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Assessment of tillage practices and weed management methods in wheat crop at Bundelkhand region

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Abstract

An On farm trails were conducted to assess the tillage practices and weed management methods on wheat (*Triticum aestivum* L.) at Krishi Vigyan Kendra Hamirpur, district of Bundelkhand Uttar Pradesh during Rabi 2019-20 and 2020-21. Two weed control methods and two tillage practices were taken with and without herbicide application in RBD. The result showed that Conventional tillage with two hand weeding (20 and 40 DAS) provided excellent control of all the weed species and this treatment was found non-significant with conservation tillage+ POE (Clodinafop propargyl 15%+Metsufuron methyl 1% W.P). Sowing of wheat with conservation tillage and application of Clodinafop propargyl 15%+Metsufuron methyl 1% W.P. had exhibited a significant effect on grain yield (56.48q) and straw yield of wheat during both the years of experimentation. However this treatment was found statistically at par with hand weeding treatment (54.88q) and conventional tillage + POE. The average cost of cultivation of wheat sown with conventional tillage plus hand weeding twice at 20 and 40 DAS (Rs. 45630) was recorded highest, followed by Conventional tillage with POE. The benefit: cost ratio was found to be maximum (5.98) under wheat sown with Conservation tillage and Post emergence application of herbicide, While lower was recorded with Conventional tillage plus twice hand weeding (3.84).

Keywords: Conventional tillage, conservation tillage, happy seeder, residue management, weed control

Introduction

Achieving food security for a growing population while alleviating poverty and maintaining sustainable agricultural systems poses significant challenges for many asian countries. These challenges are heightened by depleting natural resources, climate variability, rising input costs, and fluctuating food prices. In addition to this mono cropping practices, soil erosion by intensive tillage and declining organic carbon from soil are the key factor causing no sustaining of the system. To address these issues, a paradigm shift in agricultural practices is necessary. Therefore a paradigm shift in farming practices by elimination of unsustainable elements of conventional agriculture, such as monoculture, excessive disturbance of soil through tillage operations, removal of all organic materials from field are crucial for fostering a more resilient agricultural system.

Conservation agriculture (CA), has emerged as a strategic response to global sustainability challenges in agriculture. This valuable approach to crop cultivation is based on Zero/ minimal soil disturbance, the addition of organic matter through crop residue management, and effective practices for plant nutrition and pest management (Abrol and Sangar, 2006; Derpsch *et al.* 2011)^[1, 6]. Although conservation agriculture offers numerous benefits, the presence of weeds often down plays numerous advantages of conservation agriculture, sometime pose a barrier toward its adoptability. In wheat crop the shift from conventional tillage to conservation tillage influences soil bulk density, penetration resistance, aggregate mean weight diameter and surface roughness (Carman, 1996)^[2] These changes can influence weed diversity and abundance (Kumar *et al.*, 2013)^[9]. Weeds not only reduce the crop yield, but also deteriorate the quality of the produce thereby, reducing its market value (Mishra *et al.*, 2023)^[12]. Therefore attention is needed to analyze different methods of weed control. To reap the benefits of conservation agriculture (CA) with weed management practices, an on farm trail was conducted at Krishi Vigyan Kendra in Hamirpur district of Bundelkhand Uttar Pradesh.

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Methodology

The study was undertaken to assess the effect of different tillage practices and weed management methods on yield of wheat crop under rice-wheat cropping system at Krishi Vigyan Kendra Hamirpur, district of Bundelkhand Uttar Pradesh during Rabi seasons of 2019-20 and 2020-21. The soil of experimental field was sandy loam in texture, medium in organic carbon (0.65%), low in available N (262 kg/ha), medium in available P (37.6 kg/ha) and high in K (260 kg/ha) contents with pH 7.8. The experiment was laid out in randomized complete block design with five treatments comprising two tillage methods, viz. conservation tillage and conventional tillage combined with two weed management methods viz. Hand weeding at 20 and 40 DAS and application of post emergence herbicide was replicated thrice. In conventional tillage, after combine harvesting of rice the crop residue was removed and the field was ploughed with MB plough, disc harrowed twice, followed by planking. In Conservation tillage method after combine harvesting of rice crops, direct sowing of wheat on rice stubbles was done by happy seeder along with application of weedicide Clodinafop propargyl 15%+ Metsufuron methyl 1% W.P. @160 gm/ acre at 25 DAS. Wheat variety 'DBW187' was sown in rows, 22.5 cm apart. The fertilizer was applied at 120: 60: 40 kg N: P: K/ha and four irrigations were given at critical stages only by flooding method. samples were collected before sowing and after harvesting of crop by using core sampler to determine the bulk density, organic matter in soil, respectively. The various preparatory tillage and other operations have been assessed at the prevailing custom hiring rates in the district to analyses the differences between normal sown and happy seeder sown wheat crop. The inputs were also assessed at the prevailing rates in the open market. The costs involved and returns thereof were compared with that of normal sown wheat crop and happy seeder sown wheat.

