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Adaptation of happy seeder in combine harvested paddy fields a case study of district Sheikhupura Punjab, Pakistan

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Abstract

Rice residue has high contamination of silica particles therefore it is not a good feed for animals as compared to wheat straw. Performance evaluations of different sowing techniques were conducted in combine harvested residue field. Experiment was conducted at four different locations of district Sheikhupura, Dera Arain, Saranwala, Dera Balm and Sakna Dahir during 2017-18. The wheat variety GALAXY-2013 was sown in the residue field. Purpose to conduct this experimental study was to compare the performance of different wheat sowing machinery in combine harvested residue field at four different locations. As conservational technique, happy seeder and zero seed drill were used for the sowing of wheat in heavy residue field, while in conventional techniques wheat was sown with broadcasting method. There were three treatment T_1 Happy Seeder, T_2 Zero Seed Drill and T_3 Broadcasting method. Performance of different sowing method was measured on the basis of germination count, number of tillers, plant height, spike length, spikelet per spike, grain per spike, thousand grain weight, and yield per plot. Results of the study indicate that treatment T_1 (Happy Seeder) perform best with highest yield.

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Introduction

In Punjab Pakistan, rice wheat cropping zone covers Gujranwala, Gujarat, Mandi Bhao Din, Okara, Sheikhupura and Lahore districts. After combined harvested rice generally, farmers prefer to burn rice residue before wheat sowing which is the major cause of smog factor increasing air pollution, temperature, skin, respiratory diseases, and cost of production and road accidents.

Now a day's conservation agriculture is necessary to provide food for increased world population. In India, happy seeder, a conservation agriculture machine is being used from many years. Pakistan has also stated experiments to move forward to adopt happy seeder for wheat sowing in rice residue fields, but it take some time for complete adoption of this technology at farmers level.

Agricultural conservation techniques require substantial soil disturbance, continuous soil coverage through plant or crop residues, and plant rotations to achieve greater productivity. In India, attempts have been ongoing for nearly two decades to develop, refine and disseminate conservation-based agricultural technologies. Conservation agriculture techniques provide possibilities for reducing manufacturing costs, saving water and nutrients, increasing returns, increasing crop diversification, improving resource efficiency and benefiting the environment. However, there are still restrictions on promoting CA techniques, such as the absence of suitable seeders for small and medium-sized farmers in particular. To encourage CA in the region, the need to establish policy frameworks and approaches is urgent (Bhan & Behera, 2014).

In zero-tillage, it was discovered that the net income was greater, mainly due to the reduction of production costs compared to the other standard sowing methods. Research found that the zero tillage technology can provide additional revenue. To help farmers to conserve scarce resources, despite many economic and environmental benefits, the acceptance of zero tillage technology is limited and a serious constraint is the difficulties during its operation in rice stubbles field (Tripathi *et al.*, 2013). Rice covers about 11% of the world agricultural land. Asia is a world leader in rice production, accounting for about 90% of total rice area and 92% of its production (Kavya Doshora & Ravi Khetarpal, 2013).

Experiments on Happy Seeder were performed at various places in the district Fatehgarh-Sahib. The field studies were performed to assess machine's operational efficiency in the context of heavy soils, the impact of machine on wheat yield, and to assess its economics in comparison to farmers practice. Research revealed that the average weed count decrease in happy seeder plots was 28 percent. In nine studies, the wheat yield ranged from 35.0-56.25 q/ha and 31.75–50.75 q/ha for Happy seeder and conventional seed drill plots, with an average increase yield of 8.84% in Happy Seeder experimental site (Romasanta *et al.*, 2017).

In province Punjab of northwest India, harvesting is done through large combine harvesters and rice residues are usually burned after harvesting. Conservation of crop residues in the agricultural land can play a significant role in restoring soil quality and reducing environmental pollution. A series of devices ("Happy Seeder") have been developed in the last decade to meet this need, giving life to the Turbo Happy Seeder series nine versions. The machine includes a significant reduction in energy consumption, agricultural cost and the ability of sowing in field as quickly as possible after removal of rice residue (Sidhu *et al.*, 2015).

In Pakistan, happy seeder is not being used commercially at large scale. Most of the farmer burn residues after harvesting rice and prepare land for sowing of wheat. Some of the cultivators used zero seed drill, wheat seed drill (Rabi) and most of them complete their sowing operation by broadcasting method. The study was taken at different locations with main objectives; to check the performance of happy seeder and to motivate farmers to adopt the Happy Seeder technology in rice wheat cropping system.

Materials and methods

Study Area

Experiment was conducted to investigate the conservational and conventional wheat sowing methods at four different locations of district Sheikhupura Dera Arain (A), Saranwala (B), Dera Balm (C) and Sakna Dahir (D) in wheat-rice cropping system of Punjab, Pakistan.

Testing of different sowing machinery

The conservational technology used in experiment was happy seeder and zero seed drill while broadcasting taken as conventional method. Purpose of conducting this study at four different locations was that it gives accurate results in different variety of residue fields which help to predict the more accurate and efficient method of sowing having high grain yield.

