



Happy Seeder Machine Enable Direct Drilling of Wheat (*Triticum aestivum*) in Rice-wheat Cropping System

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Authors' contributions

This work was carried out in collaboration among all authors. Author BSS designed the study, performed the statistical analysis, managed the analyses of the study and managed the literature searches. Authors NSD and BSS designed the study, wrote the protocol and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during Rabi 2015-16, 2016-17 and 2017-18 by Krishi Vigyan Kendra Muksar, to find out the performance of happy seeder machine for sowing of wheat after rice crop. Happy seeder tackles the problem of paddy straw which can convert this waste into resource. In the area, farmers generally burn rice residues because they felt that it interferes with tillage and seeding operations for the succeeding crops and it has no much economical use. The average grain yield revealed that happy seeder sown crop gave 47.5 q/ha grain yield as compared to 49.6 q/ha in conventional sown method. Net return was calculated during all the years. Happy seeder sown crop gave higher net return (Rs 55279.2/ha) from conventional method (Rs. 52189.7/ha). Net return was higher due to less cost of cultivation (Rs. 22325/ha) from Rs 28641.6/ha under conventional sowing method. So with Happy seeder, low cost of production with respect to conventional tillage system gave maximum net return and it is a cost effective technology. The cost of cultivation in happy seeder was also lesser than conventional method mainly due to less cost on tillage preparation, saving in weedicides, fertilizers etc. Farmers are more interested in variable costs and economic return of newly introduced enterprises. Economic analysis assists researches to plan their research for detailed investigation and to make decision, so that it may be recommended to the farmers. So, economic analysis is essential to check the profitability and net return of the system.

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1. INTRODUCTION

The cultivation of high yielding varieties of paddy resulted in production of huge quantities of crop residues. It is estimated that nearly 90% of the paddy crop is harvested by combine harvester that results in spreading of crop residue in the fields. Due to high production of crop residue in the field after combine harvesting of paddy, direct drilling of other crops in paddy stubbles is not possible without prior removal of straw. On-farm burning of paddy straw is common and easiest method adopted by farmers to get rid of paddy straw which has deleterious effect on human and animal health, deteriorates the soil health besides environmental pollution [1]. In addition, burning also decreases the efficiency of herbicides used for controlling weeds in wheat crop. Multiple challenges associated with plough based conventional production practices that include deterioration of natural resources, declining factor productivity, yield and increasing costs of production inputs with emerging challenges of climate change in agriculture are the major threat to food security of South Asia [2-4]. In view of these losses associated with burning of paddy residues, lot of efforts are needed to find ways and means to efficiently utilize the paddy straw. Potential solutions to these issues include a shift from intensive tillage practices to conservation agriculture based crop management systems [5-7].

Looking into the serious problem of on-farm residue burning, KVK is promoting various alternatives and disposal mechanisms to manage paddy straw viz., ex-situ and in-situ management of paddy straw. Under, ex-situ management, paddy straw is collected, baled and moved away from the field for its effective use for electricity generation in biomass based power plants as a source of energy and as animal feed. The management of straw is difficult as collection of straw is done by manually or by baler machine [8]. In-situ management includes partial burning, incorporation or spreading on soil surface. For incorporating the paddy straw into soil, farmers generally needs to perform number of tractor operations comprising of chopper/mulcher followed by mould board plough, 2-3 disc harrow, 2-3 cultivator operations and 2-3 planking operations which result into excessive tillage incurring more time, energy and cost. Taking into the consideration of current

scenario, KVK Muktsar took initiatives to popularize happy seeder to tackle the problem of paddy straw which can convert this waste into resource. This machine is used for wheat sowing directly in the field having paddy straw after harvesting the crop with combine harvester and paddy straw is spreaded as mulch in the field. This mulched crop residue improves the soil health by adding organic matter into the soil and also helps in reducing the germination of weeds. Substantial saving in water has also been recorded due to less evaporation from the soil surface and less quantity of irrigation water applied at the time of first irrigation. Happy seeder technology is one such practice that potentially addresses the issues of energy, water, soil health etc [9-12] and adaptations to the climatic variability. This PTO driven machine can be operated with 50 hp tractor and covers 0.25-0.30 ha/h.

2. MATERIALS AND METHODS

A field experiment was conducted during *Rabi* 2015-16 2016-17 and 2017-18 by Krishi Vigyan Kendra (KVK), Sri Muktsar Sahib (Punjab), to find out the performance of happy seeder machine for sowing of wheat after rice crop. Happy seeder to tackle the problem of paddy straw which can convert this waste into resource. This machine is used for wheat sowing directly in the field having paddy straw after harvesting the crop with combine harvester and paddy straw is spreaded as mulch in the field. The geographical location of the experimental site has the reference to 74°30'29" east longitude, 30°26'44" North latitude. The salt affected soil of Muktsar has been categorized as sodic soil and saline sodic soil. The area is characterized by semi-arid type of climate with hot and dry early summers from April-June followed by hot and humid period during July-September and cold winters during December-January. The mean maximum and minimum temperatures show considerable fluctuations during different parts of the year. Summer temperature exceeds 38°C and may go up as high as 45°C with dry summer spells. Winter experiences frequent frosty spells especially during December and January and minimum temperature records as low as 0.5°C. The annual rainfall of the area is 430.7 mm, most of which is received during July to September (Anon, 2007). After combine harvesting of rice crop, the loose straw of the crop was uniformly distributed to the whole field. The soil was sandy

loam, slightly alkaline in reaction (pH 7.75), high EC (0.930 dS/m), low in available organic carbon (0.24%), medium in available phosphorus (17 kg/ha) and high in available potassium (720 kg/ha). The area is in major rice growing pockets of Punjab. Wheat variety HD 3086 was sown after rice crop. Recommended fertilizer to each sowing method was applied at the appropriate time. Nitrogen, phosphorus and potassium were applied through urea, single superphosphate and muriate of potash, respectively. The crop was sown on first week of November every year. The demonstration plots were sown directly with the happy seeder whereas in conventional method operations of 2 disc harrow, 2 cultivator and 2 planker are needed before the sowing of wheat. The observations on yield and economics were recorded.

