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Effect of tillage practices and water regime on nutrient uptake and yield of wheat (*Triticum aestivum* L.) in Uttar Pradesh

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Abstract
A field experiment was conducted during 2013-14 and 2014-15 at Meerut, Uttar Pradesh. The objective of our study was to establish an understanding of how nutrient uptake and wheat yield can be improved and how land configuration and tillage practices can be modified to be more efficient in water use through layering of precision- conservation crop management techniques. The experiment consisting of five tillage practices T_1- Wide raised beds, T_2- Narrow raised beds, T_3- Conventional tillage, T_4- Reduced tillage, T_5- Zero tillage and three treatments viz I_1 – IW/CPE 0.45, I_2 - IW/CPE 0.60, I_3 - IW/CPE 0.75 was laid out in split plot design with three replications. Tillage practices influenced the grain yield significantly during both the years of study. During 2013-14 T_1 (wide raised beds) recorded the maximum grains yield (48.96 q ha^{-1}) and T_2 (narrow raised beds) remained statistically at par with it. Increase in level of moisture content by furrow irrigated raised beds techniques increased the N, P and K uptake from T_5 and formT_1 treatment and with water regime IW/CPE 0.75 (I_3) during both the years of study, respectively.

Keywords: Tillage, Raised beds, IW/CPE, NPK, Yield, Wheat

1. Introduction

Wheat (*Triticum spp.*) is one of the most important cereal crop in the world. It is grown across a wide range of environments around the world and has the highest adaptation among all the crop species. More land is devoted worldwide to the production of wheat than any other. It contributes about 60% of daily protein requirement and more calories to world human diet than any other food crop. Bed planting in rice-wheat system is a technique for improving resource use efficiency and increasing yield. This technique not only saves the resources like water, nutrients and labor but also facilitates the greater diversification of cropping system Jat *et al*., (2005) [1]. In this system wheat is planted on top of raised beds that are usually superficially reshaped for sowing the next crop. Crops are planted in rows on top of the raised beds and irrigation water is applied through the furrows between the beds which greatly enhances water conservation and drainage. The great benefit for wheat production resulting from bed planting is the tremendously enhanced field access which facilitates controlling weeds and other pests, handling nutrients, reducing tillage and managing crop residues. Their applications have traditionally been associated with water management issues, to reduce the adverse impact of excess water on crop production or to irrigate crops in semi-arid and arid regions Sayre (2004) [2]. Where water productivity is comparatively low. A widely used application of raised beds in many semi-arid and arid areas is to plant crops on the edges of beds or ridges that are formed between fur-rows that carry irrigation water. With the lessons learnt from Mexico (semi-arid, sub-topical highlands), the raised bed planting system is being evaluated and advocated for many crops including wheat in south Asia Sayre and Ramos (1997) [3], Dhillon *et al.*, (2000) [4] and Saharawat *et al*., (2010) [5]. In the recent years, planting of wheat on raised bed is being advocated in South Asia for improving resource use efficiencies, especially water use efficiency (WUE). While, significant increase in WUE on laser level fields has been reported by several researchers under different soil and climatic conditions Gupta *et al.*, (2003) [6] and Jat *et al*., (2008) [7]. However, the results reported for wheat productivity due to raised bed planting technique were quite inconsistent Hobbs and Gupta (2003) [8] and Bhushan (2007) [9] compared to flat bed planting. Review of the literature indicates that very little to no data exist on application of raised bed planting on a precision laser levelled field. Coupling the two techniques has potential to further enhance the overall resource use efficiencies associated with wheat production in IGP.

The objective of this study was to evaluate the effect of precision land leveling and furrow irrigated raised bed planting techniques on productivity and input use efficiency in irrigated wheat on a sandy loam soil of IGP. It is hypothesized that a system-atic effort on integrated technologies (precision laser levelling and raised bed furrow irrigation) would improving resources use efficiency under semi-arid sub-tropical climatic conditions of IGP of India.

2. Materials and Methods

Site description

The experiment was conducted at Crop Research Centre of the University situated in Indo-Genetic plains of western Uttar Pradesh in Western Plains Zone. It's geographically located at 29° 05' 19" N latitude, 77° 41' 50" E longitudes and at an elevation of 237 metres above the sea level during *rabi* 2013-14 and 2014-15 at a same site in both the years. The climate of this region is semi-arid and sub-tropical with extremes hot weather in summer and cold weather in winter season. There is gradual decrease in mean daily temperature in January reaching as low as 5.6^0C and further a gradual increase is registered reaching as high as 36.6 ^{0}C in months of April. Occasionally, frost does occur during the months of December and January. The maximum temperature was highest in fourth week of April during both the years. Rainfall was occurred 177.0 mm and 203.3 mm during crop period in 2013-14 and 2014-15. The mean weekly weather data for the crop period of 2013-14 and 2014-15.

