

Demonstrations on Happy seeder in wheat to stop paddy residue burning

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The total geographical area of Jalandhar district is 2.66 lakh ha, occupying 5.3% of the total geographical area of the state and situated between the fertile agricultural land of rivers Beas and Sutlej, covering 11 blocks and 954 villages which are fully electrified and well connected with all weather roads. Temperatures in the summer vary from average highs of around 48°C to average lows of around 25°C and winter temperatures have average highs of 19°C to lows of -7°C. The climate is dry on the whole, except during the brief southwest monsoon season during July and August. The average rainfall of the district is 700 mm. The agricultural productivity is very high, i.e. 41.09 and 48.47 q/ha for paddy and wheat, respectively, in the district which has been achieved with assured irrigation, use of HYV seeds, good infrastructural support, etc. The fertilizer consumption of the district is 225 kg/ha of cropped area.

Key words: Burning of paddy straw, Conventional method, Happy seeder, KVK

OUT of total area of Jalandhar district, net sown area is 2.33 lakh ha (2015-16) which is 100% irrigated (97% by tube wells) with a cropping intensity of 178%. Out of total area, the area under forest, orchard and vegetables is 5,600 ha, 1,796 ha and 31,419 ha, respectively. In Jalandhar, most of the farmers are small to medium farmers with 2-10 ha of land holding, comprising of 93.4%. The major crop of Jalandhar are paddy, wheat and other crops like maize, sugarcane, potato, pulses and oilseed.

Wheat is the major crop of Punjab and also in Jalandhar covering an area of 1.70 lakh ha followed by paddy covering 1.67 lakh ha. 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. One tonne of crop residue on burning releases 1,515 kg CO₂, 92 kg CO, 3.83 kg NO_x, 0.4 kg SO₂, 2.7 kg CH₄, and 15.7 kg non-methane volatile organic compounds. The gaseous emissions from burning of paddy straw analyzed 70% CO₂, 7% CO, 0.66 % CH₄, and 2.09% N₂O. In addition, burning also decreases the efficiency of herbicides used for controlling weeds in wheat crop. 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.

One tonne of straw on burning releases 3 kg of particulate matter, 60 kg of CO, 1,460 kg of CO₂, 199 kg of ash and 2 kg of SO₂. The major pollutants that are emitted during crop residue burning are given in Table 2.

Burning of farm waste causes severe pollution of land and water on local as well as regional

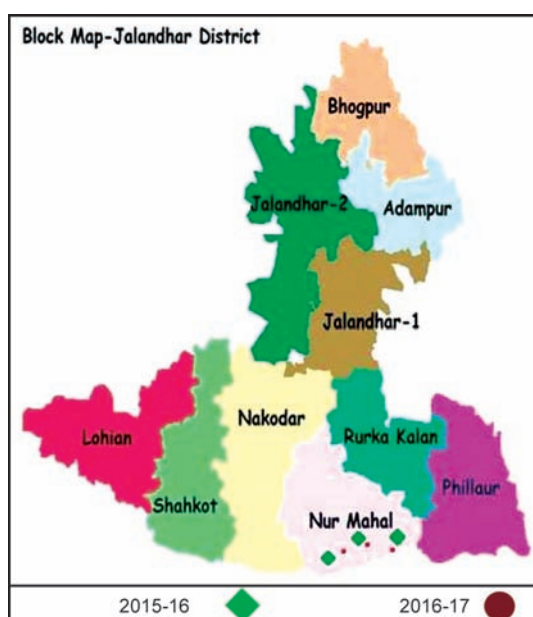


Fig. 1. Demonstration conducted during 2015-16 and 2016-17

Table 1. Catagory of farmers in Jalandhar

Category of Farmers	No of families
Marginal (<1 hac)	3,910
Small (1-2 ha)	7,041
Semi Medium (2-4 hac)	14,108
Medium (4-10 hac)	14,385
Large (>10 hac)	4,332
Total	43,776

Table 2. Major pollutants emitted during crop residue burning

Category	Pollutants	Source
Particulars	SPM (PM100)	Incomplete combustion of inorganic material, particle on burnt soil
	RPM (PM10)	Condensation after combustion of gases and incomplete
	FPM (PM2.5)	Combustion of organic matter
Gases	CO	Incomplete combustion of organic matter
	NO ₂	Incomplete combustion of organic matter
	N ₂ O	Oxidation of N ₂ in air at high temperature
	O ₃	Secondary pollutant, form due to nitrogen oxide and hydrocarbon
	CH ₄ /Benzene	Incomplete combustion of organic matter
	PAHS	Incomplete combustion of organic matter

SPM – Suspended particulate matter; PM – particulate matter; FPM – fine particulate matter.

scales. This also adversely affects the nutrient budget in the soil (Table 3). It results in the emission of smoke which if added to the gases present in the air like methane, nitrogen oxide and ammonia, can cause severe atmospheric pollution. These gaseous emissions can result in health risk, aggravating asthma, chronic bronchitis and decreased lung function. Burning of crop residue also contributes indirectly to the increased ozone pollution. Therefore Happy seeder demonstrations were conducted by KVK to control pollution caused by residue burning and its adverse impact on human and animal health.

