Direct drilling into stubbles with the Happy Seeder

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IN A NUTSHELL

- The Happy Seeder technology offers a solution to the problem of direct drilling into heavy stubbles, enabling the stubble to be retained on the surface as a mulch
- The rapid development of the technology, from concept to commercial reality in four years, has resulted from synergies between Australian and Indian engineers and scientists
- The Happy Seeder technology needs to be evaluated for a wide range of cropping systems – after one season's testing in Australia, it is thought that the Turbo Happy Seeder may be more appropriate for heavy rice stubbles

Lack of suitable machinery is a major constraint to direct drilling into the heavy stubbles that commonly occur in irrigated and high rainfall cropping systems, mainly due to blockage in many parts of the seeding mechanism, and failure to obtain good seed soil contact.

Stubble burning is widely practised in irrigated cropping systems in Australia and around the world as a rapid and cheap option, allowing quick turn around between crops. In the irrigation areas of southern NSW, most rice and wheat stubbles, and about 50% of maize stubbles, are burnt. In the tiny state of Punjab, north west India, about 10 million tonnes of rice residues are burnt each year prior to wheat sowing, causing terrible air pollution and health problems as well as huge losses of nutrients and organic carbon.

A recent novel approach to address heavy stubbles with much promise is the "Happy Seeder", which combines stubble mulching and seed drilling functions into the one machine. The stubble is cut and picked up in front of the sowing tynes, which therefore engage almost bare soil. The stubble is then deposited behind the seed drill as a surface mulch. In addition to the benefits of direct drilling and retaining organic matter, the mulch also assists moisture conservation and weed control. The surface mulch is broken down and incorporated into the soil by natural biological processes over time, improving soil properties, and saving fuel and time over mechanical incorporation.

Figure 1 The original Happy Seeder concept in Punjab, India – a 35 hp tractor successfully sowing into 6.5 t/ha spread rice straw

Figure 2 Wheat, which was sown into standing rice residues with the original Happy Seeder, coming up through 0, 4 and 8 t/ha of rice straw mulch

The first Happy Seeder

The original Happy Seeder was conceived and built by John Blackwell of CSIRO Griffith at Punjab Agricultural University (PAU) in India in July 2001, as part of a large ACIAR project *Permanent beds for irrigated rice-wheat and alternative cropping systems in north west India and south east Australia*.

The Happy Seeder technology was initially developed for direct drilling wheat into rice residues (typically 5–9 t/ha of tough anchored and loose straw), in north west India where tractors are usually 35–45 hp.

The first Happy Seeder consisted of a standard Indian seed drill with inverted T-boots attached by three-point linkage behind a forage harvester with a modified chute (Figure 1).

Preliminary tests with wheat sown into about 6 t/ha of rice stubble on the flat and beds were very encouraging (Figure 2), however in some situations establishment was poor, due to poor seed/soil contact and uneven distribution of the straw.

The Indian team involved with the project improved this early version of the Happy Seeder by putting independent PTO (power take off) driven hydraulics on the forage harvester, enabling it to be used with any tractor in India, as most tractors in India do not have remote hydraulics. This was also done for all subsequent versions of the Happy Seeder.

The second generation machines for India - the Combo+ Happy Seeder

The Indian team then set about designing and building an improved machine, using the same approach, which ultimately resulted in the Combo+ Happy Seeder. The main improvements were:

1. combining the forage harvester and drill into a single, compact, light weight (540 kg), 2 m wide machine (hence the name "Combo") which can be easily mounted on a three point linkage
2. reducing the cutting width in front of each sowing tyne (20 cm spacing) from 20 cm to 7 cm – reducing the load of mulch and power requirement
3. putting independent PTO driven hydraulics on the machine, enabling it to be used with any tractor (most tractors in India do not have remote hydraulics)
4. adding a very narrow strip tillage assembly in front of the sowing tynes, which improved seed/soil contact on the sandy loam and loam soils in Punjab (the Combo+) (Figure 3)

The Combo+ Happy Seeder has been used to sow wheat into rice residues (of up to about 9 t/ha) in numerous sites in Punjab, and more recently in other parts of India and Pakistan, with very encouraging results. However, the technology has potential application in a range of cropping systems such as the establishment of mung beans in wheat residues in India.

The third generation machine for India - the Dasmesh Turbo Happy Seeder

While the Combo+ Happy Seeder was giving good enough results to become a recommended practice for Indian farmers, there were still some problems with straw flow through the chute with moist or wet straw resulting in clumpy distribution, too much straw over the plant rows (and therefore very difficult to line up the sowing runs, as well as impeding establishment), and large amounts of dust.

Dasmesh Mechanical Works and PAU came up with a very clever approach which eliminates the chute, greatly reduces the amount of dust, and the sowing lines are now more exposed and visible (Figure 4), thus overcoming most of the difficulties experienced with the previous models of Happy seeders. The Turbo design represents a quantum improvement over previous incremental improvements to the approach. We are unable to reveal more at present, as the Indians are investigating opportunities for patenting.

WATCH THIS SPACE

Figure 3 *Direct drilling wheat into rice residues with the Combo+ Happy Seeder*

Figure 4 *The Turbo Happy Seeder with seed rows left relatively exposed – hopefully a big advantage for establishment, especially for sowing into rice stubbles*

Testing the concept in Australia

CSIRO and IREC recently imported two Combo+ Happy Seeders for testing the concept in Australian situations. Potential applications include wheat into maize, cotton, rice or wheat stubbles, and soybean into wheat or barley. A recent trial near Whitton shows successfull establishment of soybeans in a 4.5 t/ha barley stubble (Figure 5). CSIRO hopes to import a Turbo Happy Seeder in time for sowing of winter 2006 crops, with the option of disc openers as well as the simple T-boot.