Soil physico-chemical properties

The soil was sandy loam with pH 8.0 and 7.9 (1:2.5 soil to water). The top soil of the experimental site was sandy loam overlying silty clay, with an abrupt change to sandy loam at about 90 cm. Bulk density was 1.51and 1.56 g cm^{-1} in the top-soil. Organic carbon 0.50 and 0.51%, available N 242.7 and 244.5 kg ha^{-1} available P 12.0 and 12.3 kg ha^{-1} and available K 201.3 and 202.2 kg ha^{-1} at the start of the experiment in 0 to 15 cm soil layer during 2013-14 and 2014-15, respectively.

Experiment details

The treatments consists of five tillage practices (T1, Wide raised beds, T2, Narrow raised beds, T3, Conventional tillage, T4, Reduced tillage, T5, Zero tillage) and three irrigation schedules (I_1 – IW/CPE 0.45, I_2 - IW/CPE 0.60, I_3 - IW/CPE 0.75). The study was made in split plot design with three replications. In FIRBS, 15 cm high and 45 cm broad bed with a furrow width of 25 cm between the beds was prepared with planting three rows of wheat in rows 15 cm apart. Half dose of N and full dose of P and K through urea, single super phosphate and muriate of potash, respectively, were applied at sowing and remaining N was applied after first irrigation. Wheat DBW-17 was sown on15 November and 22 November 2013 and 2014 and harvested on 15 April and 20 April, in 2014 and 2015, respectively. Other management practices were adopted as per recommendations of the crop under irrigated conditions. The nutrient uptake by the crops was obtained as product of nutrient concentration and yield.

Preparation of wide raised beds

At the beginning of the experiment soil was tilled by harrowing and ploughing followed by one field levelling with a wooden plank, and raised beds were made using a tractor-drawn multi crop zero till cum raised bed planter with inclined plate seed metering devices. The dimension of the wide beds were 107 cm wide (top of the bed) x 12 cm height x 30 cm furrow width (at top) and the spacing from centre of the furrow to another centre of the furrow was kept at 137 cm. Six rows of wheat were sowing on each raised bed.

Preparation of narrow raised beds

At the beginning of the experiment soil was tilled by harrowing and ploughing followed by one field levelling with a wooden plank, and raised beds were made using a tractor-drawn multi crop zero till cum raised bed planter with inclined plate seed metering devices. The dimension of the narrow beds were 37 cm wide (top of the bed) x 15 cm height x 30 cm furrow width (at top) and the spacing from centre of the furrow to another centre of the furrow was kept at 67 cm. Two rows of wheat were sown on each raised beds.

Preparation of Conventional tillage

After the rice harvest, following the conventional practice of two harrowing, two ploughing (using a cultivator) and one planking (using a wooden plank) that followed pre-sowing irrigation and wheat was seeded in rows 20 cm apart using a seed drill with a dry-fertilizer attachment.

Preparation of Reduce tillage

In this system tillage perse still exists, but numbers of preparatory tillage operations are reduced significantly. The soil is disturbed prior to planting by rotavator to prepare the seedbed and wheat will be sown in rows 20 cm apart.

Preparation of Zero tillage

Zero-till system is planting crops with minimum of soil disturbance. In this, seeds are placed directly into narrow slits 2-4 cm wide and 4-7 cm deep made with a drill fitted with chisel, inverted T" without land preparation.

Nutrient application

Plant nutrients were applied as per the state recommendations for wheat (N_{120}+ P_{60} + K_{40}). Urea, di-ammonium phosphate and muriate of potash, were placed in band in seed rows at the time of sowing using zero till cum raised beds planter with inclined plate metering device. The remaining N was broadcasted with dry urea in two equal splits of 30 $kg{\cdot}N{\cdot}ha^{-1}$, (N_{30}) at crown root initiation (CRI) and the flag leaf initiation (FLI) crop growth stages.

