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Research Article

Assessment of Happy Seeder as a Resource Conservation Technology in Hamirpur District of Uttar Pradesh, India

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ABSTRACT

Residue burning in conventional agriculture poses a significant challenge, resulting in the loss of vital plant nutrients and contributing to environmental degradation. To address these issues, it is important to develop feasible, cost-effective, and environmentally friendly technologies. In light of this pressing concern, an on-farm trial was conducted during 2019-20 & 2020-21 to evaluate the performance of happy seeders based on yield and economics, compared to the existing farmer's conventional practice of sowing the wheat crop. The Happy Seeder, a resource-conserving technology for residue management in agricultural systems, has gained significant attention for its potential to improve soil health, reduce the burning of crop residues, and promote sustainable agricultural practices. This study assesses the effectiveness and adoption of the Happy Seeder in Hamirpur District, Uttar Pradesh, India, focusing on its role in resource conservation, cost savings, and productivity enhancement. The study revealed that the average reduction in weed count in happy seeder fields was 33.3% compared to normal sown wheat. Sowing of wheat crops with a happy seeder yielded 5% more over farmer's fields. Happy seeder sown wheat recorded higher net income (Rs. 92454/ha) with B:C ratio of 1:4.4 compared to normal sown wheat i.e. Rs. 80026 /ha with B:C ratio of 1: 3.3.

Keywords: *Conservation tillage, cost of cultivation, Happy seeder, rice residue, wheat.*

INTRODUCTION

Residue burning is a prevalent practice in the rice-wheat cropping system (RWCS), where rice and wheat are cultivated in rotation throughout the year. Even though Bundelkhand is usually known for pulse production, farmers in the region are turning to rice cultivation because of improved irrigation facilities, changing rainfall patterns, and the attractive market price of basmati rice. In the district, combined harvesting of rice and wheat is a common practice, leaving a large amount of crop residues in the fields.

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Residue burning is often practiced by farmers to clear fields. The gaseous emissions from the burning of paddy straw analyzed 70% CO_2, 7% CO, 0.66 % CH_4, and 2.09% N_2O (Sidhu et al., 2007). Bundelkhand region is known for extreme heat and drought, which severely affect wheat crop growth, development, and yield during maturity due to strong heat waves (Kumar et al., 2023). Happy seeder zero tillage is a good option for growers of rice where wheat crop can be sown in standing stubbles of rice which avoids the preparatory tillage of the field, and the crop can be sown 7-10 days earlier in a single pass (Iqbal et al., 2017 & Dhillon, 2016) as delayed sowing of wheat resulted in serious decline in grain yield wheat due to poor germination, less tillering and small spike size, reduced kernel weight. (Mullarkey & Jones, 2000, Sial et al., 2001 & Radmehr et al., 2003). Brar et al. 2010 reported that sowing of timely varieties of wheat after 15 November results in yield losses of 1 % per day. A happy seeder could be a viable option to address the issue of residue burning and encourage timely wheat sowing. The Happy Seeder is an innovative tractor-mounted machine that integrates both stubble mulching and seed drilling functions. This advanced technology enables farmers to efficiently sow wheat immediately following their rice harvest, thereby eliminating the need for residue burning in land preparation. In response to the challenges associated with sowing wheat following the rice harvest, an on-farm trial was carried out at KVK, Hamirpur, during the 2019-20 and 2020-21, to evaluate the performance of the happy seeder as compared to the farmer's practice of sowing the wheat crops. Various researchers have shown that wheat crops sown with happy seeders gave comparatively higher yields than the conventional practice of wheat sowing. Dhillon G S (2016) and Sidhu et al. (2007) also reported a 9-15 % higher wheat grain yield, which was sown with a happy seeder machine. It was also found that rice residue incorporated into the happy seeder machine helped in weed reduction as well as soil moisture conservation at the initial growth stages of the wheat crop. Hence, implementing happy seeder technology for sowing wheat may prove to be a viable alternative for the in-situ management of paddy straw and for enhancing profitability.

MATERIALS AND METHODS

The study was conducted in the Hamirpur district of Uttar Pradesh. The Krishi Vigyan Kendra (KVK) in Hamirpur conducted on-farm trials utilizing Happy Seeder technology during the Rabi seasons of 2019-20 and 2020-21. In conventional methods of wheat sowing, 3 ploughing, 1 harrowing and 1 planking was done. While in the case of happy seeder sowing techniques, wheat was sown in full residue condition, i.e. without any burning of crop residue in a single pass. The seed rate of wheat was kept at 100 kg/ha. Wheat variety DBW-187 was used for sowing. The fertilizer rate was kept at 120:60:40 N, P_2O_5 and K_2O kg/ha^{-1}. The soil texture of site was Silty clay loam. All sowing was done in the first week of November to the last week of November. All other cultural operations followed as per the package of practices of this region. Yield and yield attributing characteristics were recorded by using a meter quadrant. No weed control methods were implemented for either sowing condition. Weed density was taken by counting number of weed per meter square at 30 DAS. Data of each site were averaged before taking for analysis.