Results and Discussion

Effect on weeds

The major weed flora observed in the experimental field included, *Anagalis arvensis* (37.4%), *Chenopodium album* (22.8%), *Avena fatua* (10.7%), *Phalaris minor* (9.2%) and *Rumex acetocella* (8.0%). Other minor weeds, viz. *Phalaris minor*, *Coronopus didymus*, *Lathyrus aphaca*, *Vicia sativa* and *Cyperus rotundus* accounted for 5.1% of total weed population. Conventional tillage with two hand weeding (20 and 40 DAS) provided excellent control of all the weed species in both the

years, though the differences were non- significant with conservation tillage+ POE (Clodinafop propargyl 15%+Metsufuron methyl 1% W.P.), while the significant difference was recorded with conventional tillage + POE. Similarly, wheat grown with conservation tillage recorded 40.2 percent lower weed density compared to wheat sown with conventional tillage. This was owing to more suppression ability of rice residue under conservation tillage as mulch resulting in lower weed density. Rice residue present on the soil surface might have acted as a physical barrier for weed seedling emergence, delays the time of emergence, and allows crops to gain an advantage over. Results are corroborated with Singh *et al.*, (2005), Chauhan and Johnson, (2010), Yadav *et al.*, (2018), Salam *et al.*, (2020), Puniya, *et al.*, (2023) ^[11, 4, 24, 16] who reported less weed density under reduced/ zero tillage. More tillage practice under conventional tillage provides the environment for more weed germination. Chhokar *et al.*, (2007), Nath *et al.* (2016) ^[7, 16]. also reported that conservation tillage reduced the germination and poor stunted growth of weeds.

Growth, Yield attributes and Yield: Different tillage has not brought significant difference in height. However maximum height (96.40 cm) was attained under conservation tillage+ POE treatment which was found statistically at par with all the treatments except conventional tillage + No weed control (weedy plot). Tillers per square meter were significantly higher among the conservation tillage+ POE (461.5), which was statistically at par with the hand weeding treatment (456.3) and conventional tillage + POE (412.2) treatment but found significant superior to conservation tillage+ No weed control. The lower tillers were obtained with conventional tillage + No weed control (328.0) treatment. Higher number of grains per ear and weight per spike (g) were found associated with conservation tillage+ POE (69.08& 3.80) remained at par to all the treatments except (56.77&3.26) conventional tillage + No weed control (Weedy plot). Similarly highest test weight (45.07 g) was achieved by conservation tillage+ POE and least value was observed with (41.75g) conventional tillage + No weed control (Weedy plot). Maximum plant height, tillers, number of grains per ear, weight per spike(g) and test weight observed in treatment conservation tillage+ POE was attributed due to optimum moisture availability, better root development and maximum uptake of nutrients as reported by other researchers like Singh *et al.*, (2020), Soomro *et al.*, (2009), Zamir *et al.*, (2010) ^[22, 25, 27].

Table 1: Yield attributes and yield affected by tillage practices and weed management in wheat crop. (Average of 2019–20 & 2020–21)

Treatments	Plant height (cm)	Weed density no/m ²	Tillers (m) ²	No. of grain per spike	weight per spike (g)	1000 grain weight (g)	Grain yield q/ha	Straw yield q/ha
CTW +HW at 20 & 40 DAS	96.08	9.90	456.3	68.14	3.73	45.01	54.88	75.52
CTW + No weed control	91.25	68.75	328	56.77	3.26	41.75	41.38	59.48
CTW + POE at 25 DAS	95.39	14.45	445.7	66.88	3.69	44.21	53.4	71.43
CSTW + No weed control	95.98	41.25	412.2	63.09	3.6	44.25	47.73	64.57
CSTW+ POE at 25 DAS	96.4	12.45	461.5	69.08	3.8	45.07	56.48	80.45
CD @ 5%	1.19	3.1	25.7	3.19	0.359	1.05	3.4	6.06

CTW- Conventional tillage wheat, CSTW- Conservation tillage wheat, HW- Hand weeding, POE- Post-emergence herbicide

Sowing of wheat with conservation tillage and application of Clodinafop propargyl 15%+Metsufuron methyl 1% W.P. had exhibited a significant effect on grain yield and straw yield of wheat during both the years of experimentation. However this treatment was found statistically at par with hand weeding treatment and conventional tillage + POE. It was observed that conservation tillage with and without post emergence herbicide

reported with higher yield compared to conventional tillage. However, yield difference was recorded with conservation tillage without weed control practices. This treatment (conservation tillage without weed control practices) yielded 12.8 percent higher yield over conventional tillage with no weed control.

