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Zero tillage technology awareness a boom success story among farmers in the district Kushinagar, Uttar Pradesh

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Abstract
The study was conducted in the different Block of Kushinagar district in U.P. under Frontline Demonstration by Krishi Vigyan Kendra, Kushinagar through coordinating Institution ICAR-IIVR, Varanasi, U.P. Demonstration with Zero Tillage wheat has shown primarily positive impacts on wheat crop management, particularly through reduced input needs combined with potential yield increase. To evaluate the economics of high yielding variety (PBW 502) and their utilisation in zero tillage to improve income of farmers and agricultural productivity, the utilisation of high yielding variety under frontline demonstration programme was demonstrated and calibrated using the data of a field experiment in the district. The average yield of high yielding variety was recorded 34.1 q/ha over conventional sowing it is 27.9 q/ha by using local variety of wheat. In another case study, the average yield in zero-tillage method was recorded 36.6 q ha^{-1} over conventional sowing it is 27.4 q/ha by using local variety of wheat. The average yield of PBW 502 was 34.1 q/ha and yield of zero tillage technique was 36.6 q/ha. The data collected from the field were analysed and the result of the study in respect of percentage increase in yield in PBW 502 with ZT increased 7.33% over farmers practice by using PBW 502. The B:C ratio was observed higher side by using PBW 502 is 1.6 as compared to conventional method sowing of wheat is 1.4. The B: C ratio was observed higher side in zero-tillage method is 1.6 as compared to conventional method sowing of wheat is 1.5. The finding have clearly established that wheat sowing can be advanced in yield by using PBW 502 over utilisation of local variety of wheat, under zero tillage method it also clearly established that wheat sowing can be advanced in yield over conventional tillage system.

Keywords: Zero Tillage, PBW 502, Wheat Productivity, Frontline Demonstration, Kushinagar

Introduction

India is the second largest producer of wheat (*Triticum aestivum* L.) in the world with an average annual production of 80 Mt (million tons) in recent years (Anonymous, 2011) [1]. It accounts for approximately 11.79 per cent of world's wheat production (FAO, 2011) [1]. After the Green Revolution, the production of wheat has shown a huge increase. The major states involved Uttar Pradesh, Punjab and Haryana. They account for nearly 70 percent of the total wheat production of the country. Punjab and Haryana yield the highest amount of wheat because of the availability of better irrigation facilities. Wheat is the second most important food crop of India next to rice and demand for wheat in the country is increasing day by day.

The greatest demand for wheat in the coming years will have to be met by increasing devotion of land to wheat or increasing yield per unit area. In India, wheat grown on an area of 30.37 million hectare with total production of 90.78 million tonnes making an average yield of 2.99 t/ ha, while in Jharkhand, wheat grown on an area of 1.7 million hectares with total production of 3.36 million tonnes, making an average yield of 1.98 t/ ha (Anonymous, 2015). Among various factors responsible for low yield of wheat crop in the country, sowing time and varietal (genotypic) selection are of primary importance. Wheat is sown in winter and it has its own definite requirements for temperature and light for emergence, growth and flowering (Dabre *et al.*, 1993) [3].

Demonstration with Zero Tillage wheat in the rice-wheat systems have shown primarily positive impacts (Pandey *et al.*, 2003) [5] on wheat crop management, particularly through reduced input needs combined with potential yield increases. Hobbs and Gupta (2003) [5] also supported that Zero Tillage technique reduced input needs for wheat production. Due to the adoption of ZT technology, the number of field operations for wheat crop establishment (including tillage) decrease from an average of seven to only one (Malik *et al.*, 2002a) [6]. Effects on soils, weeds, pests and diseases in ZT typically improves soil quality in various dimensions, including soil structure, soil fertility and soil biological properties. ZT typically reduces the incidence of weeds in the wheat crop (Malik *et al.*, 2002a); (Malik *et al.*, 2002b) [6]. In fact, ZT reduced the nematodes population and enhanced both the earthworm population and predator diversity and density in wheat (Malik *et al.*, 2002a); (Malik *et al.*, 2002b) [6].

Therefore, utilisation of high yielding genotypes, with mid-range of adaptability to edaphic and environmental conditions is very essential to increase yield per hectare and utilization of zero tillage method for sowing of wheat to

increase yield per hectare. Keeping this in view, the present study was therefore, designed to determine the effect of zero tillage method and response of high yielding variety (PBW 502) on yield of wheat and economics of wheat cultivation.

Materials and Methods

The trial was carried out during Rabi season on 15 farmer's field of the district with size of trial in 15 acre. The machine Zero till seed cum fertilizer drill was provided by Krishi Vigyan Kendra. The farmers were selected on the basis of their past experience. Before trial training was conducted to farmers about use of Zero till seed cum fertilizer drill machine by the KVK, Soil Scientists. Yield effects, cost savings and profitability, socio-economic and method impacts were study on above trial.

