect of tillage and nutrient management practices on dry matter accumulation (g m^{-2}) different growth stage in wheat crop

Treatment	30 DAS		60 DAS		90 DAS		At Maturity	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Tillage Practices								
ZT	23.9	24.1	364.4	368.9	663.1	665.1	1026.6	1032.3
CT	25.9	26.5	367.8	372.7	667.6	674.2	1058.3	1069.5
S.Em(±)	0.57	0.49	2.07	1.87	1.62	1.99	23.1	10.6
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Nutrient management								
N_1	25.8	26.5	369.9	374.2	668.3	674.2	1041.1	1035.5
N_2	25.5	25.7	367.2	374.2	666.5	671.4	1004.2	1007.8
N_3	24.4	24.6	361.4	366.4	661.4	664.2	1062.1	1046.3
N_4	21.0	21.7	359.6	363.7	674.0	678.7	1113.3	1158.4

N_5	28.0	28.4	374.5	378.7	657.9	661.4	954.5	951.8
N_6	24.8	25.0	363.9	369.5	663.9	668.2	1079.8	1105.6
S.Em(±)	1.61	1.62	2.38	2.35	2.36	2.37	15.5	17.1
CD (P=0.05)	NS	NS	7.50	7.41	7.43	7.45	48.9	53.8
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

ZT= Zero tillage; CT= Conventional tillage; N_1= 150kg N (after irrigation); N_2= 150kg N (before irrigation); N_3= 125kg N (Nutrient expert); N_4= SSNM & Green Seeker; N_5= 225kg N; N_6= 150kgN (SPAD based); DAS= Days after sowing; S.Em (±)= Standard error of mean; CD= Critical difference

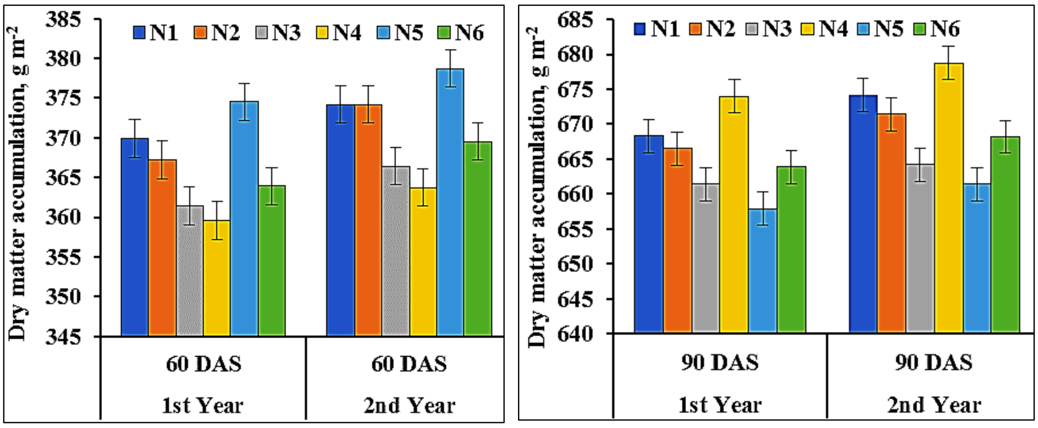

Fig 1: Effect of N management practices on dry matter accumulation of wheat during 60 and 90 days after sowing during the study

Table 4: Effect of tillage and nutrient management practices on leaf area index (LAI) at different growth stage in wheat crop