Nutrient uptake (kg ha^{-1})

The nutrient uptake by wheat crop at harvest had been worked out by using the following equation:

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

3. Results and Discussion

Nutrient uptake (kg ha^{-1})

Nitrogen: The scrutiny of data on nitrogen uptake by wheat grain as presented in Table 1 and revealed that different crop planting methods significantly influenced nitrogen uptake by wheat grain and straw. Wheat sown on wide raised beds (T_1) recorded significantly higher nitrogen uptake by wheat grain during both the years of study but was statistically at par with wheat sown on narrow raised beds plots (T_2), respectively. Treatments T_4 and T_5 were at par with each other, however, they recorded significantly higher nitrogen uptake over T_3.The lowest nitrogen uptake in wheat grain was observed under conventional tillage practice (T_3) and reduced tillage planting plots (T_4) which were statistically at par with each other during 2013-14 and 2014-15, respectively.

Table 1: Effect of tillage practices and water regime on nitrogen uptake and its total uptake.

Treatment	N Uptake (Kg ha^{-1})				Total N uptake (Kg ha^{-1})	
	Grain		Straw			
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Tillage practices						
T_1	85.98	84.18	32.18	30.57	118.16	116.74
T_2	82.47	80.47	32.90	29.72	115.37	110.20
T_3	71.43	69.59	30.29	23.13	101.73	92.71
T_4	76.71	74.82	33.52	24.55	110.23	99.37
T_5	77.22	73.77	34.01	28.10	111.23	101.86
SEm(±)	*1.73*	*1.15*	*0.084*	*0.74*	*2.35*	*1.68*
C.D. (P=0.05)	*5.63*	*3.74*	*0.28*	*2.42*	*7.65*	*5.47*
Water regime						
I_1	77.55	72.50	30.31	25.42	104.86	97.92
I_2	78.43	76.27	32.48	27.52	110.91	103.80
I_3	83.81	80.82	34.96	29.89	118.27	110.81
SEm(±)	*0.94*	*1.30*	*0.44*	*0.43*	*1.25*	*1.67*
C.D. (P=0.05)	*2.77*	*3.84*	*1.30*	*1.28*	*3.69*	*4.85*

The data on different levels of tillage practices have significant variation in total nitrogen uptake during both the years. The maximum total nitrogen uptake (118.16 and 116.74 kg N ha^{-1}) was recorded with the application of wheat sown on wide raised beds (T_1) but statistically at par with sowing wheat on narrow raised beds (T_2) and wheat planted by zero till plots (T_5). However, the differences among T_3, T_4 and T_5 treatments were non-significant during the years of experimentation. The interaction effects were non-significant. Weil and Magdoff (2004) [10] Govaerts *et al*., 2006 [11] Alam, 2014 [12]

The different levels of water regime had significant effect on nitrogen uptake in grain of wheat as in Table 1. Significantly more uptake of nitrogen in grain was obtained with I_3 during both the years of study. Higher grain yield and nitrogen content of wheat grain in this treatment might be the reason for higher nitrogen uptake by wheat grain in I_3. Maximum total nitrogen uptake was recorded with highest level of irrigation i.e. 3 irrigation (I_3), which differed significantly from 2 irrigation (I_2) and 1 irrigation (I_1) during both the years. The lowest total uptake of nitrogen was observed under IW/CPE 0.45 (I_1) and IW/CPE 0.60 plots (I_2) where (I_2) was statistically significant over (I_1) during experimentation.

Phosphorus: The data in Table 2 revealed that different tillage practices on uptake of phosphorus was more in 2013-14 than 2014-15. The phosphorus uptake (kg ha^{-1}) in wheat grains and straw was significantly higher with wheat sown on wide raised beds (T_1) followed by wheat sown on narrow raised beds (T_2) plots during both the years of study. All other methods of establishment differed significantly except wheat sown by zero tillage (T_5) and reduced tillage (T_4) practices plots which were statistically at par with each other during both the years of study. Water regimes significantly affected the phosphorus uptake by wheat grains and straw during experimentation. Significantly higher phosphorus uptake was noticed in IW/CPE 0.75 (I_3) (16.49, 15.32 and 13.25, 12.65 kg ha^{-1}) during both the years of study. All water regime levels differed significantly from each other and phosphorus uptake was increased with increase in irrigation levels/frequency. The phosphorus uptake by wheat grains and straw in I_3 as compared to I_2 and I_1 might be due to higher grain and straw yield and phosphorus content in grains and straw in this treatment.

Table 2: Effect of tillage practices and water regime on phosphorus uptake and its total uptake.

