

## Performances of wheat (*Triticum aestivum*) under various tillage and nitrogen management in sub-Himalayan plains of West Bengal

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### Abstract

A field experiment was conducted at Instructional Farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal during *rabi* 2008-09 and 2009-10 to assess the performance of wheat under different tillage conditions (conventional tillage, reduced tillage and zero tillage) and nitrogen levels (100, 125 and 150 kg/ha). It was revealed that zero tillage led to improvement in growth and yield attributing characters, viz., plant height, number of tillers/running meter, number of panicles/plant, number of filled grains/spike, spike length and test weight. There was a significant increase in crop yield (14.29%) of wheat under zero tillage over conventional tillage. Nitrogen uptake in grain and straw were not influenced significantly under various tillage operations, though maximum uptake was recorded with zero tillage due to higher grain yield. Effective tillers per running meter increased by 18.9% with 150 kg/ha of nitrogen over 100 kg/ha. Yield increment was recorded to be 11.86 and 24.40% with application of 125 and 150 kg/ha of nitrogen over 100 kg/ha respectively. Zero tillage exhibited a higher net return (Rs. 20,430.00 /ha) and B-C ratio (2.31) over other tillage practices.

**Keywords:** Nitrogen, tillage, wheat, yield

## 1. Introduction

Rice-wheat is a predominant cropping system in *Terai* zone of Bengal occupying 26.10 thousand hectare area with a production of 49.80 thousand tons. Poor productivity of wheat (1908 kg/ha) is a great concern in this zone. Sowing of wheat in these areas gets delayed due to late harvesting of medium to long duration rice, the previous crop in the rotation. Wet soil conditions further delayed the sowing of wheat as it takes another 20-25 days to come in working condition. Delayed sowing resulted in a reduction of yield to the tune of 37.5 kg/ha/day (Pal *et al.*, 1996). The adoption of Resource Conservation Technologies (RCTs) as no-till is considered vital for improving the productivity of rice-wheat system and prime driver for zero tillage is not the water saving or natural resource management but the monetary gain (Ereinstein *et al.*, 2008). In these areas sowing of wheat with zero-till drill or behind country plough advances the sowing time 10-15 days and also saves the time and cost involved in field preparation. It has been observed that zero tillage reduces the problem of weed infestation and improves

fertilizer and water use efficiency which can enhance the yield up to 40.60% (Dixit and Bhan, 1997). Even some low land rice fallows with restricted irrigation facilities can be brought under cultivation with this technology. Keeping these in mind, an experiment has been planned to assess the performance of wheat under different tillage conditions and nitrogen levels.

## 2. Materials and methods

The experiment was conducted at KVK Instructional Farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal during *rabi* 2008-09 and 2009-10. The soil was sandy loam having mineralizable N (140.50 kg/ha), available P (21.30 kg/ha) and available K (133.60 kg/ha) with pH 5.9.

The experiment was laid out in split plot design. Three different tillage practices, viz., conventional tillage (5-6 ploughings followed by 2 cross harrowings), reduced tillage (opening of rice fallows with country plough and sowing behind the plough) and zero tillage (sowing

with zero-till-drill) were assigned to main plots; while three nitrogen levels, viz., 100, 125 and 150 kg/ha of nitrogen were randomly allocated to sub-plots with three replication.

Wheat variety PBW 343 was taken in this experiment and sown on December 03 in each year of experimentation. Spraying of Glyphosate 41 SL@ 2 kg a.i./ha was done 5-7 days prior to sowing. Full dose of P (26.31 kg/ha) and K (50 kg/ha) were applied at the time of seeding while nitrogen (25% as basal+50% at CRI+ 25% at active tillering) was applied as per treatment. Four irrigations were applied uniformly to all the treatments as per requirement. Boron and zinc were supplied to the crop through foliar sprays twice, once at 30-35 DAS and another at 50-55 DAS. The crop was harvested on April 04 and 07 during 2008-09 and 2009-10 respectively. During the entire growing period the crop received 29.2 and 16.4 mm rainfall in two consecutive years respectively.