Treatment	**30 DAS**		**60 DAS**		**90 DAS**	
Tillage	**2014-15**	**2015-16**	**2014-15**	**2015-16**	**2014-15**	**2015-16**
ZT	0.47	0.54	2.64	2.83	2.34	2.48
CT	0.47	0.55	2.66	2.86	2.37	2.51
S.Em(±)	0.04	0.01	0.04	0.01	0.01	00.1
CD (P=0.05)	NS	NS	NS	NS	NS	NS
Nutrient management						
N_1	0.48	0.56	2.69	2.88	2.39	2.55
N_2	0.48	0.54	2.64	2.84	2.36	2.49
N_3	0.45	0.52	2.62	2.82	2.32	2.44
N_4	0.45	0.51	2.61	2.80	2.31	2.42
N_5	0.50	0.60	2.71	2.91	2.43	2.59
N_6	0.46	0.53	2.63	2.83	2.33	2.48
S.Em(±)	0.18	0.02	0.02	0.02	0.02	0.03
CD (P=0.05)	NS	NS	0.07	0.06	0.05	0.10
Interaction	NS	NS	NS	NS	NS	NS

ZT= Zero tillage; CT= Conventional tillage; N_1= 150kg N (after irrigation); N_2= 150kg N (before irrigation); N_3= 125kg N (Nutrient expert); N_4= SSNM & Green Seeker; N_5= 225kg N; N_6= 150kg N (SPAD based); DAS= Days after sowing; S.Em (±)= Standard error of mean; CD= Critical difference

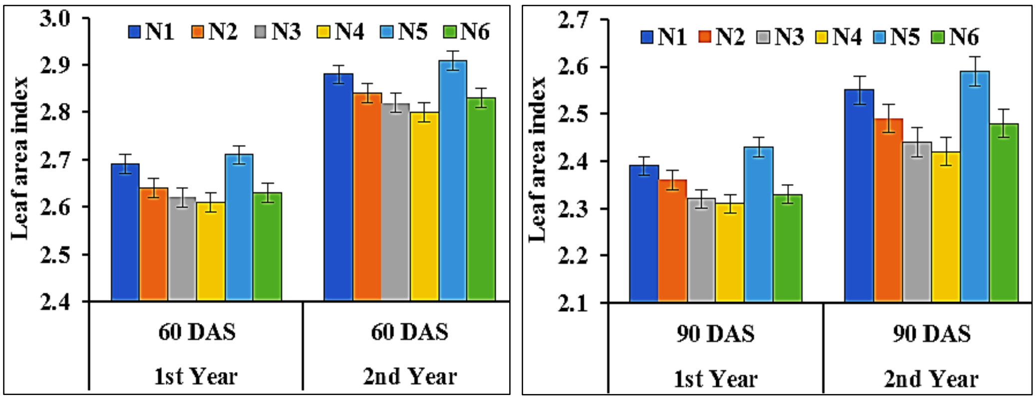

Fig 2: Effect of N management practices on dry matter accumulation of wheat during 60 and 90 days after sowing during the study

However, in the next year the treatment N_5 remained at par with N_1 (100% RDF), N_2 (100% RDF) and N_6 (SPAD based N management). The split application of N at before and after irrigation did not affect the CGR as the treatments N_1 and N_2

remained statistically at par in the entire cases through put the study. During 60-90 DAS the highest CGR was noted in Nutrient Expert based treatment (N_4) with lower dose of N application than in 100% RDF in both the years. From the two years of experimentation it was observed that the high dose of N fertilizer failed to enhance the growth rate particularly during ear head initiation to pre-flowering (Table 5).

Table 5: Effect of tillage and nutrient management practices on crop growth rate (gm^{-2} day^{-1}) of wheat.

Treatment	30-60 DAS		60-90 DAS	
Tillage Practices	**2014-15**	**2015-16**	**2014-15**	**2015-16**
ZT	11.85	11.49	9.96	9.87
CT	11.40	11.54	10.0	9.46
S.Em(±)	0.20	0.06	0.02	0.40
CD (P=0.05)	NS	NS	NS	NS
Nutrient management				
N_1	11.47	11.59	9.95	10.00
N_2	11.39	11.55	9.98	8.23
N_3	11.24	11.40	10.00	9.93
N_4	11.29	11.40	10.48	10.50
N_5	13.05	11.68	9.45	9.38
N_6	11.31	11.49	10.00	9.96
S.Em(±)	0.34	0.09	0.03	0.66
CD (P=0.05)	1.07	0.29	0.09	2.08
Interaction	NS	NS	NS	NS