Treatment	P Uptake (Kg ha^{-1})				Total P uptake (Kg ha^{-1})	
	Grain		Straw			
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Tillage practices						
T_1	17.44	16.19	9.61	9.92	27.05	26.11
T_2	16.00	15.22	9.63	9.15	25.63	24.37
T_3	12.60	11.88	8.07	6.37	20.67	18.25
T_4	13.90	13.08	9.05	6.88	22.95	19.96
T_5	14.20	13.20	9.63	7.98	23.83	21.18
SEm(±)	*0.44*	*0.19*	*0.26*	*0.20*	*0.49*	*0.36*
C.D. (P=0.05)	*1.42*	*0.62*	*0.86*	*0.64*	*1.60*	*1.16*
Water regime						
I_1	13.25	12.65	8.31	7.33	19.67	19.99
I_2	14.75	13.77	9.57	8.03	20.95	21.80
I_3	16.49	15.32	9.71	8.82	24.80	24.14
SEm(±)	*0.27*	*0.27*	*0.15*	*0.17*	*0.35*	*0.37*
C.D. (P=0.05)	*0.81*	*0.79*	*0.45*	*0.50*	*1.05*	*1.09*

The data regarding the total phosphorus uptake (kg ha^{-1}) presented in Table 2 revealed that wheat sown on wide raised beds (T_1) gave significantly higher total phosphorus uptake (27.05 and 26.11 kg ha^{-1}) by wheat grains and straw followed by T_5 (wheat sown by zero tilled plots) and T_2 (wheat sown on narrow raised beds) during both the years of study. T_3 “conventional tilled” plots resulted in significantly lower (20.67 and 18.25 kg ha^{-1}) total phosphorus uptake during both the years of study. Wheat sown on furrow irrigated raised beds increased the N and P uptake in grain and straw both but

the uptake of N and P was increased with increase in nitrogen content in grain and straw significantly over conventional tillage method during both the years. Wright *et al*., (2007) [13] Kotzé and Preez (2008) [14] and Kumar *et al*., (2014) [15].
Further it was observed from the data that total phosphorus uptake by wheat grains and straw was significantly more with I_3 during both the years of study and all levels of water regimes were differed significantly among each other.

Potassium: The perusal of data embodied in Table 3 showed that the difference between different crop establishment methods was significant for potassium uptake of wheat grains and straw during both the years of study. Wheat sown on wide raised beds (T_1) recorded significantly higher uptake of potassium (22.42, 21.64 and 110.35, 98.70 kg ha^{-1}) as compared to all other methods of establishment during 2013-14 and 2014-15, respectively. All tillage practices were differed significantly from each other except wheat sown on narrow raised beds (T_2), wheat planted in zero tilled plots (T_5), and wheat seeded in reduced tilled (T_4) which were statistically at par with each other during the years of study.

Table 3: Effect of tillage practices and water regime on potassium uptake and its total uptake.

Treatment	K Uptake (Kg ha^{-1})				Total K uptake (Kg ha^{-1})	
	Grain		Straw			
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Tillage practices						
T_1	22.42	21.64	110.35	98.70	132.78	120.34
T_2	21.47	19.89	104.18	96.15	125.65	116.04
T_3	17.55	16.54	102.15	81.84	119.70	98.39
T_4	19.45	18.21	103.37	84.97	122.82	103.18
T_5	19.92	17.98	109.71	93.74	129.63	111.72
SEm(±)	*0.59*	*0.21*	*2.41*	*2.24*	*2.91*	*2.30*
C.D. (P=0.05)	*1.93*	*0.69*	*7.86*	*7.30*	*8.93*	*7.48*
Water regime						
I_1	18.68	17.37	100.67	87.25	119.35	104.63
I_2	20.23	18.69	104.14	91.33	124.36	110.02
I_3	21.58	20.49	110.49	97.46	132.07	117.95
SEm(±)	*0.25*	*0.36*	1.40	1.31	*1.60*	*1.64*
C.D. (P=0.05)	*0.73*	*1.06*	4.14	3.85	*4.72*	*4.85*

Amongst the different water regimes, the significantly more potassium uptake of wheat grains and straw was obtained with I_3 treatment during both the years of study. Treatment I_2 was significantly superior over I_1 during experimentation. Treatment I_1 recorded lower potassium uptake in grain and straw during both the years of study reported by Sharma *et al*., 2005 [16] Singh and Yadav, (2006) [17].
The total uptake of potassium increased with the increasing levels of irrigation during both the years of study. Highest total potassium uptake (132.07 and117.95 kg ha^{-1}) was recorded with water regime IW/CPE 0.75 where highest level of irrigation i.e. 3 irrigations (I_3), which differed significantly from 2 irrigations (I_2) and 1 irrigation (I_1) in both the years Table 15. The difference in the total potassium uptake at water regime I_2 was significantly higher as compared to I_1 irrigation level in both the years. However the K uptake through grain and straw was due to variation in grain and straw yield recorded under different planting technique treatments as the K content in grain and straw was statistically at par in all the treatments during both the years. Similar result have been reported by Rani *et al*., (2009) [18] Naresh *et al*., (2014) [19] Idnani and Kumar, (2013) [20].

