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Zero Tillage in Wheat under Rice-Wheat Cropping System in Kymore Plateau and Satpura Hills Region of Madhya Pradesh

B K Tiwari, Smita Singh, K S Baghel, A K Patel, Akhilesh Kumar and A K Pandey

JNKVV, Krishi Vigyan Kendra, Rewa 486 001 (Madhya Pradesh)

ABSTRACT

The study was conducted in the different blocks of Rewa district in Madhya Pradesh. On farm trials with zero tillage wheat has shown primarily positive impact on wheat crop management, particularly through reduced input needs combined with yield increase. The trials were conducted during the *rabi* season at 40 farmers fields, to assess the production potential and economic benefit of sowing of wheat under zero tillage method versus conventional tillage (farmer's practice). Improved technology consisted of wheat variety GW 322, integrated nutrient management (100:60:40:25 kg of N:P:K:S/ha+ *Azotobacter* + PSB @ 10 ml/kg of seed), integrated pest management (deep ploughing + seed treatment with *Trichoderma viridae* @ 10 ml/kg seed) under irrigated conditions during *rabi* seasons of 2016-17 to 2019-20. The improved technologies recorded mean yield of 44.66q/ha, which was 24 per cent higher than that obtained under farmers' practice of 38.29q/ha. Similarly, improved technologies gave higher mean net return of Rs. 59874/-ha with a benefit cost ratio 3.41 as compared to farmers' practice (Rs. 43848/-ha).

Key Words: Integrated nutrient management, Pest management, Wheat, Zero Tillage, Yield.

INTRODUCTION

Rice-Wheat cropping system is dominating and contributing 33.97 per cent area of Rewa district of Madhya Pradesh. More than 50 per cent sowing of wheat gets delayed due to late harvesting of preceding kharif crop like rice, due to delay in onset of monsoon and adoption of long duration hybrid rice. Late sown wheat suffers due to sub-optimal temperature at the time of sowing which causes delayed germination, slow growth, lesser development and ultimately low yield. The main emphasis is therefore, on increasing the productivity of wheat by adopting improved cultivation practices. If agronomic practices are fine tuned and weeds are managed properly, the wheat productivity can be enhanced.

Crop management practices like residue management, choice of crop establishment method and optimum seed rate have pronounced effect on crop-weed interference and wheat productivity. The future increase in the productivity of wheat will greatly depend upon improvements in soil environment by proper management of resources with utilization of crop residues and other agricultural wastes. Demonstration on zero tillage (ZT)wheat in the rice-wheat systems have shown primarily positive impacts (Pandey *et al*, 2003) on wheat crop management, particularly through reduced input needs combined with potential yield increases. Hobbs and Gupta (2003) 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). Effects on soil, weeds, pest and diseases in ZT typically improves soil quality in various dimensions, including soil structure, soil fertility and soil biological properties. ZT typically reduced the incidence of weeds in the wheat crop (Malik

Corresponding Author's Email:brajeshjnau2007@gmail.com

et al, 2002a). Jaidka *et al* (2020) concluded that farmers prefer happy seeder technology (residue retention) over in-situ incorporation for sowing wheat into combine harvested rice fields in Punjab. Therefore, utilization of high yielding variety, 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 GW322 on yield and economics of wheat.