ZT= Zero tillage; CT= Conventional tillage; N_1= 150kg N (after irrigation); N_2= 150kg N (before irrigation); N_3= 125kg N (Nutrient expert); N_4= SSNM & Green Seeker; N_5= 225kg N; N_6= 150kg N (SPAD based); DAS= Days after sowing; S.Em(±)= Standard error of mean; CD= Critical difference

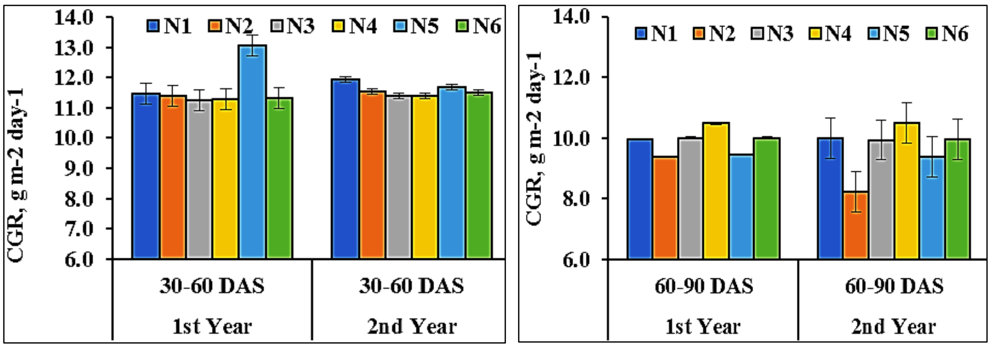

Fig 3: Effect of N management practices on crop growth rate (CGR), g m^{-2} day^{-1} of wheat during 30-60 and 60-90 days after sowing during the study

Discussion

There were non-significant differences was observed in plant population of wheat under tillage management options as well as nutrient management practices at 25 days after sowing (DAS) in rabi 2014-15 and 2015-16. According to Pirjo *et al.* (2010), there were no significant differences were observed in plant population of wheat. There was no significant difference were observed in the plant height of wheat due to different tillage practices at all crop growth stages in both the year of experiment. Among the nutrient management practices, the N_5 (nitrogen enriched plot) recorded highest plant height in all of the crop growth stages which is significantly superior over rest of treatments. However, treatment N_1 (150 kg/ha) and N_3 (125 kg/ha) recorded maximum and minimum plant height respectively. The above statement is supported by the statement of Iqbal *et al.* (2012) [3] who reported that maximum plant height was obtained in wheat with the application of 150 kg N/ha whereas, minimum plant height was obtained with the application of 125kg N/ha. The tillage practices failed to exert any significant effect on biomass accumulation of wheat at all the growth stages during Rabi 2014-15 and 2015-16. Higher biomass was accumulated in conventional tillage over zero tillage practice at all the growth stages of wheat during Rabi 2014-15 and 2015-16. It was observed that nutrient expert and green seeker-based strategy did not affect the dry matter accumulation at earlier stages (Table 3), but it maintained and performed best at maturity. At maturity, the nutrient expert-based N management treatment (N_4) recorded the highest dry matter accumulation in among the N management treatments which was significantly superior than all other treatments except SPAD based N management (N_6). These results are in conformity with the statement of Zemichael *et al.* (2017) [9] who noticed that split application of N fertilizer produces the maximum dry matter in wheat compared to either excess or low application. The result indicated that application of N at right time in right amount enhance the vegetative growth and later the productivity of the crop (Ghosh *et al.* 2018).