4. Yield

Yield is a function of various parameters like crop dry matter accumulation, number of tillers, number of grains spike^{-1} and grain weight etc. Yield is the most important criteria for evaluating the effects of applied treatments. Crop productivity is the rate at which a crop accumulate biomass which depends primarily on the photosynthesis and conversion of light energy into chemical energy by green plants. The data on crop yield is presented in Table 4 revealed that crop yield increased with each increment in moisture retention level.

Table 4: Effect of tillage practices and water regime on grain, straw and biological yield.

Treatment	Grain yield (q ha^{-1})		Straw yield (q ha^{-1})		Biological yield (q ha^{-1})	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Tillage practices						
T_1	48.96	48.19	62.78	61.55	111.74	109.74
T_2	47.01	46.17	58.51	57.55	105.52	103.72
T_3	42.34	41.45	51.47	50.57	93.81	92.02
T_4	44.54	42.81	53.17	51.95	97.71	94.76
T_5	45.07	43.90	59.12	56.81	104.19	100.71
SEm(±)	*0.77*	*0.82*	*1.33*	*1.67*	*2.07*	*2.24*
C.D. (P=0.05)	*2.51*	*2.69*	*4.35*	*4.79*	*6.74*	*7.31*
Water regime						
I_1	40.95	39.87	51.19	49.84	92.13	89.71
I_2	45.78	44.70	57.31	55.96	103.08	100.66
I_3	50.02	48.94	62.54	61.26	112.56	110.20
SEm(±)	*0.50*	*0.54*	*0.64*	*0.67*	*1.13*	*1.21*
C.D. (P=0.05)	*1.48*	*1.60*	*1.88*	*1.97*	*3.34*	*3.57*
Interaction I ×T	Sig	Sig	Sig	Sig	Sig	Sig

The grains yield was higher during 2013-14 and 2014-15.Tillage influenced the grain yield significantly during both the years of study. Wheat sown on wide raised beds (T_1) were recorded the maximum grains yield, straw yield and biological yield and narrow raised beds (T_2) remained statistically at par with it. The reduction in grain yield due to more tillage i.e. traditional practices with was 3.06, 2.43 and 3.25 % compared to T_1 (wide raised beds), T_2 (narrow raised beds) and T_5 (zero tillage) practices, respectively. However, wheat sown on wide raised beds registered 11.79 and 11.32 % a significant yield improvement over conventional practices. Significantly higher grain yield straw yield and biological yield was obtained in IW/CPE 0.75 (I_3) was treatment which remained statistically at par with I_2 treatment. I_1 "conventional tillage" treatment recorded minimum grain yield (40.95 and 39.87 q ha^{-1}) during the years of study, respectively. Similar reported was Singh and Katiyar (2014) [21] and Sepat *et al.,* (2015) [22]. Significantly yield increased with the every successive increase in moisture supply by moisture retention and bed configuration. Similar results of increased yield were also reported by Idnani and Kumar, (2012) [23] and Mishra, *et al.*, (2016) [24].

The interaction, tillage × irrigation water was significant for the grain, straw and biological yield. The magnitude of increase in straw yield due to improvement in moisture supply by tillage modes with wheat sown on raised beds was higher in I_3 as compared to other irrigation water.

5. Soil analysis at the harvest

Organic carbon

The data in respect of organic carbon in plough layer of the soil after harvest is given in Table 5. The organic carbon status improved significantly in treatments where wheat was grown with conservation tillage during both the years of study. However, the organic carbon build up was accrued where wheat was grown with Furrow Irrigated Raised Beds and zero tilled plots. The differences in organic carbon content among different establishment methods were found to be non-significant except reduced tilled plots and conventional method during both the years of study.

Table 5: Soil properties after harvest of wheat.