The data on plant height and other yield attributing characters viz., plant height, number of tillers/meter, number of panicles/ plant, number of filled grains/spike, spike length and test weight were recorded at harvest. The data on grain yield and straw yield were also taken at harvest and harvest index were calculated accordingly. Economic analysis was carried out using the prevailing market price. The statistical analysis of data was done following the procedure for analyzing split-plot and by using statistical software MSTAT-C version 2.1 (Michigan State University, USA). Significant differences between the treatments were compared with the critical difference at  $\pm 5\%$  probability by LSD.

### 3. Results and discussion

**3.1 Effect of tillage:** It was revealed that zero tillage led to improvement in growth and yield attributes, viz., plant height, number of tillers/running meter, number

of panicles/ plant, number of filled grains/spike, spike length and test weight (Table 1.). Excepting the test weight all other yield attributing character increased significantly under the practice of zero tillage. The highest number of effective tillers/running meter (83), number of panicles/plant (10.3), number of filled grains/spike (46.8) as well as spike length (11.70 cm) were recorded with zero tillage and the values were significantly higher over the values recorded under reduced tillage or conventional tillage. These could be due to various favourable factors under zero- tillage like proper placement of seed in a narrow slit made by zero till drill as well as emergence of wheat seedlings under favourable moisture content. There was a significant increase in crop yield (14.29%) of wheat under zero tillage over conventional tillage. This yield differences was mainly due to increase in major yield attributing character under favourable weather. Tripathy and Chauhan (2000), Yadav *et al.*(2005) also reported similar results. Nitrogen uptake in grain and straw were not influenced significantly under various tillage operations, though maximum uptake was recorded with zero tillage due to higher grain yield. Zero tillage exhibited a higher net return (Rs. 20,430.00 /ha) and B-C ratio (2.31) over other tillage practices. It was mainly due to less operational cost as there was no cost incurred towards land preparation and manual weeding. Singh *et al.* (2009) also reported higher net return under zero tillage over conventional tillage. Gupta *et al.* (2007) recorded 6.77% and 9.33% increase in net return and B-C ratio under zero tillage over conventional tillage respectively. It was interesting to note that B-C ratio (1.98) was higher in reduced tillage against conventional tillage (1.68) despite lesser yield. Huge curtailment in the cost of land preparation resulted in such improvement in B:C ratio. However, line sowing behind country plough was supposed to a tedious and specialized skillful job.

**Table 1.** Growth and yield attributing character of wheat as influenced by tillage and N-levels (mean of 2 years)

Treatments		Plant height (cm)	No. of effective tillers/meter	No. of panicle/ plant	No. of filled grains /spike	Spike length (cm.)	Test weight (g)
Tillage	Conventional Tillage (CT)	92.7	74	9.0	39.8	9.98	41.50
	Reduced Tillage (RT)	94.5	62	7.8	40.5	10.08	40.89
	Zero Tillage (ZT)	99.8	83	10.3	46.8	11.70	41.92
	CD (P=0.05)	NS	7.5	1.1	3.1	0.68	NS
N-levels (Kg/ha.)	100	88.5	71	8.3	40.5	10.21	40.80
	125	96.8	79	9.8	42.3	11.50	41.51
	150	104.8	88	10.9	48.7	12.13	41.96
	CD (P=0.05)	7.2	8.3	1.4	3.9	0.71	NS

**Table 2.** Yield of wheat as influenced by tillage and N-levels (mean of 2 years)

Treatment		Grain yield (q/ha)	Straw yield (q/ha)	Harvest Index (%)
Tillage	Conventional Tillage (CT)	31.50	40.90	43.48
	Reduced Tillage (RT)	29.20	37.60	43.71
	Zero Tillage (ZT)	36.00	46.10	43.85
	CD (P=0.05)	1.70	3.10	NS
N-levels (Kg/ha.)	100	29.50	38.60	43.30
	125	33.00	42.90	43.47
	150	36.70	46.70	44.00
	CD (P=0.05)	3.10	4.20	NS