The leaf area index (LAI) also remained statistically at par under the different tillage practices at all the growth stages of wheat during 2014-15 and 2015-16. Among the nutrient management practices, maximum LAI was observed with treatment, N_5 (225kg N ha^{-1}) in all the growth stages which was statistically at par with treatment N_1 (150kg N ha^{-1}) in most of the growth stages during the study. Just like LAI, the crop growth rate (CGR) was not varied significantly between the tillage practices in all the cases during Rabi 2014-15 and 2015-16. Under the N management practices the split application of N at before and after irrigation did not affect the CGR as the treatments N_1 and N_2 remained statistically at par in the entire cases throughout the study. At initial stages due to high application of N the CGR may higher in (N_5) in both years but failed to maintained at later stages (Table 5). During 60-90 DAS the highest CGR was noted in treatment, Nutrient Expert based treatment (N_4) with lower dose of N application over 100% RDF in both the years. On the basis of two-year experimentation, it was observed that the high dose of N fertilizer failed to enhance the growth rate particularly during ear-head initiation to pre-flowering. These results are in agreement with the statement of Sui *et al*. (2013) [8] who observed that biomass partition and CGR were faster at vegetative stage when large amount of N fertilizer was applied as a basal dose but becomes slow in reproductive stage as well as ripening stages which affects the yield, while split application increases the biomass partition and CGR at later stages of the wheat which improve the yield of wheat.

Conclusion

Based on the result obtained during both years of experimentation, it may be concluded that the performance of timely sown irrigation wheat crop under conventional and zero tillage conditions were found to be statistically alike in obtaining all the growth parameter of wheat.

Among the different nutrient management practices, the 70% N of SSNM based on Nutrient Expert (NE) along with Green-Seeker guided N application may be recommended for effective and efficient management practices for resource efficient and cost-efficient production of wheat. Hence, it may be suggested that precision N management based on Nutrient Expert tool and Green-Seeker guided N management can potentially improve all the crop growth parameter of wheat.

References

1. Cassman KG, Peng S, Olk DC, Ladha JK, Reichardt W, Dobermann A, Singh U. Opportunities for increased nitrogen use efficiency from improved resource management in irrigated rice system. Field Crops Research. 1998; 56:7-39.
2. Gupta R, Seth A. A review of resource conserving technologies for sustainable management of the rice–wheat cropping systems of the Indo-Gangetic plains (IGP). Crop Protection. 2007; 26(3):436-447.
3. Iqbal J, Hayat K, Hussain S. Effect of sowing dates and nitrogen levels on yield and components of wheat (*Triticum aestivum* L.). Pakistan Journal of Nutrition. 2012; 11:531-536.
4. Khurana HS, Philips SB, Bijay S, Alley MM, Doverman A, Sindhu A *et al*. Agronomic and economic evaluation site specific-nutrients management for irrigated wheat in north-west India. Cycling Agroeasys. 2008; 8:15-31.
5. Peng S, Garcia FV, Laza RC, Anico AL, Visperas RM, Cassman KG. Increased nitrogen use efficiency at high yield levels using a chlorophyll meter on high-yielding irrigated rice. Field Crops Research. 1996; 47:243-252.
6. Pirjo PS, Lauri J, Ari R, Susanna M. Tiller traits of spring cereals under tiller-depressing long day conditions. Field Crops Research. 2009; 113:82-89.
7. Raun WR, Solie JB, Johnson GV, Stone ML, Mullen RW, Freeman KW *et al*. Improving nitrogen use efficiency in cereal grain production with optical sensing and variable rate application. Agronomy Journal. 2002; 94:815-820.
8. Sui B, Feng F, Tian, G, Hu X, Shen Q, Guo S. Optimizing nitrogen supply increases rice yield and nitrogen use efficiency by regulating yield formation factors. Field Crops Research. 2013; 150:99-107.
9. Zemichael B, Dechassa N, Abay F. Yield and nutrient use efficiency of bread wheat (Triticum Aestivum L.) as influenced by time and rate of nitrogen application in Enderta, Tigray, and Northern Ethiopia. Open Agric. 2017; 2:611-624