Wheat varieties were sown by broadcasting method as per treatment scheduled. The recommended basic full dose of P, K and half dose of nitrogen as basal and the remaining nitrogen was applied in 2 equal doses, half at tillering and the rest half at boot stage. The sources of nutrients were urea, single super phosphate and muriate of potash for N, P and K, respectively. The recommended dose of fertilizer was 125 kg N, 65 kg P_20_5 and 45 kg K_2O per hectare. The crop was sown in the field using a seed rate of 150 kg/ha by broadcasting method and in ZT method 115 kg/ha.

Keeping in the view need, under wheat cultivation area to increase area for research varieties for wheat cultivation in the district therefore Krishi Vigyan Kendra, has taken following technologies i.e. Promotion of short duration varieties of wheat. Promotion of research varieties of wheat and Use of Zero Tillage method (ZT) for sowing of Wheat, intervention by front line demonstration.

PBW 502 is a high-yielding, rust-resistant wheat variety developed by Punjab Agricultural University (PAU) for timely sown, irrigated conditions in North India. It typically yields 55–60 quintals/hectare (or ~20.4 q/acre), maturing in 130–140 days. Its grain is yellowish-white and it is suitable for chapati and bread production.

Key Characteristics of PBW 502 Wheat Variety

- **Yield & Maturity:** It has high-yield potential (55-60 Q/ha). It is a medium-duration variety maturing in about 128-140 days.
- **Suitability:** Ideal for timely sowing in Punjab, Haryana, and Uttar Pradesh.
- **Plant Height:** The plant is roughly 80–100 cm tall.
- **Disease Resistance:** Offers strong resistance to stripe rust and leaf rust.
- **Grain Quality:** Produces yellowish-white, high-quality, medium-to-large grains.
- **Sowing Period:** The ideal time for sowing is during the first half of November.

Zero tillage (ZT) in wheat is a sustainable, cost-effective cultivation method where seeds are sown directly into unploughed soil using a zero-till drill, bypassing traditional land preparation. It reduces production costs by 50-60%, conserves water, reduces weed growth (especially *Phalaris minor*), and improves soil health by retaining previous crop residues.

Key Aspects of Zero Tillage Technology for Wheat

- Methodology: The soil is left undisturbed from the harvest of the previous crop (typically rice) to the sowing of wheat. A tractor-mounted zero-till seed-cum-fertilizer drill opens narrow slits (6-13 cm deep) to place seeds and fertilizer simultaneously.
- Operational Benefits:
- Cost Savings: Eliminates 100% of tillage costs, significantly saving on tractor fuel and labor.
- Improved Yield: Often results in a 3.5% to 6.0% yield increase, particularly in late-sown conditions, because the precise, timely sowing avoids moisture loss.
- Reduced Weed Intensity: The undisturbed soil reduces the germination of weeds like *Phalaris minor*.
- Environmental Impact: It minimizes soil erosion, enhances soil structure, and reduces carbon emissions by avoiding burning of crop residues, which can instead be used as mulch.
- Time Management: Facilitates earlier sowing of wheat after rice harvest, avoiding late-sown penalties.
- Best Practices: Requires effective weed control, usually by applying a herbicide like Glyphosate before sowing if weeds are present, and proper management of the previous crop's stubble.

Results and Discussion

Grain yield of wheat crop is the result of combined effect of various yield contributing components. It is evident from the data that high yielding variety affected the grain yield. Maximum grain yield (35.8 q/ha) was obtained when wheat was sown by use of PBW 502 with minimum grain yield (32.9 q/ha). Maximum grain yield (23.90 q/ha) was obtained when wheat was sown by use of local wheat variety with minimum grain yield (16.61 q/ha). Average grain yield (34.1 q/ha) was obtained when wheat was sown by use of PBW 502 and Average grain yield (27.9 q/ha) was obtained in case of local wheat variety, under field trials of 15 Farmers.

The cultivar PBW 502 recorded % increase in yield was 20.8 as compared to local wheat variety. The variety recorded higher gross return (52546.7 Rs/ha) and net return (19590.0 Rs/ha) as compared to local variety having gross return (49286.7 Rs/ha) and net returnee (14034.7 Rs/ha). Gross cost for the cultivation of PBW502 was 32956.7 Rs/ha, in case of local variety gross cost was 35252.0 Rs/ha due to management practices. B: C ratio was also worked out for both farmers practice using HUW 502 and local from sowing to harvesting as given in Table 1.

The zero-tillage method is not remunerative but also eco-friendly. It envisages 100 per cent saving in land preparation as wheat sowing is done just after harvesting of preceding rice crop without any ploughing. Thus in zero tillage the soil is left undisturbed from harvest of rice to sowing of wheat. The data collected from the field were analyzed and the results of the study in respect of (i) Percentage increase in yield of pbw 502 with ZT and (ii) Economics and Benefit Cost ratio of pbw 502 with ZT are summarized in Table 2.