Treatment	Organic carbon (%)		Available N (Kg ha^{-1})		Available P (Kg ha^{-1})		Available K (Kg ha^{-1})	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
Tillage practices								
T_1	0.54	0.56	245.5	248.4	13.5	13.8	207.8	208.0
T_2	0.53	0.55	244.5	246.2	13.4	13.5	206.5	206.8
T_3	0.50	0.51	240.7	241.3	12.2	12.3	203.2	204.4
T_4	0.50	0.52	241.3	242.5	12.4	12.5	204.5	204.7
T_5	0.52	0.53	242.9	244.6	12.7	13.0	203.9	204.2
SEm(±)	*0.006*	*0.006*	*0.62*	*0.97*	*0.31*	*0.10*	*0.35*	*0.34*
C.D. (P=0.05)	*0.018*	*0.019*	*2.03*	*3.16*	*1.08*	*0.34*	*1.15*	*1.11*
Water regime								
I_1	0.53	0.55	244.2	246.5	13.7	13.3	206.8	206.9
I_2	0.52	0.54	243.3	244.9	12.7	12.9	205.3	205.7
I_3	0.50	0.51	241.4	242.4	12.4	12.8	203.5	204.3
SEm(±)	*0.008*	*0.008*	*0.74*	*0.91*	*0.38*	*0.23*	*0.32*	*0.42*
C.D. (P=0.05)	*NS*	*NS*	*2.17*	*2.68*	*NS*	*NS*	*NS*	*NS*

The organic carbon content of the soil did not vary significantly with varying water regimes during experimentation. The maximum organic carbon content was obtained with I_1 and I_2 closely followed by other water regime Jantalia *et al*., (2007) [25] and Gál *et al*., (2007) [26].

Available nitrogen

The data collected on available nitrogen have been depicted in Table 5 showed that available nitrogen improved in all the treatments over it's from initial value 242.7 and 244.5 kg ha^{-1} during first and second year of the study. Available nitrogen status of the soil was significantly higher with T_1 as compared all other treatments and was statistically at par with T_2 and T_5, tillage practices during both the years of study. T_3 "conventional tilled" plots resulted in significantly lower (240.7 and 241.3 kg N ha^{-1}) available nitrogen in the soil during both the years experimentation. From the above results it is clear that tillage practices in conjunction with land configuration increased the available nitrogen in soil, which may be attributed to mineralization of organic sources or through solubilization of nutrient from native sources during decomposition. Perusal of data in Table 5 indicates that available nitrogen after harvesting of wheat crop was significantly influenced by the different levels of water regimes in both the years. However, it decreased slightly with increasing level of irrigation in both the years also reported by Zamuner *et al*., (2008) [27] and Lopex and Pardo, (2009) [28].

Available phosphorus

The data presented in Table 5 revealed that the available phosphorus status of the soil was improved in all the treatments over its initial values 12.0 and 12.3 kg ha^{-1} during first and second year of the study. There was no significant difference in the available phosphorus in soil by different levels of water regime in both the years. Use of different tillage practices did show significant difference on available phosphorus status in soil during both the years of study. Wheat sown on wide raised beds (T_1) recorded significantly higher available phosphorus status of the soil (13.5 and 13.8 kg ha^{-1}) and was statistically at par with wheat sown on narrow raised beds (T_2), wheat planted in zero tilled plots (T_5) during both the years of study. Wheat planted in zero tilled plots (T_5), wheat seeded in reduced tilled (T_4) and conventional tilled plots (T_3) were statistically at par with each other Pradhan *et al.,* (2011) [29] and Walker *et al.,* 2003 [30].

Available potassium

The data regarding available potassium status in Table 5 of the soil showed an increment in its status from its initial value during both the years of study. Further, in the treatments where land configuration was included, generally high content of potassium was observed but there was no significant difference in available potassium content of soil after harvest of crop due to these tillage practices i.e.T_1 and T_2, respectively. Wheat planted in zero tilled plots (T_5), reduced tilled planted wheat (T_4) and conventional tilled wheat (T_3) gave lowest available potassium status of the soil and were at par with each other during first year. In second year, the maximum available potassium was in T_1 was at par with T_2 and was significantly higher than T_4, T_5 and T_3 treatments. Further there was no significant difference in the potassium content of soil due to different water regimes Govaerts *et al*., (2006) [11] and Jat *et al.*, (2011) [31].