Higher yield under conservation tillage wheat might be due to

availability of nutrients in rice straw. Gangwar *et al.* (2004) [8] recorded significantly higher value of available soil N in zero tillage compared to conventional tillage in wheat crop. Mulching has been proved to be useful in conserving moisture and increasing productivity in wheat (Chakraborty *et al.*, 2008) [3]. Secondly, it might be due to less number of weeds. Singh *et al.*, (2013) [24] reported that the happy seeder reduced the weed population 28% over conventional tillage. Thirdly it could be due to the higher number of tillers per plant and no of grain per spike. The present investigations find support from Singh *et al.* 2009 who also observed a higher yield in happy seeder sown wheat compared to conventional tillage. Singh *et al.*, (2020),

Sidhu *et al.*, (2007), Naresh *et al.* (2011) [22, 19, 15] recorded an average higher grain yield of wheat sown with happy seeder in rice residues. The surface retention practice of straw may maintain better temperature and moisture regimes of soil which may result in higher grain yield.

Economics

On the basis of tillage practice and use of critical input, total cost of cultivation was calculated (Table.2). Different management practices such as tillage and weed control treatments influenced the cost of production and economic returns.

Table 2: Comparison of cost of cultivation under different treatments. (Average of 2019–20 & 2020–21)

Operation/Input cost	CTW +HW at 20 & 40 DAS	CTW + No weed control	CTW + POE at 25 DAS	CSTW + No weed control	CSTW+ POE at 25 DAS
Ploughing	4200	4200	4200	Nil	Nil
Harrowing +Planking	2500	2500	2500	Nil	Nil
Sowing	1700	1700	1700	1700	1700
Seed cost	4000	4000	4000	4000	4000
Hand Weeding (2)	12000	Nil	Nil	0	0
Spraying of herbicide	Nil	Nil	2400	Nil	2400
Irrigation 4/3	8000	8000	8000	6000	6000
Fertilizer @ 120-60-40 kg/ha	9230	9230	9230	9230	9230
Rat control	Nil	Nil	Nil	500	500
Harvesting & storage	8400	8400	8400	8400	8400
Misleneous	1000	1000	1000	1000	1000
Total	51030	39030	41430	30830	33230

The average cost of cultivation of wheat sown with conventional tillage plus hand weeding twice at 20 and 40 DAS (Rs. 45630) was recorded highest, followed by conventional tillage with

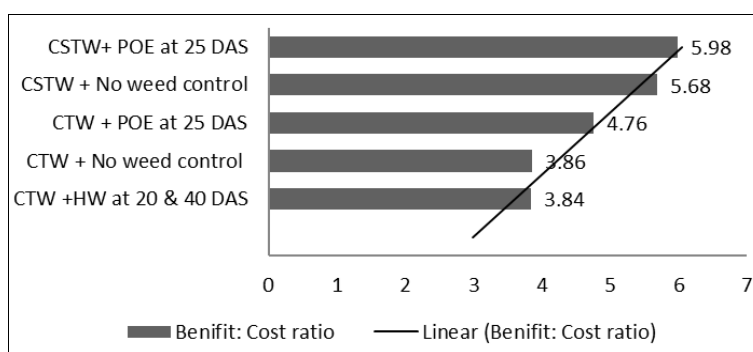
POE. The average higher net returns (Rs. 148626) was recorded under conservation tillage+ POE after excluding the gross cost from gross returns as compared to other methods.

Table 3: Cost of cultivation, Net return and Benefit: Cost ratio under different tillage practices.

Treatments	Cost of cultivation (Rs/ha)	Gross return of grain (Rs/ha)	Gross return of straw (Rs/ha)	Total gross return (Rs/ha)	Net Return (Rs)	Benefit: Cost ratio
CTW +HW at 20 & 40 DAS	45630	108465	66855	175320	129690	3.84
CTW + No weed control	33630	82491	47382	129874	96244	3.86
CTW + POE at 25 DAS	36030	105627	66167	171795	135765	4.76
CSTW + No weed control	26930	94708	58300	153008	126078	5.68
CSTW+ POE at 25 DAS	29830	111543	66912	178456	148626	5.98

The benefit: cost ratio was found to be maximum (5.98) under wheat sown with Conservation tillage and Post emergence application of herbicide. Interestingly wheat sown with conservation tillage and without herbicide application found with higher benefit: cost ratio than conventional tillage with and Post emergence application of herbicide. The Higher net return and benefit: cost ratio under conservation tillage+ POE was due

to beneficial effect of crop residue mulching and effective weed management practice, Which significantly improved yield attributes and yield, may be responsible for this higher economics. Similar results were also found by Punia *et al.*, (2023), Harish, M. N. *et al.*, (2021), Kumar *et al.*, (2016), Kumar *et al.*, (2018) [17, 9, 11, 12].



Conclusion

Based on a two-year study, it can be concluded that sowing wheat using conservation tillage resulted in a lower weed population compared to conventional tillage. Both conservation tillage methods, with or without herbicide, demonstrated higher yields and improved growth parameters, as well as a better benefit-cost ratio. In contrast, conventional tillage and hand weeding were associated with higher cultivation costs and a lower benefit-cost ratio. Therefore, conservation tillage for wheat is recommended due to its potential for higher yields and net returns.

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