MATERIALS AND METHODS

Total 40 on farm trials under real farming situations were conducted during *rabi* season of 2016-17 to 2019-20 at four different villages namely Bara, Kanoja, Purena and Delhia, respectively. The area under each trial was 0.4 ha. The soil was sandy clay-loam in texture with moderate water holding capacity, low in organic carbon (0.3-0.49%), low in available nitrogen (113-182.3 kg/ha), low to medium in available phosphorus (8.5-12.7 kg/ha), low in available potassium (189.7-249.6 kg/ha) and soil pH was slightly acidic to neutral in reaction (6.2-7.6). The treatment comprised of recommended practice (wheat variety GW322, integrated nutrient management-@ 100:60:40:25 kg N:P:K:S/ha + *Azotobacter* + PSB @ 10 ml/kg seed, integrated pest management- deep ploughing + seed treatment with *Trichoderma viridae* @ 10 ml/kg seed, sowing of wheat after rice harvesting on 15-20 November directly by zero till drilled machine without any tillage operation versus farmers' practice including pre sowing irrigation after harvesting of rice with four conventional tillage and sowing by 15-20 December. Deep ploughing was done during the April month. Crop was sown between 15 November to 20 November with a seed rate was 100 kg/ha. An entire dose of P_2O_5, K_2O and S through diammonium phosphate, K through muriate of potash and sulphur through $ZnSO_4$ and 25% nitrogen was applied as basal before sowing. The seeds were treated with *Trichoderma viridae* @10 ml/kg seeds then inoculated by *Azotobacter* and phospho-solubilizing bacteria biofertilizers each 10ml/kg of seeds. Application of Clodinofop-propargyl + metsulfuron- methyle @60g+4g a.i./ha at 25-30 DAS for effective weed management; used flat fan nozzle. Fields were irrigated at the critical stages of wheat crop and the crop was harvested between 25th March to 10th April during the study period.

Under farmer's practice, there were no deep ploughing done during summer, old mixed seed of variety GW 273 was used, broadcasting method of sowing, higher seed rate (125 kg/ha) sown, imbalance dose of fertilizers applied (60:40:0 kg N:P: K/ha), no seed treatment, no biofertilizers, no plant protection measures and one hand weeding at 30-35 DAS were performed. Harvesting and threshing operations done manually and thresher, respectively; 5m x 3m plot harvested in 3 locations in each demonstration and average grain weight taken. Similar procedure was adopted on farmers' practice (FP) plots under each demonstration then grain weight converted into quintal per hectare (q/ha). Yield data were collected from farmer's practice and trial plots. The grass returns, cost of cultivation, net returns and benefit cost ratio (B:C ratio) were calculated by using prevailing prices of inputs and outputs and finally the extension gap, technology gap and technology index were worked out. To estimate the technology gap, extension gap and technology index, following formulae given by Samui *et al* (2000).

RESULTS AND DISCUSSION

Yield attributing parameters

The Number of tillers/m^2 of wheat ranged from 353 to 431 with mean of 398 under recommended practice on farmers' field as against a ranged from 277 to 347 with a mean of 324 recorded under farmers' practice (Table1). Similarly higher harvest index was recorded under recommended practice

Table .: Productivity, growth and yield parameters, Technology gap, Extension gap and Technology index of wheat as affected by recommended practices as well as farmer's practices

Year	No. of farmers	No. of tillers/m^2		Grain yield (q/ha)			% increase over FP	Straw yield (q/ha)		Harvest index (%)		Technology gap (q/ha)	Extension gap (q/ha)	Technology index (q/ha)
		RP	FP	Potential	RP	FP		RP	FP	RP	FP			
2016-17	10	353	277	50	41.50	33.55	24	61	52	40.4	39.2	8.50	7.95	17.00
2017-18	10	412	336	50	45.75	38.52	45	66	58	40.9	39.9	4.25	7.23	8.50
2018-19	10	431	347	50	46.75	41.25	13	68	62	40.7	39.9	3.25	5.50	6.50
2019-20	10	395	336	50	44.65	39.84	12	66	59	40.3	40.3	5.35	4.81	10.70

Table 2. Economics of On Farm Trials of wheat as affected by recommended practices as well as farmer's practices.