RESULT AND DISCUSSION

The data presented in table 1, compares the yield attributes, overall yield, and economics of wheat sown under different tillage methods. The data in table 1 indicate that wheat sown using the Happy Seeder performed better than the conventional sowing method in all aspects. Happy seeder's average plant height was a little higher (101.1 cm) than normal sown wheat crop (99.9cm). As far as the numbers of effective tillers are concerned, these were found to be more under happy seeder sown wheat (429.7 m^2) as compared to normal sown wheat (423.0 m^2). A maximum number of effective tillers under no-tillage conditions in the rice crop was also reported by Kumar et al. (2005), Tiwari et al. (2019), and Abbas et al. (2009). The presence of loose paddy straw as mulch in happy seeder sown fields was observed to suppress the germination of weed seeds and the growth of weeds. Happy seeder sown wheat was recorded with lower weeds (8 weeds per m^2) compared to conventional tillage plots (12 weeds per m^2). Under happy seeder sown wheat, a 33.3 per cent reduction in weed density was observed at 30 DAS, compared to conventional tillage. The low weed density in happy seeder sown field can be attributed to mulch's smothering and allopathic effect. These findings can be supported by the observation of Rahman et al. (2005) and Chakraborty et al. (2008), who found that mulching with rice straw significantly affects moisture conservation and weed growth suppression in no-till wheat fields. The 1000-grain weight was also higher with happy seeder sown wheat. The average number of grains per spike was 47.17 and 46.33 for happy seeder sown wheat and normal sown wheat crop, respectively, Grains per spike in conservation tillage may result from improved physical, chemical, and biological properties of soil, along with better moisture conditions and temperature regulation due to residue coverage on the surface compared to conventional tillage. Results corroborate to the findings given by Kumar and Yadav (2005); Kumar et al. (2015), Alamouti and Mohammadi (2015) and Tiwari et al. (2019).

Table: 1 Yield attributes, yield and economics of wheat sown under different tillage practices

Parameters	**Sowing methods**	
	Normal sown wheat (Mean±SE)	**Happy seeder sown wheat** (Mean±SE)
Plant height (cm)	99.4±2.4	102±3.4
Tillers/m^2	423.0±3.29	429.7±4.1
Weeds (m^2)	12±2.5	8±1.8
No. of grain per spike	46.33±2.32	47.17±1.78
1000 grain weight (g)	44.87±0.87	45.50±0.60
Grain Yield (q/ha)	57.50±1.6	60.40±0.84
Straw yield (kg/ha)	74.4±2.36	78.6±1.59
Days to maturity (Days)	120±4	128±5
Cost of cultivation (Rs./ha)	33536±668	26836±634
Gross return (Rs./ha)	113562.5±429	119290±1991
Net return (Rs./ha)	80026±573	92454±531
B:C Ratio	3.38±0.094	4.44±0.012

Happy seeder sown wheat crop was recorded with a higher yield (60.40 q/ha) compared to normal sown wheat crop (57.50q/ha) practice. This increase in yield may be attributed due to favorable soil moisture, constant supply of nutrients through mineralization and also due to less weed competition under happy seeder sown wheat crop. A similar trend of results was also obtained under conservation tillage by Zamir et al. (2010), Parihar et al. (2015), Sharma et al. (2008), and Ram et al. (2010).

These results follow Sidhu et al. (2007), who reported that sowing wheat with happy seeder tillage without burning previous crop residues had 10% more yield compared to the conventional method. Singh et al. (2021) also reported higher under-conservation tillage. It was also observed that the crop sown with a happy seeder machine took 7-10 days more towards maturity than conventional sown wheat. This can be attributed to higher soil moisture content and a longer period of availability of soil moisture in straw retaining fields. Similar results have been reported by Tiwari et al. (2019).