Percentage increase in yield: the yield in pbw 502 with ZT increased 33.9% over local variety. The average yield in pbw 502 With Zero tillage method was recorded 36.6 q/ha over local variety it is 27.4 q/ha. The difference of yield in pbw 502 with ZT and without ZT with local variety is justified in Table 2.

Table 1: Yield and Economics of PBW - 502 as compared to Local variety of wheat

Sl No	Yield (q/ha)		% Increase	Economics of PBW-502 (Rs/ha)				Economics of Local variety (Rs/ha)			
	PBW-502	Local		Gross cost	Gross Return	Net Return	** BCR	Gross cost	Gross Return	Net Return	** BCR
1	34.2	25.3	17.80	32400	52200	19800	1.61	34200	48800	14600	1.43
2	33.2	26.8	23.88	33100	53000	19900	1.60	35600	49200	13600	1.38
3	32.9	27.3	20.51	32450	51900	19450	1.60	34400	47900	13500	1.39
4	33.7	27.8	21.22	34100	52600	18500	1.54	36600	48400	11800	1.32
5	35.8	28,7	19.86	32500	52500	20000	1.62	34200	49300	15100	1.44
6	33.6	27.8	20.86	33200	53200	20000	1.60	35700	49700	14000	1.39
7	34.7	28.5	21.75	32700	53700	21000	1.64	34500	50300	15800	1.46
8	35.8	30.7	16.61	32900	52800	19900	1.60	36000	48800	12800	1.36
9	34.2	28.4	20.42	33100	51900	18800	1.57	36300	49700	13400	1.37
10	33.8	29,7	23.90	32400	52700	20300	1.63	34400	49900	15500	1.45
11	34.3	28.8	19.10	33150	52000	18850	1.57	35700	48800	13100	1.37
12	33.5	27.3	22.71	32600	52300	19700	1.60	36200	50100	13900	1.38
13	33.6	27.3	23.08	32800	51700	18900	1.58	34780	48750	13970	1.40
14	34.2	28.7	19.16	33400	52600	19200	1.57	35500	49350	13850	1.39
15	33.6	27.6	21.74	33550	53100	19550	1.58	34700	50300	15600	1.45
Average	34.1	27.9	20.8	32956.7	52546.7	19590.0	1.6	35252.0	49286.7	14034.7	1.40

Table 2: Yield and Economics of PBW-502 with ZT as compared to Local variety of wheat

Sl No	Yield (q/ha)		% Increas e	Economics of PBW-502 with ZT (Rs/ha)				Economics of Local variety (Rs/ha)			
	PBW-502 with ZT	Loca l		Gross cost	Gross Return	Net Return	** BCR	Gross cost	Gross Return	Net Return	** BCR
1	36.4	27.8	30.94	33800	54500	20700	1.61	35100	51300	16200	1.46
2	35.7	25.2	41.67	32900	54400	21500	1.65	34800	52100	17300	1.50
3	36.9	28.4	29.93	32600	52700	20100	1.62	33900	49800	15900	1.47
4	36.7	26.9	36.43	31600	53000	21400	1.68	34600	48800	14200	1.41
5	37.5	28.7	30.66	32900	52800	19900	1.60	34800	49300	14500	1.42
Aver age	36.6	27.4	33.9	32760.0	53480.0	20720.0	1.6	34640.0	50260.0	15620.0	1.45

Benefit Cost ratio: B: C ratio (BCR) were also worked out for both PBW 502 with ZT and local variety from sowing to harvesting as given in Table 2. The B: C ratio as observed from table has been more in PBW 502 with ZT field as compare to local variety of sowing of wheat. It is because of reduction in primary tillage operation in ZT method as well as due to higher production. Verma *et al.*, (2017) also supported that zero-tillage method is superior as compared to conventional method sowing of wheat.

The average yield in PBW 502 with ZT was recorded 36.6 q/ha (Table 2).

Over PBW 502 sowing it is 34.1 q ha-1 (Table 1). The data collected from the field were analyzed and the result of the study in respect of percentage increase in yield in PBW 502 with ZT increased 7.33% over farmers practice by using PBW 502 without ZT. From the economic point of view PBW 502 with ZT was recorded (Rs.20720.0/ha) higher net return as compared to PBW 502 without ZT (Rs.19590.0/ha). Rawat and Varma (2006) also supported that zero tillage is that it reduces the cost of cultivation which was more economical in comparison to conventional method of sowing.

Awareness among farm machinery and line sowing of wheat

Conclusions

It is concluded from the results of the experiment that in order to get maximum yield of wheat variety PBW 502 was found to be more suitable variety as compared to local variety. PBW 502 with ZT can also be recommended for higher yield of wheat in Kushinagar, U.P.

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