Year	No of demonstration	Yield (q/ha)		% increase over FP	Gross expenditure (Rs/ha)		Gross returns (Rs/ha)		Net returns (Rs/ha)		B:C ratio	
		RP	FP		RP	FP	RP	FP	RP	FP	RP	FP
2016-17	10	41.50	33.55	24	24850	22560	75053	60809	50203	38249	3.02	2.69
2017-18	10	45.75	38.52	45	23735	30570	82676	69732	58941	39162	3.48	2.28
2018-19	10	46.75	41.25	13	24650	31215	89420	79000	64770	47785	3.6	2.53
2019-20	10	44.65	39.84	12	25650	31215	91231	81412	65581	50197	3.55	2.60

(40.3-40.9 % mean value of 40.5%) as compared to farmers' practice (ranged between 39.2-40.3%, mean of 39.8%).The higher values of number of tillers/m^2 and harvest index following recommended practice as well as farmers practice were due to the timely sowing, use of latest high yielding variety, proper stover management, integrated nutrient management and integrated pest management on wheat during four years of experimentation. Similar results have been reported earlier (Singh *et al,* 2013a; Sharma and Singh, 2011; Prasad, 2005).

Grain yield

The yield of wheat obtained over the years under recommended practice as well as farmers practice are presented in Table1. The productivity of wheat ranged from 41.50 to 46.75 q/ha with mean yield of 44.66 q/ha under recommended practice on farmers field as against a yield ranged from 33.55 to 41.25 q/ha with a mean of 38.29 q/ha recorded under farmers' practice. In comparison to farmers practice there was an increase of 12-45% higher productivity during 1916-17 to 2019-20 following recommended practices. The higher yield of wheat under recommended practices was due to the use of latest high yielding variety, timely sowing, proper straw management, integrated weed management, integrated nutrient management and integrated pest management. Similar results have been reported earlier by Sidhu *et al* (2015) and Bohra and Kumar, 2015)

Economics

The inputs and outputs prices of commodities prevailed during four years of experimentation were taken for calculating cost of cultivation, net returns and benefit cost ratio (Table 2). The investment on production by adopting recommended practices ranged from Rs.23735/- to 25650/ha with a mean value of Rs.24721/ha against farmers' practice where the variation in cost of production was Rs. 22560/-to Rs. 31215/ha, it was higher under FP due to additional three conventional tillage operations. Cultivation of wheat under recommended practices gave higher net return of Rs.50203/- to Rs.65581/ha, compared to Rs.38249-50197/ha, under farmers' practice during 2016-17 to 2019-20. The average benefit cost ratio of recommended practices was 3.41, varying from 3.02 to 3.6 and that of farmers' practice was 2.52, varying from 2.28 to 2.69. This may be due to higher yields obtained under recommended practices compared to farmers practice. Similar results have been reported earlier on wheat by Tomar (2010) and Tripathi *et al* (2013).

Extension and Technology Gap

The extension gap ranging between 4.81-7.95q/ha during the period of study emphasized the need to educate the farmers through various means for the adoption of improved agricultural production to reverse the trend of wide extension gap (Table 1). The trend of technology gap ranging between 3.25 – 8.50q/ha reflected the farmer's cooperation in carrying out such demonstration with encouraging results study period. The technology gap observed may be attributed to the dissimilarity in weather conditions. The technology index showed the feasibility of the evolved technology at the farmer's field. The lower the value of technology index, the more is the feasibility of the technology. As such, the reduction in technology index to 6.5% during 2018-19 from 17% during 2016-17 exhibited the feasibility of the demonstrated technology in this region.

CONCLUSION

The result of on farm trials convincingly brought out that the yield of wheat could be increased higher with the intervention on zero tillage method of wheat sowing, varietal replacement, integrated weed management, integrated nutrient management and integrated pest management in wheat production in the Rewa district. To safeguard and sustain the food security in India, it is quite important to increase the productivity of wheat under limited resources and reduce the cost of production by growing wheat with zero tillage machine. Favorable benefit cost ratio is self explanatory of economic viability of the experimentation and convinced the farmers for adoption of improved technology of wheat production. The technology suitable for enhancing the productivity of wheat and calls for conduct of such demonstration and increase the number of custom hiring centers under the transfer of technology programme by KVKs.

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