Parameters measured during experiment

Germination count

By selecting one meter square area at different locations in each treatment, germination count was done.

Number of Tillers

Number of tiller was calculated by selecting three different specific areas $1m^2$ in each treatment field.

Plant Height (cm)

Plant height was calculated by selecting different plants from each treatment and replication before harvesting.

Length of Spike (cm)

Spike length was calculated by measuring the length of different spikes.

Spikelet per spike

Number of spikelet per spike was calculated by counting the spikelet of different spikes.

Grain per spike

Grain per spike was calculated by counting the grains of different spikes from each replication**.**

1000-grain weight

These were calculated by weighing the one thousand seed.

Yield

Plot having (2m×3m) area yield was calculated from each treatment. By using bench mechanical scale balance, grain was weighted

Result and discussion

Germination count

Germination count (Table 1) was maximum (200.08) of treatment T_1 as compare to other treatment, because of additional part of rotor which crushes the rice residue and mix with soil to increase the fertility of soil with higher moisture content. Germination count was minimum (170.33) in broadcasting because in this method depth of seed placement was non-uniform in soil.

The mean values of treatments are significant with each other at 5% level of probability. However, germination count of site-A and C are non-significant with each other, while site-B and D are significant with each other at 5% level of probability.

Table 1. Mean Germination Count.

Treatment	Site A	Site B	Site C	Site D	Mean
Happy Seeder	206.00a	192.33 bc	203.33 a	198.67 ab	200.08 A
Zero Seed Drill	191.33bcd	191.33 bcd	199.33 ab	187.67 cde	192.42 B
Broad casting	181.67de	178.33 e	162.00 f	159.3 f	170.33 C
Mean	193.0A	187.33 AB	188.22 A	181.89 B	

Number of Tillers

Results displayed in Table 2 show that maximum number of tillers was recorded in treatment T_1 (Happy seeder) with mean value of 292.0. It was followed by treatment T_2 (Zero seed drill) with mean value of 252.50. Whereas minimum germination count was recorded in treatment T_3 (Broadcasting) with mean value of 235.58.

The mean values of all the treatments are all significant with each other and the mean value of site C is significant from other three sites while site A, B and D are non-significant with each other at 5% level of significance.

Table 2. Number of Tillers.

Treatment	Site A	Site B	Site C	Site D	Mean
Happy Seeder	281.33 a	293.33 ab	307.00 a	286.33 b	292.00 A
Zero Seed Drill	263.33 d	245.67 e	264.33 cd	236.67 e	252.50 B
Broad casting	232.33 e	233.33 e	240.00 e	236.67 e	235.58 C
Mean	259.00 B	257.44 B	270.44 A	253.22 B	

Plant Height

Results displayed in (Table 3) showed that maximum height was recorded in treatment T_1 (Happy Seeder) with mean value of 111.83cm. It is closely followed by treatment T_2 (Zero Seed Drill) with mean value of 110.42cm. Whereas minimum plant height was recorded in T_3 (Broadcasting) with mean value of 109.25cm.

The mean value of treatment T_1 is non-significant with treatment T_2 while highly significant with treatment T_3, while mean value of all the sites are non-significant with each other at 5% level of probability.

Table 3. Plant Height.

Treatment	Site A	Site B	Site C	Site D	Mean
Happy seeder	112.00ab	112.33a	111.33abc	111.67ab	111.83A
Zero seed drill	111.00abc	111.67ab	109.67abc	109.33bc	110.42AB
Broad casting	109.33bc	110.33abc	108.67c	108.67c	109.25B
Mean	110.78A	111.44A	109.89A	109.89A	

Spike Length

Results displayed in (Table 4) showed that maximum length was recorded in treatment T_1 (Happy seeder) with mean value of 15.09cm. It is closely followed by treatment T_2 (Zero seed drill) with mean value of 13.80cm. Whereas minimum length was recorded in treatment T_3 (Broadcasting) with mean value of 12.45cm. The mean values of all the treatments are significant with each other while the mean values of all the sites are non-significant with each at 5% level of probability.

Table 4. Spike Length.

Treatment	Site A	Site B	Site C	Site D	Mean
Happy seeder	15.03 ab	15.33 a	15.00 ab	15.00 ab	15.09 A
Zero seed drill	14.07 bc	13.00 cde	14.06 bc	13.66 cd	13.70 B
Broad casting	12.80 de	12.33 e	12.66 de	12.00 e	12.45 C
Mean	13.96 A	13.55 A	13.91 A	13.55 A	

Spikelet per Spike

Results displayed in (Table 5) showed that maximum numbers was recorded in treatment T_1 (Happy seeder) with mean value of 19.58. It is closely followed by treatment T_2 (Zero seed drill) with mean value of 18.50. Whereas minimum was recorded in treatment T_3 (Broadcasting) with mean value of 15.51.