3. RESULTS AND DISCUSSION

Farmers are more interested in variable costs and economic return of newly introduced enterprises. Economic analysis assists researchers to plan their research for detailed investigation and to make decision, so that it may be recommended to the farmers. So, economic analysis is essential to check the profitability and net return of the system. The variability in net return is more important than variability in crop yield. The demonstrations on happy seeder were laid out at KVK farm during 2015-16, 2016-17 and 2017-18 for showcasing this technology to the farmers. During *rabi* 2015-16 KVK Muktsar has an area of 6 ha under paddy crop and demonstration with happy seeder was conducted on 5.6 ha of paddy area. During this season the response of happy seeder was not so good. The grain yield obtained with happy seeder was 41.0 q/ha as compared to 46.05 q/ha in conventional method of sowing. This was old version happy seeder without press wheel and only 9 tines (1.8 meter width). This happy seeder was fitted with only two adjustment wheels. Researchers noticed that two wheat rows surrounding the adjustment wheels having more growth and tillers as compared to other rows which receive less availability of sun light in standing stubbles. There was need to modify this wheat sowing machine.

Whereas during *rabi* 2016-17, out of 8.8 ha area of paddy crop, 8 ha sowing was done with happy seeder. During this year all the demonstrated area was sown with Modified happy seeder known "PAU Happy Seeder". This happy seeder was containing 10 tines with row spacing of 20

cm and total width of 2 meters. This modified PAU happy seeder was fitted with press wheels after the every two adjoining tines. Wheels were fitted after the tines which pressed the entire paddy straw, which resulted into the uniform and good crop emergence as compared to the previous year. The results of these demonstrations had revealed that the wheat sown with PAU happy seeder is better in every aspect as compared to the conventional method of wheat sowing. Total 48.08 q/ha grain yield was obtained with these demonstration as compared to 49.06 q/ha in conventional sowing method. Although the grain yields under happy seeder sowing is low but produced higher net return (Rs. 56095/ha) as compared to conventional method (Rs. 51925/ha). Similarly B:C was also higher in happy seeder (3.56:1) from conventional sowing (2.87:1). Both net return and Benefit cost ratio was higher in happy seeder sowing due to less cost of cultivation by PAU Happy seeder sowing method (Table 1).

Similarly during 2017-18 grain yield obtained with happy seeder (53.5 q/ha) was slightly less as compared to conventional method (53.7 q/ha) but B:C ratio was again higher in happy seeder (3.05:1) from conventional sowing (2.11:1). But both net return and Benefit cost ratio was higher in happy seeder sowing from conventional sowing method (Table 2). The result also confirmed the findings of earlier workers [13-15] where grain yield is slightly higher with conventional method as compared to happy seeder sowing method but produced lower net return and Benefit cost ratio from happy seeder. Wheat sowing with happy seeder reduced the number of operations (2 disc harrow, 2 cultivator and 2 planker operations) resulting in reduction of the cost of cultivation. Germination of crop was good resulting in uniform crop stand with luxuriant growth. The average weed count in happy seeder was very less as compared to conventional method of sowing wheat crop.

However, as we considered the average grain yield of the all three years of the study it was revealed that happy seeder sown crop gave 47.5 q/ha grain yield as compared to 49.6 q/ha in conventional sown method. Net return was calculated during all the years. Happy seeder sown crop gave higher net return (Rs 55279.2/ha) from conventional method (Rs. 52189.7/ha). Net return was higher due to less cost of cultivation (Rs. 22325/ha) from Rs 28641.6/ha under conventional sowing method (Table 2). The result also confirms the findings of

Table 1. Yield and economics of wheat crop sown with happy seeder and conventional method during 2015-16 and 2016-17

Planting method	2015-16					2016-17				
	Grain yield q/ha	Gross return(Rs.)	Input cost (Rs.)	Net Return (Rs.)	B:C ratio	Grain yield q/ha	Gross return (Rs.)	Input cost (Rs.)	Net Return (Rs.)	B:C ratio
Happy seeder	41.00	62525	22257.5	40267.5	2.81	48.08	78000	21905	56095	3.56
Conventional method	46.05	70150	28450	41700	2.47	49.06	79625	27700	51925	2.87

Table 2. Yield and economics of wheat crop sown with happy seeder and conventional method during 2017-18

	2017-18					Average				
	Grain yield q/ha	Gross return (Rs.)	Input cost (Rs.)	Net Return (Rs.)	B:C ratio	Grain yield q/ha	Gross return (Rs.)	Input cost (Rs.)	Net Return (Rs.)	B:C ratio
Happy seeder	53.5	92287.5	22812.5	69475	3.05	47.5	77604.2	22325.0	55279.2	3.14
Conventional method	53.7	92718.75	29774.7	62944	2.11	49.6	80831.2	28641.6	52189.7	2.48

earlier workers [16,13,15] where grain yield is slight higher with conventional method as compared to happy seeder sowing method but produced higher net return and Benefit cost ratio.

4. CONCLUSION

Happy seeder, low cost of production with respect to conventional tillage system gave maximum net return and it is a cost effective technology. The cost of cultivation in happy seeder was also lesser than conventional method mainly due to less cost on tillage preparation, saving in weedicides, fertilizers etc.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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