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Happy seeder - A conservation agriculture technology for managing rice residue for Central Punjab conditions

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ABSTRACT : Field experiments on Happy seeder were conducted during 2009-10 and 2010-11 in farmer participatory research mode at different locations in the district Fatehgarh Sahib. The field experiments were conducted on 9 different locations to evaluate the operational performance of Happy seeder machine in context of heavy soils of district Fatehgarh Sahib, the effect of Happy seeder on wheat yield in heavy soils and to work out the economics of Happy Seeder as compared to farmer's practice. The study reveled that, the average reduction in weed count in happy seeder plots was 28% compared to conventional sown wheat. Wheat yield during these two years in 9 experiments was varied from 35.0 - 56.25 q/ha and 31.75 – 50.75 q/ha for Happy seeder and conventional seed drill plots, respectively with an average increase in yield of 8.84 % in Happy seeder plots.

KEY WORDS : Happy Seeder, Wheat yield, Residue management, Paddy residues, Rice-wheat rotation

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Rice-wheat is a major crop rotation in Indo-gangatic region. About 26.5 lacs ha area is under this rotation in the state of Punjab alone (Anonymous, 2011). Globally no-tillage and minimum tillage technologies are showing their edge over the conventional practices in terms of economics, water saving and eco-friendly. In north-western India combine harvesting of rice and wheat is a common practice leaving large amount of crop residues in the fields. The area under combine harvested rice and wheat is about 91% and 82% of the total area under the two crops, respectively. Total quantity of paddy straw produced annually under these crops in the state is about 22 mt (Gajri *et al.*, 2002). while, at present more than 80% of wheat residue is collected by the farmers after combine harvesting using straw combine. Rice straw is considered poor feed for animals due to its high silica content and has also no other economic uses and remains unutilized. To vacate fields for the timely sowing of wheat, majority of the rice straw is burnt in situ by the farmers because residues interfere with tillage and seeding operations for the next crop. Burning of rice stubble is rapid and cheap option for farmer which causes a serious atmospheric pollution as well as human health. Besides, it also results in the loss of plant nutrients and organic carbon of the soil and thus deteriorates the soil health and texture. It is estimated that in Punjab alone, about 2.0 lakh tones of N and S in the paddy residues is lost during burning, costing more than Rs. 200 crores at the prevailing prices (Sidhu *et al.*, 2007). One ton of crop residue on burning releases 1,515 kg CO_2, 92 kg CO, 3.83 kg NOx, 0.4 kg SO_2, 2.7 kg CH_4, and 15.7 kg non-methane volatile organic compounds. The gaseous emissions from burning of paddy straw analyzed 70% CO_2, 7% CO, 0.66 % CH_4, and 2.09% N_2O (Sidhu *et al.*, 2007).

The direct drilling of any crop in to combine harvested rice stubbles from a reasonable rice yield has not been possible without prior burning or removal of straw. This problem has been addressed by a machine named 'The Happy Seeder' which was developed in the department of Farm Power and Machinery in collaboration with CSIRO Land and Water Australia under the financial assistance from ACIAR. Thus, to evaluate the performance of Happy seeder machine in context of heavy soils of district Fatechgarh Sahib the machine was evaluated for following objectives;

– To evaluate the operational performance of Happy seeder machine in context of heavy soils of district Fatehgarh Sahib.

– To study the effect of Happy seeder on wheat yield in heavy soils.

– To work out the economics of Happy seeder as compared to farmer's practice.

Happy seeder combines the stubble mulching and seed drilling functions into the one machine. It consists of a rotor mounted with the gamma type blades for managing the paddy residues and a zero till drill for sowing of wheat. Happy seeder cuts the standing stubbles/loose straw coming in front of the sowing tyne and clean each tyne twice in one rotation of rotor for proper placement of seed in soil. The rotor blades push the residues as surface mulch between the seeded rows.

METHODOLOGY

Field experiments were conducted during 2009-10 and 2010-11 in farmer participatory research mode at different locations in the district Fatehgarh Sahib. The farmer participatory field trails locations were selected on the basis of different blocks of the district Fig. A. The area is characterized by sub-tropical, semi-arid climate with dry summers (March-June) and severe winters (December-January). The area experiences an annual rainfall of 700 mm of which 80% is received during July-September coinciding with the rice season, whereas the remaining 20% is received during *Rabi* (November-April) season. The average maximum and minimum air temperatures are 35 and 18 °C, respectively during summer and 22.6 and 6.7 °C during winter.

Fig. A : Experimental locations in district Fatehgarh Sahib

Management of paddy residues:

The previous rice crop had been harvested with a combine harvester with a cutting height of approximately 50-60 cm. After rice harvest, the windrows of loose residues ("header tailings") were manually spread evenly across the areas to be sown with residues retained, and removed wheat was sown with help of happy seeder in the residual moisture of paddy crop. Average rice straw load at farmers fields varied from 7.5 to 9.1 t/ha. Straw load was estimated from grain yield and variety-specific harvest index. Plot size of 4000 m^2 was selected for Happy seeder and conventional seeding of wheat. In farmer practice the wheat was sown after burning of paddy residues + 2 disking + 2 cultivator + 2 planker + seed drill + planker.

