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Impact of zero tillage over conventional tillage in Kushinagar district of Uttar Pradesh

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Abstract

An experiment was conducted at Amawakhas Nyaypanchayat, Kushinagar district of U.P. Under National Innovation in Climate Resilient Agriculture (NICRA) Project for the investigation of impact of zero tillage over conventional tillage during the year 2012 to 2016. Reduced cost of tillage and irrigation under zero tillage production of wheat results in yield increase possibly through optimised sowing time and enhanced water use efficiency attributes. The experimental results are indicative to the fact that zero tillage was found superior over conventional tillage in context of following yield attributes viz. spike length, number of spikes per meter, number of grain per spike except test weight. Therefore, production of zero till wheat was higher i.e. 40.55 quintals which was 8.22% higher than conventional tillage i.e. 37.22 quintals per hectare. Average savings w.r.t. cost of cultivation under zero till wheat amounted to INR 7265.69 per hectare. The profit margin increased by INR 13171.07 per hectare. Zero tillage method also recorded higher Benefit Cost ratio at 2.34 as compared to conventional tillage method (1.70).

Keywords: Zero tillage, conventional tillage, yield attributes

Introduction

Triticum aestivum L. accounts for 36.2% of total grain production of the country second only to rice. It is grown under diverse agro-climatic conditions. Wheat is usually sown by broadcasting the seed onto a level soil surface and other shallow tillage operations further assist in incorporation and production. Also sowing in closely spaced shallow drilled rows on flat beds is practiced. Under broadcasting, there is a requirement of additional 7-12 days for land preparation, high input cost besides delayed wheat sowing. Delayed wheat sowing is one of the prominent critical deciding factor responsible for low yields.

Gupta and Seth, 2007^[7] reported adoption of surface seeding and various RCTs such as zero tillage for timely sown wheat with reduction in cost of production by the farmers. Reduced fuel consumption for tillage and irrigation with corresponding savings under input costs have been reported due to adoption of wheat cultivation under zero tillage (Malik *et al* 2003; Bhushan *et al* 2007)^[2, 3]. Introduction of ZT seed drill during early 2012-16 under the project area made wheat sowing possible in freshly harvested paddy fields with the added benefit of utilizing residual matter from previous crop. Zero-tillage wheat ensures minimal tillage, allows for earlier planting of wheat, significant cost savings as well as higher yields. Input cost-saving effect is the main driver behind the propagation and spread of Zero tillage. It is a minimum tillage practice wherein the crop is sown directly into untilled soil after the harvest of the previous crop. The technique is much acclaimed for its enhanced water use efficiency, prospects for soil fertility improvement with higher per capita profits (Erenstein, 2009)^[8].

Zero tillage is a sustainable practice that facilitates germination, improve both soil physical properties and fertility besides which timely sowing increases net return (Malhi *et al.*, 2006; Franchini *et al.*, 2007)^[5, 4]. Halvorson *et al.* (2000)^[6] reported that no tilled wheat yield is greater than under minimum and conventional tillage methods. Erenstein and Laxmi, 2008^[9] reported reduction in cost of production and capitalises by saving of sowing time by 10-15 days as compared to conventional tillage of wheat.

Materials and Methods

The study was conducted at village Amwakhas under district Kushinagar of Uttar Pradesh. Amwakhas was selected for conducting trials pertaining to interventions under NICRA.

The largely followed rice-wheat cropping system was prone to low yield of wheat due to delayed sowing and lack of awareness about suitable crop varieties and corresponding farm mechanization. Village amwakhas, district Kushinagar comes under North Eastern Plain Zone which itself adds further complexity. Kushinagar district was targeted to ensure wide spread adoption of zero tillage. The said village consists of various tolls (18 hamlets) with 2156 ha under cultivation. Two hundred and twenty one farmers were involved under various trials conducted during 2012-2016. During the initial phases farming households were selected randomly on the basis economic backwardness for demonstration. Zero tillage was demonstrated at 84 farmers field in a total area of 17.48 hectares during 2012-13. The area under zero tillage of wheat increased to 46.16 ha in 2016. Conventional tillage plots were also sown alongside for a better understanding and first-hand

experience of the participating farmers and others closely associated.

Results and Discussion

Yield attributes and grain yield

The data as recorded for spike length, number of grains per spike, grain yield in quintals, test grain weight and number of spikes per meter square are presented in table 1. The parameters under consideration were found to be highest in 2015-2016 (8.32, 39.3, 42.1, 41.7 and 375) for conventional tillage and 8.45, 43.16, 45.7, 41.84 and 391.20 under ZT respectively) which was similarly followed by 2014-15 under both conventional tillage and zero tillage practices. The lowest yield attributes were found in 2013-14 (8.05, 35.0, 30.2, 38.28 and 352 under conventional tillage w.r.t 8.27, 36.10, 33.3, 38.4 and 371.02 respectively for zero till.