WANTED

Farmers willing to trial the Happy Seeder concept, please contact Liz Humphreys or John Blackwell at the Griffith CSIRO on 02 6960 1500

The Australian Happy Seeder

A larger version of the Happy Seeder was recently developed for Australian conditions, funded by Twynam Pastoral Co. Pty Ltd (Figures 6 and 7). The machine comprises a modified 4 m Tierri stubble mulcher combined with a 4 m Stubble King seed drill. The seed drill has double discs with press wheels and parallelogram seeding assemblies providing the capability of sowing on bed or flat layouts.

Large scale trial

The Twynam Happy Seeder was initially tested for soybeans drilled into wheat stubble, with satisfactory results in comparison with other establishment methods. In 2005 it was used in a large trial comparing three methods of establishment of wheat into fresh but relatively light rice straw (~8.5 t/ha). The rice crop had been harvested with a stripper front, therefore there were no loose residues. The treatments tested were:

1. **Burnt** - stubble burnt, direct drilled with air seeder with narrow points, row spacing 22 cm

2. **Great Plains** - direct drilled with a Great Plains triple disc seeder into standing stubble, mulched after sowing, row spacing 25 cm

3. **Happy Seeder** - direct drilled with the Twynam Happy Seeder into standing stubble, row spacing 22 cm

The sowing rate was 80 kg seed/ha in the burnt treatment, and 100 kg/ha in the two treatments with stubble retained. Fertiliser was applied with seed, 125 kg/ha DAP (23 kg N/ha and 25 kg P/ha). The crop was sown into dry topsoil in mid to late May 2005, and established on rain in June. Each treatment was applied to a whole bay (~5.0 ha) and replicated five times. There were no irrigations or further fertiliser applications. The crop was sprayed for rust using Tilt® @ 250 mL/ha on 30 September.

Happy Seeder not so happy

Sowing with the Twynam Happy Seeder was unsatisfactory due to frequent blockage of the chute, resulting in many

Table 1
Establishment, growth and yield of wheat after rice

Treatment	No. plants/m^2 establishment	Growth at time of end of heading of Burnt treatment		Grain yield (12%) t/ha
		Dry weight t/ha	No. spikes/m^2 (% headed)	
Burnt	120	6.4	361 (98%)	4.2
Great Plains	118	4.4	297 (83%)	3.1
Twynam Happy Seeder	83	3.1	124 (67%)	2.6

Figure 5 *Establishment of soybeans in barley stubble at Whitton, using the Combo+ Happy Seeder*

Figure 6 *The Twynam Happy Seeder*

stops, and deposits of large clumps of mulch every time the machine was stopped to clear a blockage. This problem could be solved by increasing the air flow by replacing the mulcher blades with ones more closely representative of those from a forage harvester. Dust was also a major problem – on the very last pass the tractor caught on fire because of dust accumulation around the turbocharger.

Establishment, growth and yield were best in the Burnt treatment, and worst with the Happy Seeder (Table 1). The number of established plants was similar in the Burnt and Great Plains treatments, but the plant stand was much more variable with the Great Plains due to poor establishment on the large harvester wheel tracks where the straw had been flattened. We suspect poor seed soil contact due to incomplete straw pickup as the chute blocked, and heavy mulch deposits in places due to clearance of blockages.

Heading was delayed in the mulched plots relative to the Burnt treatment, more so with the Happy Seeder than the Great Plains treatment. At the time of heading there were three times as many spikes and twice the dry weight in the Burnt compared with the Happy Seeder treatment. However, the differences in grain yield were not as dramatic as the differences in early growth, with the Great Plains yielding 74% of the Burnt, and the Happy Seeder 63% of the Burnt.

We have decided not to continue to improve and test the Twynam Happy Seeder as we believe that the new approach of the Turbo Happy Seeder is far superior, particularly as it leaves the seed rows exposed, assisting establishment through the mulch (Figure 4). We hope to be able to test the Turbo seeder sowing wheat into rice stubble in 2006.

Further Australian testing needed

Collaboration between Australian and Indian engineers and scientists has resulted in tremendous synergy, culminating in the development of the Turbo Happy Seeder technology, which is poised to solve the problem of direct drilling into heavy stubbles and trash, around the world.

Direct drilling and stubble retention offer many benefits, including large fuel savings, rapid turn around between crops, increased chance of double cropping, improved soil properties, and reduced air pollution (particulates in smoke and greenhouse gases). Mulching, as opposed to incorporation, offers the additional benefit of moisture retention and weed suppression. However, the Happy Seeder technology may not be suited to all situations due to effects of the mulch on soil temperature and toxic effects of the products of breakdown of some stubbles on some crops.

The technology needs to be tested for a wide range of cropping systems and situations to identify where it can be successfully applied.

CSIRO will be undertaking limited testing of the technology in southern NSW in a new ACIAR project which commenced recently. We are keen to undertake trials with farmers, and will also be testing the technology at the Murrumbidgee Shire Community Experimental Demonstration Farm (the "Coly Demo Farm"). A major objective of the work at Coleambally will be to quantify the effect of the mulch on water savings.

Acknowledgements

Our work on the development and testing of the Happy Seeder is funded by the Australian Centre for International Agricultural Research (ACIAR), Punjab Agricultural University, CSIRO, Dasmesh Mechanical Works Pty Ltd and Twynam Pastoral Co. Pty Ltd. We are grateful to many farmers in India and Rob Houghton, Whitton, for collaboration in on-farm trials.

Further information

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Figure 7 *Direct drilling wheat into rice residues at Gundaline*