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RESEARCH ARTICLE

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Evaluation of wheat sowing technologies under paddy residue conditions

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ABSTRACT : Evaluation of different wheat sowing technologies under paddy residue conditions were conducted in a combine harvested paddy field. Field of paddy variety PR-121 was harvested with combine. The straw load was 8.22 t/ha at moisture content of 20.2 per cent. Wheat variety (HD 2967) was sown with different farm machines *viz.*, T_1: Happy seeder, T_2: Spatially modified no till drill and T_3: Roto till drill in combine harvested paddy fields. In T_1, all the paddy straw was remained in the field itself but spreaded uniformly manually/stubble shaver, in T_2, 40 per cent of loose paddy straw removed manually/chopping of paddy straw with paddy straw chopper cum spreader while in T_3, there was a partial collection of loose paddy straw manually for better operation of the machines. The grain yield was maximum in treatment T_2 (5395.9 kg/ha).

KEY WORDS : Happy seeder, Spatially modified no till drill, Roto till drill, Paddy straw chopper cum spreader, Stubble shaver

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INTRODUCTION

Rice-wheat is the major cropping system of Punjab. The increasing constraints of labour and time have led to the adoption of mechanized farming in highly intensive rice-wheat system. In Punjab, mostly the paddy and wheat crops are harvested by combines. The wheat residue is collected by the farmers after combine harvesting using straw combine and often fed to animals, paddy straw is considered as poor feed for animals due to high silica content. One tonne of rice straw contains approximately 5-6 kg N, 0.8-0.9 kg P and 15-20 kg K, while one tonne of wheat straw contains 4 kg N, 0.6-0.7 kg P and 8-10 kg K (Singh, 2012). Burning is the normal and easiest method of crop residue management option because residues interfere with tillage and seeding operations for the next crop. Presently, more than 80 per cent of total rice straw produced annually is being burnt by the famers in 3-4 weeks during October-November (Singh *et al.*, 2010). The gaseous emissions from burning of rice straw analyzed 70 per cent CO_2, 7 per cent CO, 0.66 per cent CH_4 and 2.09 per cent N_2O. Substantial loss of plant nutrients (especially N and S) and organic carbon occurs during burning of crop residues, which has important implications for soil health (Singh *et al.*, 2005).

The major problem in sowing under no tillage is the frequent choking of the furrow opener of no-till drill due to long loose straw of paddy lying in the windrows, after harvesting by combines. The paddy straw present in the field often builds up in front of the tines of the drill and eventually blocks the tine and frame, causing unwanted

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interruptions, uneven seeding rate and depth and a patchy stand of plants (Graham *et al.*, 1986). Shukla *et al.* (1984) studied the problems in cutting straw, accumulation of straw on tines and formation of big clods. It was concluded that the germination and yield of crop was equal or sometimes higher in no-tillage system as compared to conventional tillage system. They also reported that coulter arrangement fitted with seed-cum-fertilizer drill worked satisfactorily in manually harvested paddy fields but failed to work under heavy residue conditions. Bansal (2002) studied that when no-till and strip-till drill is operated in chopped and well-spread paddy straw condition, there is marginal increase in straw accumulation as compared to clean field. Singh and Singh (1995) studied the effect of stubble height on the performance of zero till drill. They concluded that the standing stubble of various height up to 30 to 40 cm do not have effect on sowing performance of seed drill. However, the loose straw residue not burnt/spread on the ground resulted in frequent choking of drill in between furrow openers and frame of the drill. Keeping above points in view, farmer participatory trials were conducted to evaluate the performance of different farm machines for direct sowing of wheat in combine harvested paddy fields *viz.*, Happy Seeder, Spatially modified no till drill and Roto till drill in district Hoshiarpur during 2013-14.

EXPERIMENTAL METHODS

The study was carried out in villages Todarpur, Kangar and Panjoura of district Hoshiarpur. The brief description of various farm machines used for sowing of wheat in paddy residue conditions is as follows.