Table 1: Data pertaining to various wheat yield attributes viz. spike length, number of grains per spike, total grain yield, test grain weight and number of spikes per meter square as recorded during 2013-2016.

Year	Variety	Length of Spike (cm)		No. of grains / spike		Grain production (q/ha)		Test weight		No. of spike/m ²	
		CT	ZT	CT	ZT	CT	ZT	CT	ZT	CT	ZT
2012-13	PBW-502	8.10	8.28	37.8	41.25	35.4	38.41	40.90	41.10	362.0	375.86
2013-14	HD-2733	8.05	8.27	35.0	36.10	30.2	33.3	38.28	38.4	352	371.02
2014-15	HD-2967	8.30	8.42	38.1	42.54	41.2	44.8	41.53	41.72	365	381.5
2015-16	HD-2967	8.32	8.45	39.3	43.16	42.1	45.7	41.71	41.84	375	391.20

*CT- Conventional tillage, **ZT- Zero tillage

Grain yield is a functional aggregate of various yield attributes such as spike length, number of grains per spike, test grain weight (1000 grains) and number of spikes per meter square. Grain yield as observed differed marginally w.r.t tillage methods employed. Data presented in table 1 shows that conventional tillage fields had lower grain yields during 2013-2016 than zero tilled fields. The lowest wheat grain production was recorded in 2013-14 (30.2 q/ha and 33.3 q/ha) under both conventional and zero tillage. Highest grain yield was recorded both in conventional and zero tillage practices (42.1 q/ha and 45.7 q/ha) during 2015-2016. Mean grain yield of four years showed 8.16% more grain production under zero tillage practices w.r.t conventional tillage practices. Bear *et al.*, 1994^[10] deduced the probable outcome of delayed sowing results in less time availability for desired physiological growth and development besides loss possibility due to high temperature during the grain filling stage under conventional tillage. Higher yield of wheat in zero tillage has

been reported by many authors (Cham *et al.*, 2002; Bauer *et al.*, 2002)^[11, 12] courtesy better utilisation and retention of soil moisture, increase in water use efficiency, nutrients recycling availability and uptake besides less fluctuation of soil temperature.

Economic

The average cost of cultivation under zero tilled wheat of 2012-2016 was 28997.8 Rs which was 20.03% less in comparison to conventional tillage i.e. 36263.5 Rs as evident from table 2. Zero tillage farmers obtained higher benefits during the four years (2.51, 1.75, 2.54, and 2.58) w.r.t broadcasting i.e. (1.81, 1.44, 1.84 and 1.92) as evident from B:C ratio. Maximum B:C ratio was recorded in the year 2015-16 (1.92 and 2.58) while least B:C ratio was recorded in the year 2013-14 (1.44 and 1.75) under both conventional and minimal tillage respectively.

Table 2: Economics of cost of cultivation with zero tillage during the year 2013-2016

Year	Variety	Gross cost		Gross return		Net return		B:C Ratio	
		CT	ZT	CT	ZT	CT	ZT	CT	ZT
2012-13	PBW-502	30915	23804.7	55259.4	59942.0	29090	41259.84	1:1.81	1:2.51
2013-14	HD-2733	36044.1	29789.62	51914.0	57742.0	15869.9	27952.38	1:1.44	1:1.75
2014-15	HD-2967	39150	30937	72388.0	78714.0	33238	47777	1:1.84	1:2.54
2015-16	HD2967	38945	31460	74938	81346	35993	49886	1:1.92	1:2.58

Tillage and zero tillage. It was also observed that the average gross return and net return with zero tillage of the four year (2012-2016) was 69436.0 Rs and 41718.8 Rs which was higher 9.13% and 46.1% in comparison to average gross return and net return of conventional tillage i.e. 63624.8 and 28547.7 rupees respectively.

Conclusion

In this experiment zero tillage reduces the cost of cultivation and irrigation with increase in yield. The experimental results

revealed that performance of zero tillage was found superior over conventional tillage. Mean grain yield of four year showed that zero tillage practices produced 8.16% more grain than conventional tillage practices. Zero tillage practices were demonstrated at 84 farmers field in a total of 17.48 ha during 2012-13. The area under zero tillage of wheat increased to 46.16 ha in 2016. Yield of wheat in zero tillage was more than the conventional tillage. This can be due to minimal tillage benefits i.e. better utilisation of soil moisture, increased water use efficiency (as evident from less irrigation requirement)

and stability of soil parameters due to previous crop residue incorporation. Hence, this technology is an important alternative to save resources and enhance the net farm income.

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