Table: 2 Comparative cost structures in Normal sown wheat and happy seeder sown wheat

Operations	Normal sown wheat Rs./ha	Happy seeder sown wheat Rs./ha	Saving in Happy seeder sown wheat over normal sown
Ploughing	3600	Nil	3600
Harrowing	2300	Nil	2300
Sowing	1500	1500	-
Seed cost	4000	4000	-
Irrigation (4)	2200	2200	-
Fertilizer @120-60-40 N P_2O_5 and K_2O kg/ha	7636	7636	-
Spraying of herbicide	1800	1800	-
Insect - pest and rat control	1500	1500	-
Combine Harvesting	3600	3600	-
Labour	4400	3600	800
Mislleneous	1000	1000	-
			Additional yield advantage= 2.9 q @1975= 5727
Total	33536	26836	Total = 6700+ 5727=12427

The costs incurred in sowing wheat crops using normal methods compared to the happy seeder technology are discussed in Table 2. The happy seeder enables the direct sowing of wheat into rice residue, eliminating the need for ploughing and harrowing. This presents a significant opportunity for farmers to reduce cultivation costs. The comparison indicates an additional cost of Rs. 6700 per hectare for field operations in the traditionally sown wheat field compared to those using the happy seeder technology. The sowing of crops with a happy seeder yielded 2.9 quintals per hectare of additional yield compared to conventional tillage fields. Furthermore, direct sowing wheat using this technology results in a profit of Rs. 12427 per hectare compared to traditionally sown wheat fields. Total cost saving is estimated to be Rs. 6700/ha, equivalent to a 20% cost reduction using the Happy Seeder, as supported by the present study's findings (Saunders et al., 2012).

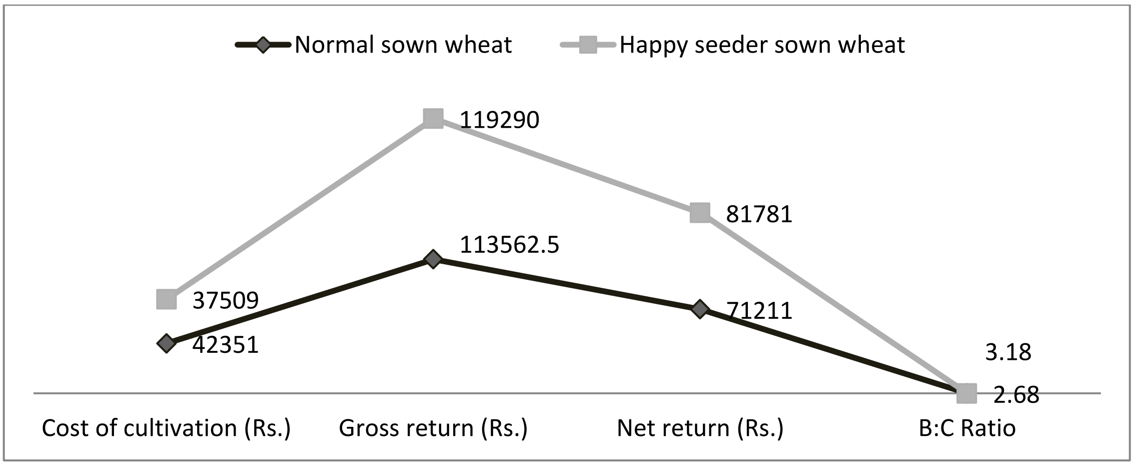

Fig.:1 Graphical representation of economics under happy seeder and conventional system of sowing

According to the economic analysis, using a happy seeder for sowing wheat has been found to be a more economical technique when compared to conventional practices. By utilizing this techniques costs, time, and energy are saved, ensuring timely sowing of wheat and leading to improved yield Wheat crop sown with a happy seeder recorded with higher net income (Rs. 92454/ha) with B:C ratio of 1:4.4 compared to conventional tillage i.e. Rs. 80026 ha^{-1} with B:C ratio of 1: 3.3.This rise in B:C ratio attributed to the use of the happy seeder which curtails the expenses of agricultural operations to be incurred on soil preparation. The timely sowing of wheat on rice residues promotes better growth of wheat crops, ultimately leading to the highest grain yield and, subsequently, the highest net return. These results are in accordance with Sidhu *et al.* (2007) and Quddus et al. (2020), who reported that the cost of establishment with zero tillage and happy seeder is about half the cost of establishment using conventional practice.

CONCLUSION

The study has ascertained that the happy seeder technology is a viable alternative to the burning of rice residue. It also found that this technology can save the cost of cultivation, ranging from Rs. 4000- 6000 per hectare in field preparation when compared to conventional tillage. In addition, the mean output of wheat crops was higher than the conventional method of sowing. This technology can save substantial time because the happy seeder can be brought into the field immediately after the rice harvest. These savings are significant because any delay in planting wheat affects its productivity. So this technology not only ensures maximum yield but also saves fuel, energy, and time of sowing, hence it is a profitable practice. Furthermore, the average yield of wheat was higher with Happy Seeder sowing compared to conventional methods.

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Author Contribution
All authors have participated in critically revising of the entire manuscript and approval of the final manuscript.

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