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Performance of different tillage practices and moisture regimes on yield attribute, yield and economics in wheat

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Abstract
The experiment was conducted during rabi season 2015-16 and 2016-17. The present investigation entitled "Effect of Tillage Practices and Moisture Regimes on the Performance of Wheat" was conducted at Agronomy Research Farm, of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj) Faizabad (U.P.). The experiment was laid out in split plot design having four tillage practices (zero tillage, reduced tillage + sowing by seed cum ferti drill, conventional tillage + sowing on beds and conventional tillage+ sowing by seed cum ferti drill) as main plot treatments and five moisture regimes (irrigation at 0.8 IW/CPE, irrigation at 1.0 IW/CPE and irrigation at 1.2 IW/CPE irrigation at 3 Irrigation each at CRI, Late jointing and Milking stage and 5 Irrigation each at CRI, Tillering, Late jointing, Flowering and Milking stage) as sub plot treatments. 20 treatment combinations were replicated three times. The result revealed that the yield and yield attributes were recorded significantly higher in conventional tillage + sowing on bed, which was *at par* with conventional tillage+ sowing by seed cum ferti drill during both the years due to performance of tillage practices. However, the yield and yield attributes were significantly higher under irrigation at 1.0 IW/CPE being *at par* with 1.2 IW/CPE ratio and 5 Irrigation each at CRI, tillering, late jointing, flowering and milking stage over rest of the treatments causes optimum availability of moisture at critical stage of the crop growth. The maximum net income (Rs. 82428 ha^{-1}) and benefit cost ratio (2.49) were calculated under conventional tillage + sowing on beds along with irrigation at 1.0 IW/CPE ratio.

Keywords: Tillage, moisture regimes, yield attributes, yield, economics and wheat

Introduction
Wheat (*Triticum spp.*) belong to the family Poaceae, is one of the most important cereal crop in the world. In India wheat is the second most important food crop next to rice and it contributes nearly 35% to the national food basket. Among winter crops, it contributes about 49% of the food grains. It ranks first in the world among the cereals both in respect of area (225.07 m ha) and production (736.98 mt). In India, total area under wheat is 31.72 m ha with the production and productivity of 96.0 m tonnes and 3.13 tonnes ha^{-1}, respectively (USDA, 2017). In India, total production of wheat crop was 86.53 mt from an covered area of 30.23 m ha during the recent past 2015-16 Rabi season and accounts for 38 per cent 4th Advance Estimates.(Directorate of Economics and Statistics, Ministry of agriculture and farmers Welfare, India, 2016) [9]. In India, the state wise production tops with of the Uttar Pradesh 26.87 mt, followed by Madhya Pradesh 17.69 mt, Punjab 16.08 mt, Haryana 11.35 mt, Rajasthan 9.87 mt, and Bihar 4.75 mt. These top six states together contributed about 93 per cent of the total wheat production. The increase in wheat production was maximum in the case of Uttar Pradesh 4.46 mt, Followed by Punjab 1.03 mt and Haryana 1.0 mt. The demand of wheat by 2020 has been projected to be between 105 to 109 million tonnes in the country. Tillage is practiced in soils for controlling weeds, breaking crusts (improving water entry), increasing surface roughness (assisting water storage) and preparing a seedbed. The type of tillage method to be practiced, however, depends upon the soil type and the climate of the area (Coughlan *et al*., 1989) [8]. Various techniques *viz*., zero-tillage (ZT) and bed planting have proved to be beneficial in terms of improving soil health, water use and crop productivity (Anonymous, 1995) [2]. ZT is widely adopted by farmers in the Northwestern Indo gangatic plain of India, particularly in areas where rice is harvested late (Bhushan *et al*., 2007) [7]. It reduces irrigation requirements compared with conventional-tillage by using residual water more

effectively (Erenstein *et al*., 2007). Bed planting, another RCT, has benefits like reduced seed rate, rainwater conservation, mechanical weeding and less crop lodging (Gupta and Seth, 2007).