KVK, Jalandhar in the services of farmer

Krishi Vigyan Kendra, Jalandhar at Nurmahal was established in 2006 on Phillaur-Nakodar road, latitude 31°19'26.74" N, longitude 75°34'39.46"E, elevation: 262 m at a distance of 45 km from Ludhiana have an operational area of 25 acres, out of which 20 acres of land is under

cultivation and 5 acres of land is under buildings, roads, paths and irrigation channels.

The On Farm Trials (OFTs) are conducted at farmers' fields to assess the performance of various latest technologies developed by National Agricultural Research System and farmers practice. Similarly, frontline

demonstrations are conducted at farmers' field to educate the farmers to adopt the new varieties, technologies and methods with the help of these demonstrations. KVK scientists impart short and long duration trainings to the farmers and farm women in the field to enrich the knowledge of the farmers to adopt the recommended practices. The farmers are also provided the vocational trainings on dairy farming, hybrid seed production, beekeeping, establishment of custom hiring centres, preservation of fruits and vegetables etc. to the make them self employed.

Initiatives of KVK to combat residue burning

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 of its effective use for

electricity generation in biomass based power plants as a source of energy, card board/paper manufacturing, mushroom cultivation or/and as animal feed. The collection of straw is done manually or by baler machine. The manual collection of straw is labour intensive, while using baler machine is very costly as small farmers cannot afford high cost machine. However potato farmers have started adopting baler machine on custom hiring basis. While wheat farmers rely on the *in-situ* management of the paddy straw. *In-situ* management includes partial burning, incorporation or spreading on soil surface (using Happy seeder machine). To incorporate the paddy straw into soil, farmers generally need 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.

Initiatives of KVK, Jalandhar

Taking into the consideration of current scenario, KVK, Jalandhar took initiatives to popularize Happy seeder (HS) to tackle the problem of paddy straw which can convert this waste into resource. Happy Seeder machine is capable of direct drilling of wheat into heavy paddy residue load (7-9 t/ha straw). Happy seeder consists of a rotor for managing the paddy residues and a zero till drill for sowing of wheat. Flail type (Gamma) blades are mounted on the straw management rotor which cuts the standing stubbles/loose straw coming in the front of the sowing tine and clean each line twice in one rotation of rotor for proper placement of seed in soil. The rotor blades/flails push the residues as surface mulch between the seeded rows. 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 spread as mulch in the field. This mulched crop residue improves the soil health by adding organic matter into the soil and also helps reducing the growth of weeds. Substantial saving in water

Table 3. Nutrient content of paddy straw and amounts removed with one tonne of straw residue

	N	P ₂ O ₅	K ₂ O	S	Si
Content in straw, percent dry matter	0.5–0.8	0.16–0.27	1.4–2.0	0.05–0.10	4–7
Removal with 1 t straw, kg/ha	5–8	1.6–2.7	14–20	0.5–1.0	40–70

Source: Rice straw management, Dobermann and Fairhurst (2002).



Fig. 1. Happy seeder machine directly sowing wheat into heavy paddy

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. This PTO driven machine can be operated with 50 hp tractor and covers 0.25-0.30 ha/h.

Demonstration at KVK farm

The demonstrations on Happy seeder were also laid out at KVK farm during 2015-16 and 2016-17 to showcasing this technology for the farmers. The soil of KVK farm is light textured i.e. sandy loam with soil pH 7.8. The electrical conductivity (EC) is 0.44 ds/m. The status of organic carbon (OC) is medium i.e. 0.57%. The status of phosphorus (P) and potash (K) fall under higher category i.e. > 9 kg/acre and > 55 kg/acre, respectively. The status of micro nutrients such as zinc, iron, manganese and copper is fine. The quality of water is fit for agriculture use with EC value of 800 micro mhos/cm and RSC value of 1.0 me/l. The data of these FLDs of wheat sowing with Happy seeder have been observed. The observed data were analyzed and compared with conventional method i.e. farmers' practice (after burning of rice straw). The results are also discussed during SAC meetings and special field days were organised to

make awareness among other farmers about the technology.