6. Conclusion

The N, P and K content in grain and straw of wheat crop was not influenced by the water regimes in both the years. The K content was more in straw as compared to grain during both the year of study. Use of different tillage practices gave significant result in respect to N, P and K content in grain and straw during both the year. The maximum P content in grain was recorded with furrow irrigated raised beds. The N, P and K uptake was more in 2013-14 than in 2014-15 in both grains as well as in straw. The uptake of N, P and K in grain and straw were increases significantly with the increasing levels of irrigations. The data on total uptake of N, P and K also followed same trend as observed in their uptake in grain and straw and increased with the increasing levels of irrigation during both the year of study. Different tillage practices have significant variation in total N, P and K uptake during both the year. The maximum total N, P and K uptake was recorded under wide raised beds plots.

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8. References

1. Jat ML, Singh S, Rai HK, Chhokar RS, Sharma SK, Gupta RK. Furrow Irrigated Raised Bed Planting Technique for Diversification of Rice-Wheat System of Indo-Gangetic Plains. Journal of Japan Asso-ciation for International Cooperation for Agriculture and Forestry. 2005; 28:25-42.
2. Sayre KD. Raised Bed Cultivation, In: R. Lal, Ed., Encyclopedia of Soil Science, Marcel Dekker, Inc., New York, 2004.
3. Sayre KD, Morena Ramos OH. Application of Raised Bed Planting Systems to Wheat, Wheat Program Special Rep. 31., CIMMYT, Mexico, 1997.
4. Dhillon SS, Hobbs PR, Samra JS. Investiga-tions on Bed Planning System as an Alternative Tillage and Crop Establishment Practice for Improving Wheat Yields Sustainably, Proceedings of the 15th Conference of the International Soil Tillage Research Organization, Fort Worth, 2-7, 2000.
5. Saharawat YS, Singh Bhagat, Malik K, Ladha JK, Gathala MK, Jat ML, Kumar V. Evaluation of Alternative Tillage and Crop Establishment Methods in a Rice-Wheat Rotation in North Western IGP, Field Crop Research, 2010; 116(3):260-267.
6. Gupta RK, Naresh RK, Hobbs PR, Jiaguo Z, Ladha JK. Sustainability of Post Green Revolution Ag-riculture: The Rice-Wheat Cropping Systems of the Indo- Gangetic Plains and China, In: J. K. Ladha *et al.*, Eds., Improving the Productivity and Sustainability of Rice- Wheat Systems: Issues and Impact, ASA, Spec. Publ. 65, chapter 1:, ASA Madison, 2003, 1-25.
7. Jat ML, Gathala MK, Singh KK, Ladha JK, Singh S, Gupta RK *et al*. Experiences with Permanent Beds in the Rice-Wheat System of the Western Indo-Gangetic Plain, In: E. Humphreys and C. Roth, Eds., Permanent Beds and Rice-Residue Management for Rice-Wheat System of the Indo-Gangetic Plain, ACIAR Proceedings. 2008; 127:98-107.
8. Hobbs PR, Gupta RK. Resource Conserving Technologies for Wheat in the Rice-Wheat System, In: J. K. Ladha *et al.*, Eds., Improving the Productivity and Sustainability of Rice-Wheat Systems: Issues and Impact, ASA, Spec. Publ. 65, chapter 7, ASA Madison, 2003, 149-171.
9. Bhushan L, Ladha JK, Gupta RK, Singh S, Padre AT, Saharawat YS *et al.* Sav-ing of Water and Labour in a Rice-Wheat System with No-Tillage and Direct Seeding Technologies. Agronomy Journal. 2007; 99(5):1288-1296.
10. Weil RR, Magdoff F. Significance of soil organic matter to soil quality and health. Soil organic matter in sustainable agriculture. CRC Press, New York, 2004.
11. Govaerts B, Sayre KD, Ceballos Ramirez JM, Luna-Guido ML, Limon-Ortega A, Deckers J, Dendooven L. Conventionally tilled and permanent raised beds with different crop residue management: Effects on soil C and N dynamics. Plant & Soil. 2006; 280(1-2):143-155.
12. Alam Md, Khairul, Islam Md, Monirul, Salahin, Nazmus *et al*. Effect of tillage practices on soil properties and crop productivity in wheat-mungbean-rice cropping system under subtropical climatic conditions. The Scientific World Journal. 2014, 1-15.
13. Wright AL, Hons RM, Lemon RG, Mcfarland ML, Nicholas RL. Stratification of nutrients in soil for different tillage regimes and cotton rotations. Soil & Tillage Research. 2007; 96:19-27.
14. Kotze E, Preez Du CC. Influence of long-term wheat residue management on acidity and macronutrients in an Avalon soil. S. Afr. J. Plant Soil. 2008; 25:14-21.
15. Kumar Rajeew, Pandey DS, Singh VP. Wheat (*Triticum aestivum* L.) productivity under different tillage practices and legume options in rice (*Oryza sativa* L.) and wheat cropping sequence. Indian Journal of Agricultural Sciences. 2014; 84 (1): 101-106.
16. Sharma AR, Singh R, Dhyani SK. Conservation tillage and mulching for optimizing productivity in maize-wheat cropping system in the outer western Himalayan region - a review. Indian Journal of Soil Conservation. 2005; 33(1):35-43.
17. Singh Mahendra, Yadav BL. Effect of organic materials and zinc on growth and yield of wheat under irrigation with high RSC water. Haryana Journal of Agronomy. 2006; 22(2):142-144.
18. Rani N, Sidhu BS, Beri V. Organic rice (*Oryza sativa*) and wheat (*Triticum aestivum* L.) production quality and economics in irrigated agriculture. Indian Journal of Agricultural Sciences. 2009; 79(1):20-24.
19. Naresh RK, Rathore RS, Yadav RB, Singh SP, Misra AK, Kumar V *et al*. Effect of precision land levelling and permanent raised bed planting on soil properties, input use efficiency, productivity and profitability under maize (*Zea mays*) – wheat (*Triticum aestivum* L.) cropping system. African Journal of Agriculture Research. 2014; 9(36):2781-2789.
20. Idnani LK, Kumar Ashok. Performance of wheat (*Triticum aestivum* L.) under different irrigation schedules and sowing methods. Indian Journal of