Material Methods

The present investigation entitled "Effect of Tillage Practices and Moisture Regimes on the Performance of Wheat" was carried at Agronomy Research Farm, of Narendra Deva University of Agriculture and Technology, Narendra Nagar Kumarganj, Faizabad (U.P.) out of during Rabi season, 2015-2016 and 2016-17. Geographically this experimental site falls under sub humid, sub-tropical climate of Indo-gangatic was conducted alluvial (IGP) plains having alluvial calcareous soil and located at 260.47 North latitudes, 82.120 East longitudes, at an attitude of about 113.0 meter from mean sea level. The experiment was constituted with 20 treatment involving four tillage practices in main plot and five irrigation levels in sub plot was laid out in split plot design with three replications. The experiment was laid out in given following *viz.*, tillage practices mention are: T_1-Zero tillage, T_2-Reduced tillage+sowing by seed cum ferti drill, T_3-Conventional tillage+ sowing on beds and T_4-Conventional tillage+ sowing by seed cum ferti drill as main plot treatment and five irrigation levels I_1-Irrigation at 0.8 IW/CPE, I_2-Irrigation at 1.0 IW/CPE, I_3-Irrigation at 1.2 IW/CPE, I_4-Irrigation each at CRI, Late jointing and Milking stage and I_5-5 Irrigation each at CRI, Tillering, Late jointing, Flowering and Milking stage as sub plot treatment. Wheat was sown on 15th November during in both years (2015-16 and 2016-17) at with a row spacing of 20 cm with seed cum ferti drill. Recommended dose of fertilizer N:P:K 120:60:40 kg ha-1 gave in crop. Experimental field was slit loam in texture with low organic carbon (0.381 0. 0.421 %), low nitrogen (160.27 and 165.53 kg ha^{-1}), and medium in phosphorus (16.83 and 17.78 kg ha^{-1}) and high range in potassium (258.57 and 265.27 kg ha^{-1}). The variety was sown PBW-502. Ii is widely adopted in the area NWPZ. This variety may be grown in Entire North East India of India. It gives an average yield of 46-50 q ha$^{-1.}$ The Effective tillers were observed in running meter, and then converted values in square meter. The straw yield was computed by deducting the grain yield from the total biological yield and the grain yield data were adjusted at 14%moisture content. Statistical significance between mean differences among the treatment for different parameter was analyzed using the critical differences (CD) at 0.05 % probability level. Economics of various treatments was worked out on the basis of grain and straw yield per hectare. The cost of cultivation and gross profit were estimated on prevailing market price. The B: C ratio was calculated: Benefit: Cost ratio = Net profit (Rs. ha^{-1})/ Cost of cultivation (Rs. ha^{-1}).

Results and Discussion

Effect of tillage practices on yield attributes and yield

Data is present in Table -1. The yield attribute and yield was significantly affected by different tillage practices in wheat**.** The maximum number of effective shoots (m^{-2}) was recorded under conventional tillage + sowing on beds (T_3) over rest of the treatment, which being *at par* with conventional tillage+ sowing by seed cum ferti drill (T_4) and reduced tillage + sowing by seed cum ferti drill (T_2) as well as number of spikes m^{-2} and Number of grains spike^{-1} were recorded significant except 1000-grains weight (g) respectively, during both the years. However, the lowest all the parameters were recorded with treatments zero tillage (T_1). This might be due to the tillage effect on better seed germination and plant growth under these treatments. This finding is supported by Pratik *et al.* (2002), Srivastva *et al.* (2002) Kumar *et al*. (2005), Prasad *et al.* (2005).

The highest grain and straw yield (q ha^{-1}) were observed under conventional tillage + sowing on beds (T_3), which was being *at par* with conventional tillage + sowing by seed cum ferti drill (T_4) 43.90 and 44.61 q ha^{-1} and reduced tillage + sowing by seed cum ferti drill (T_2) 42.64 and 43.33 q ha^{-1} as compare to rest of the treatments during both the years. Because increased no. of effective tillers, no. of grains spike^{-1} and grains weight of this treatments. Similar research findings were also reported by Avtar *et al.* (2002) [4], Asefa *et al.* (2004) [3] Prasad *et al. (*2010) [17] and Dhuka *et al.* (1992).

Effect of moisture regimes on yield attributes and yield

Yield attributes, which determined yield, is the resultant of the vegetative development of the crop. The entire yield attributes *viz.* no. of grains spike^{-1} and Number of effective shoots m^{-2} were significant except 1000 grains weight (g) as they were influenced due to various moisture regimes**.** The no. of effective shoots m^{-2} and no. of grains spike^{-1} were noted higher under irrigation at 1.0 IW/CPE ratio (I_2) being *at par* with 1.2 IW/CPE ratio (I_3) and 5 irrigation each at CRI, tillering, late jointing, flowering and milking stage (I_5). The lowest all the parameters was observed under 3 irrigation each at CRI, late jointing and milking stage (I_4) during both the years respectively. Similar findings were also reported by Rahman *et al.* (2000), Khatri *et al.* (2002) [13], Kumar *et al.* (2004), and Idnani and kumar (2012) [10].

The maximum grain and straw yield (q ha^{-1}) was found under irrigation at 1.0 IW/CPE (I_4), which that *at par* with 1.2 IW/CPE (I_3) and 5 irrigation each at CRI, tillering, late jointing, flowering and milking stage (I_5). This might be due to adequate moisture availability, which contributed to better yield attributes characters. Similar research findings were also reported by Nadeem *et al.* (2007), Khatri *et al.* (2002) [13] and Behera and Sharma (2014) [6].