Results of demonstrations: KVK farm

The demonstrations conducted at KVK field showed that the wheat sowing with Happy seeder is better in every aspect as compared to the conventional method of wheat sowing. The average plant height of Happy seeder was more i.e. 100.45 cm as compared to 97.5 cm for conventional method. Similarly, the number of tillers per meter length was 108 and 103/m for Happy seeder and conventional method of sowing, respectively. The average ear length was 10.8 and 9.9 cm, respectively, for Happy seeder and conventional method. It is worth mentioning that wheat sowing with Happy seeder reduced number of operations considerable (2 disc harrow, 2 cultivator and 2 planker operations) resulting in reducing the cost of cultivation. Germination of crop was good resulting in uniform crop stand with luxuriant growth. The crop matured in time and average yield of wheat sown with Happy seeder was higher i.e. 1.5 q/ha (approximately 3.4% higher) as compared to conventional method. The average weed count in Happy seeder was lesser i.e. 51-57% as compared to conventional method of

sowing. The reduction in weeds resulting in lesser use of weedicides, therefore reducing the cost of production and in better BC ratio i.e. 3.3 as compared to 2.7 as in conventional method.

Demonstrations at farmers' field

These demonstrations of wheat sowing with Happy seeder were also laid out at farmers' field in association with agriculture departments in a participatory mode. Progressive and forward looking farmers were selected in the process. The main purpose is to demonstrate the technology at farmers fields so that general perception can be evaluated and further refinement can be made in the technology package. Various demonstrations on Happy seeder were laid out during 2015-16 and 2016-17 respectively in village partabpura and also at KVK farm.

Results of demonstrations 2015-16 and 2016-17

Data regarding name of variety area yield water saving, weed control, cost of cultivation, net income and bc ratio was observed for Happy seeder and convention method of wheat sowing. The results of conducted Happy seeder were analyzed and compared with the farmer's practices. The results showed that the yield of Happy seeder plot was higher as compared to convention sowing. Saving in water (20 to 25%) and weed control (51 to 57%) was more in Happy seeder plot as compared to farmer's practice. Overall, the cost of cultivation in Happy seeder (₹ 7737.5/ha) was lesser than conventional method (18.8%) mainly due to less cost on tillage preparation, saving in weedicides, fertilizers etc. The net income of farmers using Happy seeder was (₹ 7896.3/ha) higher compared to farmers using conventional method of sowing.

CONCLUSION

The demonstrations conducted at KVK field showed that the wheat sowing with Happy seeder is better in every aspect as compared to the convention method of wheat sowing (farmers' practice). The average plant height of Happy seeder was more i.e.

100.45 cm as compared to 97.5 cm for conventional method. Similarly, the number of tillers per meter length was 108 and 103/m for Happy seeder and conventional method of sowing, respectively. The average ear length was 10.8 and 9.9 cm, respectively for Happy seeder and conventional method. It is worth mentioning that wheat sowing with Happy seeder reduced number of operations considerable (2 disc harrow, 2 cultivator and 2 planker operations) resulting in reducing the cost of cultivation. Germination of crop was good resulting in uniform crop stand with luxuriant growth. The crop matured in time and average yield of wheat sown with Happy seeder was higher i.e. 1.5 q/ha (approximately 3.4% higher) as compared to conventional method. The average weed count in Happy seeder was lesser i.e. 51-57% as compared to conventional method of sowing. The reduction in weeds resulting in lesser use of weedicides, therefore reducing the cost of production and in better BC ratio i.e. 3.3 as compared to 2.7 as in conventional method.

The straw spreading should be uniform before wheat sowing to be done with Happy seeder and this can

be done with the help of Super SMS attached with combine harvester. In case of Happy seeder with press wheel attachment (PAU Happy seeder), the PAU straw cutter cum spreader is required for uniform spreading of paddy straw for easiness of sowing operation of Happy seeder. Farmers should take care of following points while using Happy seeder machine for wheat sowing.

Important tips for sowing wheat by Happy Seeder machine

- The loose straw falling behind combine during harvesting of paddy should be spreaded evenly onto the field before sowing of wheat with Happy seeder for optimum germination and crop establishment.
- Loose straw can be spreaded manually, with PAU straw cutter cum spreader or by harvesting with combines which are having Super SMS (straw management system) attachment. The super SMS attachment simultaneously chops and spreads the loose straw falling behind combine in a wider area.
- Harvesting of rice crop with combine should be done at greater height (60:40 ratio) so that proportion of loose straw is lesser

than the standing stubbles.

- Moisture content of soil at the time of wheat sowing should be optimum (neither too high nor too low).
- Calibrate the machine before operation in the field for exact seed and fertilizer to be dropped without any damage.
- Tractor should be adjusted around 1500-1700 rpm before running the machine for sowing operation.
- Lift the Happy Seeder while turning on headlands to avoid hindrance problem and bending of tines.
- One acre field may be divided into four sub plots after wheat sowing for better irrigation water application.
- Proper rodent control measures are required.
- Grease all bearing, points, chain and sprockets. Oil and gear box should be checked after a specified interval as suggested by the manufacturer.

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