Happy seeder :

It consists of a rotor for managing the paddy residues and a zero till drill for sowing of wheat. Flail type straight blades are mounted on the straw management rotor which cuts the standing stubbles/loose straw coming in front of the sowing tine for proper placement of seed in soil. The rotor blades/flails guide/push the residues as surface much between the seeded rows. This PTO driven machine can be operated with 45 hp tractor and can cover 0.3-0.4 ha/hr. This machine can be used for direct drilling of wheat in uniformly spreaded paddy straw fields after combine harvested. Fig. A shows the line diagram (side view) of Happy seeder. Fig. B shows the direct sowing of wheat

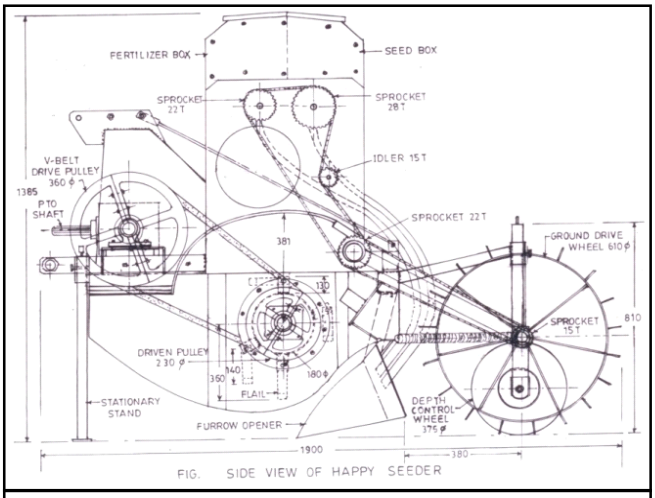


Fig. A : Line diagram of Happy seeder

Fig. B : Sowing of wheat with Happy seeder

with Happy seeder. The loose paddy residue left after the harvesting of paddy with combine was spreaded manually (Fig. C) and with stubble shaver (Fig. D) operating at a height of 1 feet above the ground for smooth functioning of Happy seeder. The total quantity of urea (110 kg/acre) had been applied in three splits doses: top dressing of 20 per cent urea (22 kg/acre) before sowing, top dressing of 40 per cent (44 kg/acre) before first irrigation and while remaining 40 per cent (44 kg/acre) urea was top dressed before second irrigation.

Spatially modified no till drill :

It is a modified no till drill which consists of three frame members. Each frame members consists of three T type furrow openers. The lateral clearance between

the adjacent openers is 80 cm while the vertical clearance from the ground is 60 cm. This machine can be used for direct drilling of wheat after chopping and spreading of paddy straw with straw chopper cum spreader. Fig. E shows the sowing of wheat with spatially modified no till drill. If 40 per cent of loose paddy straw after the combine operation collected manually (Fig. F) then this machine worked satisfactorily. In some areas, the loose paddy straw has been used for fodder.

Roto till drill :

It is a combination of rotavator and a seed drill, which can prepare the field and sow the wheat seed in a single operation. This PTO driven machine can be operated with 45 hp tractor having working width of 160 cm. The outer diameter of rotor is 16.4 cm. The overall transmission ratio from PTO to rotor is 28:15. It has a provision changing the depth of operation by adjusting the shoes on both sides. Fig. G shows the line diagram of roto till drill while Fig. H shows the sowing of wheat with roto till drill.

The average height of standing stubble and length of loose straw were 44.6 and 56.5 cm, respectively. Field of paddy variety PR-121 was harvested with combine. The straw load was 8.22 t/ha at moisture content of 20.2 per cent. Wheat variety (HD 2967) was sown with different farm machines in paddy residue conditions with different treatments as shown in Table A.

The seeding machines were calibrated for seed and fertilizer before the sowing operation. The crop

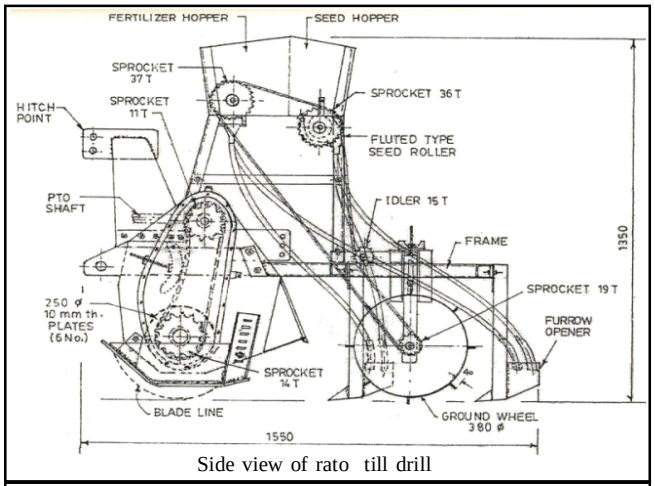
Fig. C : Spreading of loose paddy straw manually