Table 1: Effect of Tillage practices and moisture regime on growth, yield attributes and yield of wheat

Treatment	Number of Effective shoots (m^{-2})		No. of Grains spike^{-1}		1000-grains weight (g)		Grain yield (q ha^{-1})		Straw yield (q ha^{-1})	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Tillage practices (Main plot)										
T_1	359.96	364.17	34.85	35.58	39.26	39.65	39.45	40.44	54.79	55.31
T_2	395.56	398.44	38.29	39.10	39.54	39.93	42.64	43.33	58.66	59.10
T_3-	423.02	423.25	40.98	41.84	40.18	40.58	46.00	46.74	62.08	62.45
T_4	404.60	407.43	39.44	40.27	40.10	40.50	43.90	44.61	59.98	60.56
SEm ±	7.57	7.66	0.99	0.98	0.25	0.28	1.10	1.03	1.51	1.49
CD at 5%	26.19	26.51	3.43	3.39	NS	NS	3.81	3.58	5.24	5.16
Moisture regimes (Sub plot)										
I_1	381.69	387.72	36.95	37.73	39.55	39.94	40.27	41.20	55.63	56.45
I_2	418.08	421.04	40.76	41.62	40.38	40.78	46.20	47.11	61.65	61.96

I_3	417.11	416.33	40.38	41.23	40.20	40.60	45.48	45.97	61.64	61.82
I_4	354.15	357.65	34.29	35.01	39.33	39.71	38.50	39.01	54.49	54.73
I_5	408.01	408.77	39.57	40.41	39.40	39.79	44.53	45.60	60.97	61.81
SEm ±	7.06	7.09	0.66	0.68	0.416	0.42	0.72	0.75	1.01	1.02
CD at 5%	20.61	20.69	1.92	1.98	NS	NS	2.094	2.20	2.95	2.97

Table 2: Effect of Tillage practices and moisture regime on the Economics of wheat

Treatments Combination	Cost of Cultivation (Rs. ha-1)	Gros return (Rs. ha-1)	Net return (Rs ha^{-1})	B:C (%)
T_1I_1	30197	88020.18	57823.18	1.91
T_1I_2	31197	101625.64	70428.64	2.26
T_TI_3	32197	97505.66	65308.66	2.03
T_1I_4	28197	85851.61	57654.61	2.04
T_1I_5	30197	98353.31	68156.31	2.26
T_2I_1	30947	95395.03	64448.03	2.08
T_2I_2	31947	107748.70	75801.70	2.37
T_2I_3	32947	106963.62	74016.62	2.25
T_2I_4	28947	91312.71	62365.71	2.15
T_2I_5	30947	105014.33	74067.33	2.39
T_3I_1	32147	102763.81	70616.81	2.20
T_3I_2	33147	115628.64	82481.64	2.49
T_3I_3	34147	114883.65	80736.65	2.36
T_3I_4	30147	97465.56	67318.56	2.23
T_3I_5	32147	112787.10	79640.10	2.47
T_4I_1	31497	98205.56	66708.56	2.12
T_4I_2	32497	110965.39	78468.39	2.41
T_4I_3	33497	110016.93	76519.93	2.28
T_4I_4	29497	93422.20	63925.20	2.17
T_4I_5	31497	108011.55	76514.55	2.43

Economics

The maximum cost of cultivation (Rs. 34147 ha^{-1}) was conducted under treatment combination of T_3 I_3 (conventional tillage + sowing on beds along with irrigation at 1.2 IW/CPE ratio) followed by T_4I_3 (Rs. 33497 ha^{-1}), respectively. This was mainly due to higher cost of tillage and irrigation. The treatment combination of zero tillage (T_1) along with irrigation at 3 irrigation each at CRI, late jointing and milking stage (I_4) was resulted lowest cost of cultivation *i.e.* (Rs. 28197 ha^{-1}). It is due to zero tillage and less number of irrigation at (I_4).

However, the maximum grass return (Rs. 115628.64 ha^{-1}) was under T_3I_2 combination (Conventional tillage + sowing on beds along with irrigation at 1.0 IW/CPE ratio) followed by T_3I_3 (Rs. 114883.65 ha^{-1}), respectively. This was mainly due to additional output obtained expenditure made on same combination of the treatment. The highest net return (Rs. 82481.64 ha-1) was calculated under conventional tillage + sowing on beds (T_3I_2) along with 1.0 IW/CPE followed by conventional tillage + sowing on beds along with 1.2 IW/CPE (T_3I_3) (Rs. 80736.65 ha^{-1}). The benefit: cost ratio was computed highest under conventional tillage + sowing on beds with irrigation level on moisture regime treatment combination (T_3I_2) (2.49 %) which was followed by conventional tillage + sowing on beds with irrigation level 1.0 IW/CPE ratio (2.49 %) $T_3I_{5.}$ While minimum B:C ratio was calculated under Zero tillage with irrigation level 0.8 IW/CPE ratio (1.91 %) $T_1I_{1.}$ It was mainly lowest production levels under the treatment due to reduce the benefit: cost ratio of this treatment.

Thus, the present studies conclusively that the application of different tillage practices with moisture regime of irrigation levels were recorded higher grain and straw yield (q ha^{-1}) and economic return (Rs. ha^{-1}) over rest of the treatments, which was given better performance of this treatment over to other.

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