**Table 3.** Nitrogen uptake and production economics as influenced by tillage and N-levels (mean of 2 years)

Treatment		N-uptake (Kg/ha.)		N-use efficiency (%)	Cost of cultivation	Net Return (Rs./ha.)	B-C Ratio
		Grain	Straw				
Tillage	Conventional Tillage (CT)	76.50	25.70	-	18745	12755	1.68
	Reduced Tillage (RT)	74.70	24.50	-	14765	14435	1.98
	Zero Tillage (ZT)	78.30	27.10	-	15570	20430	2.31
	CD (P=0.05)	NS	NS	-	-	-	-
N-levels (Kg/ha.)	100	69.90	23.15	11.10	17955	11545	1.64
	125	75.50	28.20	13.20	18350	14650	1.80
	150	81.10	31.50	14.80	18745	17955	1.96
	CD (P=0.05)	5.20	2.80	1.10	-	-	-

**3.2 Effect of nitrogen:** Increasing fertilizer dose significantly increased plant height and other yield attributes such as number of effective tillers/running meter, number of filled grains/ spike, number of panicles/plant as well as spike length. Effective tillers per running meter were increased by 18.9% with application of 150 kg/ha of nitrogen over 100 kg/ha. Similarly, number of panicles/plant as well as number of filled grains/spike was increased consistently with each incremental doses of nitrogen application. The number of panicles/plant was increased from 8.3 to 9.8 with addition of extra 25 kg N over 100 kg/ha of N application; another addition of 25 kg/ha resulted in further increase in number of panicles/plant up to 10.9. Again, number of filled grains/spike was also increased by 20.24% with addition of 50 kg/ha of N over 100 kg/ha. This could be due to the fact that nitrogen played a vital role in increased sink size. Nitrogen is required throughout the grand growth period and hence adequate and regular supply might have a great role towards increased number of major yield attributes. Dou and Hons(2006) reported similar crop growth under different tillage systems. As test weight is basically a genetic character it was not influenced by nitrogen levels. As a result, test weight did not vary significantly with incremental doses of nitrogen.

With each successive increment in nitrogen levels from 100 to 150 kg/ha, grain and straw yield increased significantly. Yield increment was recorded to be 11.86 and 24.40% with application of 125 and 150 kg/ha of nitrogen over 100 kg/ha respectively. The trend was similar for straw yield also. The highest grain (36.70 q/ha) and straw yield (46.70 q/ha) were recorded with the highest level of nitrogen (150 kg/ha) application. There may be requirement of extra nitrogen for proper decomposition of previous paddy stubbles under zero tillage. Upon decomposition stubbles may have supplied available nutrients to crop. Again, under zero tillage, yield increased significantly with higher nitrogen levels probably due to better utilization of growth resources. The results corroborated with the findings of Gupta *et al.* (2007) and Yadav *et al.* (2005). Increasing nitrogen levels also increased nitrogen uptake significantly. The uptake of nitrogen in wheat was the highest (81.1 kg/ha) with application of 150 kg/ha of nitrogen. Increasing rates of nitrogen caused a corresponding increase in tissue contents of N in wheat plants (Ishaq *et al.*, 2001). Higher dry matter production with increased tissue N content may attribute to this higher uptake. Kharub and Chander (2010) reported higher uptake of nitrogen with increasing levels and number of splits. The highest N-use efficiency (14.8%) was also recorded with application of nitrogen @ 150 kg/ha. In terms of production economics,

net return (Rs. 18,745.00) and B-C ratio (1.96) were higher with the highest level (150 kg/ha) of N application. Each successive increment in nitrogen levels exhibited higher net return as well as B-C ratio. Each incremental dose of nitrogen resulted in proportionate increase in grain yield surplusing the extra cost incurred towards nitrogen fertilizers. Kumar and Yadav (2005) reported that all growth characters, yield attributes, yield and nitrogen uptake were significantly higher with 150 kg/ha of nitrogen over 120 kg/ha.

Zero tillage technology was supposed to be the most promising tillage options in wheat over conventional and reduced tillage operations. Increase in Nitrogen levels upto 150 kg/ha was beneficial for wheat in sub Himalayan plains of West Bengal in terms of yield, nitrogen use efficiency and net returns.

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