The mean values of all three treatments are significant with each other. The mean value of site A is significant with other sites while site B and C are significant each other and non-significant with site D at 5% level of probability.

Table 5. Spikelet per Spike.

Treatment	Site A	Site B	Site C	Site D	Mean
Happy seeder	19.00 a	19.66 a	20.23 a	19.33 a	19.58 A
Zero seed drill	16.66 cd	18.66 ab	19.00 a	19.66 a	18.50 B
Broad casting	15.00 d	15.66 cd	17.00 bc	16.00 cd	15.51 C
Mean	116.88 C	18.00 B	19.00 A	18.11 AB	

Grains per Spike

Results displayed in (Table 6) showed that maximum grain per spike was recorded in treatment T_1 (Happy seeder) with mean value of 56.75. It is followed by treatment T_2 (Zero seed drill) with mean value of 45.83. Whereas minimum grain per spike was recorded in treatment T_3 (Broadcasting) with mean value of 41.00. The mean values of all the treatments are significant with each other. Mean value of site D is significant with site B and C and non-significant with site A while site A is significant with site C at 5% level of probability.

Table 6. Grain per Spike.

Treatment	Site A	Site B	Site C	Site D	Mean
Happy seeder	53.33 b	58.33 a	61.66 a	53.66 b	56.75 A
Zero seed drill	45.66 cd	45.66 cd	47.66 c	44.33 cde	45.83 B
Broad casting	41.00 ef	42.66 def	41.33 ef	39.00 f	41.00 C
Mean	46.67 BC	48.89 AB	50.22 A	45.66 C	

Thousand Grain Weight (g)

Results displayed in (Table 7) showed that maximum weight was recorded in treatment T_1 (Happy seeder) with mean value of 42.13g. It is followed by treatment T_2 (Zero Seed Drill) with mean value of 41.53g. Whereas minimum weight was recorded in treatment T_3 (Broadcasting) with mean value of 41.20g.

The mean value of thousand grain weight of treatment T_1 is significant with treatment T_2 and T_3 while treatment T_2 and T_3 are non-significant with each other. The mean values of site A is significant with site B and C while non-significant with site D. The values of site B and C are non-significant to each other at 5% level of significance.

Table 7. 1000-Grain Weight

Treatment	Site A	Site B	Site C	Site D	Mean
Happy Seeder	41.80abc	42.16a	42.50a	42.06ab	42.13A
Zero Seed Drill	41.16bcde	41.76abcd	42.20a	41.00cde	41.53B
Broad casting	40.40e	41.73abcd	41.90abc	40.80de	41.20B
Mean	41.12B	41.88A	42.20A	41.28B	

Yield of plot (2m×3m/kg)

Results displayed in (Table 8) showed that maximum yield was recorded in treatment T_1 (Happy seeder) with mean value of 2.64kg. It is closely followed by treatment T_2 (Zero seed drill) with mean value of 2.50kg. Whereas minimum yield was recorded in T_3 (Broadcasting) with mean value of 2.09kg.

Table 8. Yield.

Treatment	Site A	Site B	Site C	Site D	Mean
Happy Seeder	2.60 abc	2.59 abc	2.75 a	2.61 ab	2.64 A
Zero Seed Drill	2.50 bc	2.39 cd	2.55 abc	2.55 abc	2.50 B
Broadcasting	2.10 ef	2.23 de	2.03 ef	2.01 f	2.09 C
Mean	2.40 A	2.40 A	2.44 A	2.39 A	

The mean values all treatments are significant with each other while all site are non-significant with each other at 5% level of probability.

Yield (t/ha)

Results displayed in (Table 9) showed that maximum yield was recorded in treatment T_1 (Happy seeder) with mean value of 4.40t/ha. It is closely followed by treatment T_2 (Zero seed drill) with mean value of 4.16t/ha. Whereas minimum yield was recorded in treatment T_3 (Broadcasting) with mean value of 3.48t/ha.

The mean values all treatments are significant with each other while all site are non-significant with each other at 5% level of probability. Present results are in accordance with H. Singh *et al.*, 2013; Iqbal *et al.*, 2017; R.P. Singh *et al.*, 2008, reported that happy seeder has the highest yield s compared to zero seed drill and broadcasting method.

Table 9. Yield (t/ha).

Treatment	Site A	Site B	Site C	Site D	Mean
Happy Seeder	4.34 abc	4.31 abc	4.58 a	4.36 ab	4.40 A
Zero Seed Drill	4.17 bc	3.99 cd	4.26 abc	4.25 abc	4.16 B
Broadcasting	3.50 ef	3.72 de	3.38 ef	3.35 f	3.48 C
Mean	4.00 A	4.00 A	4.07 A	3.98 A	

Conclusion

The results of all sites shows that treatment T_1 (Happy Seeder) has the highest grain yield amongst its competitors. Due to its comparatively better performance this machine is recommended for paddy stubble field in wheat-rice cropping zone of Punjab, Pakistan.

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