Agricultural Sciences. 2013; 83(1):37-40.
21. Singh YK, Katiyar TPS. Effect of tillage system, irrigation scheduling and depth on growth, yield attribute, yield and water use in wheat (*Triticum aestivum*). International Journal of Tropical Agriculture. 2014; 32(1-2):51254.
22. Sepat Seema, Sharma AR, Kumar Dinesh, Das TK. Effect of conservation agriculture practices on productivity and sustainability of pigeonpea (*Cajanus cajan*)-wheat (*Triticum aestivum*) cropping system in Indo-Gangetic plains of India. Indian Journal of Agricultural Sciences. 2015; 85(2):212.
23. Idnani LK, Kumar Ashok. Relative efficiency of different irrigation schedules for conventional, ridge and raised bed seeding of wheat (*Triticum aestivum* L.). Indian Journal of Agronomy. 2012; 57(2):148-151.
24. Mishra Gaurav, Kushwaha HS. Winter wheat yield and soil physical properties responses to different tillage and irrigation. European Journal of Biological Research. 2016; 6(1):56-63.
25. Jantalia CP, Resck DVS, Alves BJR, Zotarelli L, Urquiaga S, Boddey RM. Tillage effect on C stocks of a clayey Oxisol under a soybean-based crop. Soil & Tillage Research. 2007; 95:97-109.
26. Gal A, Vyn TJ, Micheli E, Kladivko EJ, Mc Fee WW. Soil carbon and nitrogen accumulation with long-term notill versus moldboard plowing overestimated with tilled-zone sampling depths. Soil & Tillage Research. 2007; 96:42-51.
27. Zamuner EC, Picone LI, Echeverria HE. Organic and inorganic phosphorus in mollisol soil under different tillage practices. Soil & Tillage Research. 2008; 99:131-138.
28. Lopex-Fando C, Pardo MT. Changes in soil chemical characteristics with different tillage practices in semi-arid environment. Soil & Tillage Research. 2009; 104:278-284.
29. Pradhan S, Bandyopadhyay KK, Sahoo RN, Sehgal VK, Singh R, Joshi DK *et al*. Prediction of wheat (*Triticum aestivum* L.) grain and biomass yield under different irrigation and nitrogen management practices using canopy reflectance spectra model. Indian Journal of Agricultural Sciences. 2013; 83(11):1136-1143.
30. Walker TW, Kingery WL, Street Joe E, Lox MS, Oldham JL, Gerard PD *et al*. Rice Yield and Soil Chemical Properties as Affected by Precision Land Leveling in Alluvial Soils. Agronomy Journal. 2003; (95):1483-1488.
31. Jat ML, Gupta Raj, Saharawat YS, Khosla Raj. Layering Precision Land Leveling and Furrow Irrigated Raised Bed Planting: Productivity and Input Use Efficiency of Irrigated Bread Wheat in Indo-Gangetic Plains. American Journal of Plant Sciences. 2011; (2):578-588.