Fig. E : Sowing of wheat with spatially modified no till drill

Fig. D : Spreading of loose paddy straw with stubble shaver

Fig. F : Collection of loose paddy straw manually

Table A : Sowing of wheat with different farm machines in paddy residue conditions	
Treatments	Condition of paddy residue
T_1: Sowing of wheat with Happy Seeder	Uniformly spreaded loose paddy straw and no burning of paddy straw
T_2: Sowing of wheat with spatial modified no till drill	40 per cent loose paddy straw collected/ chopping of paddy straw with paddy straw chopper
T_3: Sowing of wheat with roto till drill	Partial collection of loose paddy straw



Side view of rato till drill

Fig. G : Line diagram of roto till drill

Fig. H : Sowing of wheat with roto till drill

parameters *viz.*, germination count 20-30 days after sowing (DAS), effective tiller count, length of ear head, number of grains per ear head, thousand grain weight and grain yield were measured at the time of harvesting of wheat.

EXPERIMENTAL RESULTS AND ANALYSIS

The findings of the present study as well as relevant discussion have been presented under following heads :

Germination count :

A germination count was done at 20, 22, 24, 26, 28 and 30 days after sowing (DAS) the wheat crop (Table 1). The maximum germination count per meter length 30 DAS was 48.06, which was found for treatment T_2 followed by treatment T_1 which had germination count of 45.16 per meter length. The minimum germination count of 41.06 was observed in T_3 because uneven germination of wheat was observed in roto till drill sown fields. The highest germination count in treatment T_2 might be due to the reason that after chopping the paddy straw, the accumulation of paddy straw in front of furrow openers was minimum and subsequent seeding operation by modified no till drill, the seed coverage was better.

Crop establishment parameters :

The various wheat crop establishment parameters *viz.*, effective tiller count per meter length, length of ear head, number of grains per ear head and thousand grain weight are shown in Table 2. The length of ear head was

Table 1 : Average value of germination count of wheat crop under different treatments

Days after sowing	Germination count/m- length		
	T_1	T_2	T_3
20	37.50	40.55	31.65
22	39.25	42.15	34.50
24	40.46	44.10	36.25
26	43.66	46.65	38.46
28	45.10	48.06	41.06
30	45.16	48.06	41.06

Fig. 1 : A view of crop stand in treatment T_1

maximum (97.15 mm) in T_2 and minimum in T_3 (96.50 mm). The maximum effective tiller count per meter length (52.69) was in case of treatment T_2 and minimum number of tillers per meter length (50.27) was in case of T_3. The maximum number of grains per ear head (57.62) was found in treatment T_2 followed by T_1 (56.10) and treatment T_3 (56.05). The average value of thousand grain weight was maximum (42.24 g) in treatment T_2 followed by treatment T_1 (41.45 g) and T_3 (40.05 g). A view of crop stand in treatment T_1, T_2 and T_3 is shown in Fig. 1, 2 and 3.

Grain yield :

The highest grain yield (5395.9 kg/ha) was found in case of treatment T_2 and lowest in T_3 (5159.4 kg/ha) as depicted from Table 3. The average grain yield for

Fig. 2 : A view of crop stand in treatment T_2

Fig. 3 : A view of crop stand in treatment T_3

Table 2 : Average values of various wheat crop establishment parameters

Treatments	Crop establishment parameter			
	Effective tiller count/ m-length	Length of ear head (mm)	No. of grains per ear head	Thousand grain weight (g)
T_1	50.52	96.70	56.10	41.45
T_2	52.69	97.15	57.62	42.24
T_3	50.27	96.50	56.05	40.05

Table 3 : Effect of different treatments on grain yield (kg/ha) of wheat crop

Treatments	Grain yield (kg/ha)				
	Replications				
	R_1	R_2	R_3	Mean	Standard deviation
T_1	5215.4	5285.3	5262.5	5254.4	29.11
T_2	5383.1	5392.7	5411.8	5395.9	11.93
T_3	5147.3	5157.3	5173.6	5159.4	10.84

treatment T_2 was found to be significantly higher (4.58 %) than the T_3. It might be due to better seeding in treatment T_2 because in T_2, paddy straw was chopped into small size and spreaded uniformally with straw chopper cum spreader, which might have led to better decomposition of paddy straw in the soil, thereby increasing the availability of nutrients in the soil which might have helped in yielding bolder grains and hence better yield of wheat crop. Similar work related to the present topic was also done by Naresh *et al*. (2011).

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