Cultural practices:

Recommended wheat varieties were sown in the last week of October to mid November and were harvested in the third week of April the following year, Fig. B. Sowing, fertiliser, weed and irrigation management was as per recommended practice of PAU, Ludhiana. A seed rate of 100 kg/ha was used, with row spacing 20 cm, sowing depth 5-7 cm half dose of nitrogen (50 kg N/ha) was applied (broadcast) at time of first irrigation and a further 60 kg N/ha as urea was broadcast with second irrigation to wheat. Weeds were controlled by spraying fenoxaprop-p-ethyle (15 WP) 35-45 days after sowing.

Fig. B : Sowing of farmer participatory trials with Happy seeder

Monitoring – participatory trials :

Weed growth:

All weeds were counted from 0.25 m^2 quadrats 35 days after sowing (DAS), prior to any herbicide application, at all farmer participatory sites.

Grain yield:

At maturity a total area of 30 m^2 was harvested manually from four randomly selected spots within each replication. Grain was removed from the straw by manual threshing and weighed.

RESULTS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Effect of Happy seeder on weed growth:

Due to presence of straw mulch on the Happy seeder plots, it was observed that there was reduction in weed infestation particularly *Phalaris minor* which was less than 10 % as compared to conventional sowing. Average reduction in weeds was 28 % (Table 1). It was observed that the weed biomass was approximately 50 % less on the Happy seeder plots compared to no-till straw removed, consistent with other reports of suppression of weeds in wheat mulched with rice straw by (Rahman *et al.*, 2005), and many other observations of the effect of mulching on weeds in various cropping systems (Sayre *et al.*, 2005; Bilalis *et al.*, 2004; Erenstien, 2002).

Effect of Happy seeder on wheat yield:

Wheat sowing with Happy seeder technology was evaluated at several locations in the District Fatehgarh Sahib, Punjab in 2008-09 and 2009-10. The experiments were conducted in varied soil types ranging from loamy-sand to clayey-loam. Mean grain yield of wheat during these two years in 9 experiments varied from 35.0 - 56.25 q/ha and 31.75 – 50.75 q/ha for Happy seeder and conventional seed drill plots, respectively with an average increase in yield of 8.84 % in Happy seeder experiments (Table 2).

Table 1: Weed Count analysis in wheat sowing with Happy seeder and conventional method

Experiment location	Average weed count per sq m		% reduction in count
	HS	Conventional	
Baraunga Zer	25.9	59.2	47.4
Meerpur Sodhian	24.0	35.6	32.6
Meerpur Sodhian	31.2	31.6	1.3
Kotla Bajwara	17.6	27.4	35.8
Mohanmajra	27.8	46.4	40.1
Luharmajra	32.3	50.4	35.9
Saidpura	16.8	17.0	1.2
Fatehpur Raiyan	21.2	26.0	18.5
Sadhugarh	28.6	47.0	39.1
Average	25.04	37.84	27.99

HS – Happy Seeder,
Conventional – burning paddy residues + 2 disking + 2 cultivator + 2 planker + seed drill + planker.

Table 2: Comparison of experiment conducted on wheat sowing with Happy seeder and conventional method

Experiment location	Variety	Grain yield (q./ha)		% Increase in yield
		HS	Conventional	
Baraunga Zer	PBW 550	46.50	42.25	10.06
Meerpur Sodhian	PBW 502	56.25	50.75	10.84
Meerpur Sodhian	HD 2851	41.00	39.00	5.13
Kotla Bajwara	PBW 343	35.00	31.75	10.24
Mohanmajra	PBW 343	41.50	38.75	7.10
Luharmajra	PBW 550	45.25	41.75	8.38
Saidpura	HD 2733	41.25	37.50	10.00
Fatehpur Raiyan	DBW 17	52.00	48.75	6.67
Sadhugarh	PBW 550	50.00	45.00	11.11
Average	-	45.42	41.72	8.84

Table 3: Economics of HS with conventional sowing

Economics of HS	Method of sowing	
	HS	Conventional
Cost of field preparation based on Custom Hiring charges (Rs. per ha)	2125	6250
Weedicide charges (Rs. per ha)	350	1450
Rodenticide (Rs. per ha)	90	-
Total (Rs. per ha)	2565	7700
Net saving (Rs. per ha)	5135	

Economics of Happy seeder:

A net saving of Rs. 5135/- per hectare was achieved from wheat sown with Happy seeder over the wheat sown with conventional tillage after burning rice stubbles (Table 3).

Conclusion:

The Happy seeder provides the capability of sowing wheat in rice stubble with reduced or zero tillage, at the same time as maintaining or increasing yield. The technology avoids the need for burning, and the terrible air pollution due to burning in the NWIGP. The technology also brings many other benefits including retention of organic matter, suppression of weeds and soil evaporation.

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