

Seed Terminator – Farmer and manufacturer experience from prototype towards commercial unit

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A couple of years ago, we spoke to Pinnaroo farmer Wade Nickolls about his use of a chaff cart to get on top of problem weeds. Difficulties burning his chaff dumps saw him move to narrow windrow burning at the time but he held out hope of getting involved in the development of a mechanical seed destructor, which might more effectively address his situation. Two years down the track, Wade has indeed been part of the testing program for an integrated unit but it wasn't the one he first imagined.

The Harrington Seed Destructor first emerged as a towed behind unit and is now available as a machine that can be integrated directly into harvesters. The Seed Terminator has appeared as another player in the market and the principle engineer for that company, Nick Berry, is Wade's cousin. That relationship made it logical for Wade to become involved with the testing and development of the Seed Terminator for the last two seasons. We spoke to both Wade Nickolls and Nick Berry about their experiences with the machine.

The Nickolls crop 5500ha of mainly sandy loam soils about 15km south of Pinnaroo in 330mm annual rainfall (250mm GSR). They concentrate on making the most of all of their moisture and this is reflected in good yields with a Hay-Lentils-Wheat rotation. Wade, his brother Chad and their families are the fourth generation of Nickolls to farm this still expanding property. Their father Jeff remains involved in the business.

Transition from chaff cart to narrow windrows to the Seed Terminator – Why?

The Nickolls found that the chaff cart worked really well to reduce the number of weed seeds going back into the paddock. The real problem for them was burning the chaff dumps. "They were almost a menace to society! The smoke was quite annoying for neighbours when it would blow toward their houses or near the town plus they were painful to deal with. Farmers who had sheep probably utilized them better as a feed source but we don't have sheep so we had to burn them. It can work really well but it's one of those jobs that's hard to do and get right on a consistent basis."

For that reason Wade decided to adopt narrow windrow burning as an easier, less risky solution. The purchase of a second header also meant that it would make more sense to burn the windrows from both machines rather than purchasing a second chaff cart.

“We strategically burned windrows for 4-5 years in the paddocks that we thought most needed doing. We had to be careful of soil erosion. If the burn gets out of control, all the stubble in the paddock can be lost. It’s worked pretty well; it is just that in an ideal world we would want to leave that residue in the paddock. I guess the progression to the Seed Terminator was one that we always considered but we just had to wait until the technology was there and was a bit more affordable. We always thought that if there was a machine for around \$100k, then over five to ten years that would be a good investment.”

Seed Terminator

Dr Nick Berry is Seed Terminator’s research and development director. He’s a farmer’s son and a Mechanical Engineer who completed a PhD thesis entitled: *Optimisation of an impact mill that processes chaff exiting a combine harvester to devitalise lolium rigidum (annual ryegrass) seeds.*

"Australian grain growers paid me to gain a unique set of skills for developing new machinery that can efficiently destroy weed seeds at harvest time. I feel that I have the opportunity to use those skills to generate better outcomes for Australian growers."

We asked Nick about the key differences between the Seed Terminator and the Integrated Harrington Seed Destructor. “They both destroy seeds. The key difference is that we use multistage hammer mill technology. What that means is that our Seed Terminator uses swinging flails to pulverize the chaff and weed seeds against a screen. It pulverizes the material until it is small enough to pass through three stages of screens, getting smaller on the way out. In other words, it uses a combination of impact, shear, grinding and crushing to break up the material and the weed seeds. Then the screens themselves actually use a physical size classification so they have to be small enough to pass through. It works on reducing the size of the material rather than just using impact.”

Wade’s impressions

Wade has now completed two harvests with the Seed Terminator and says it works really well, doing “a great job of killing weeds and smashing things up. The first year we did have problems with the drive, wearing of the mills and getting the feed through the machine. This year we still had a few feed issues but the drive system was really good and worked well. The main problem was the amount of wear on the mill itself. It makes no difference whether you’ve got a Seed Terminator or a Seed Destructor. Friends with Seed Destructors have confirmed that. It may be our abrasive sand and stubble going through the machine. However, the concept is really good and works well; it kills weeds. It would be good to see the lifespan of the mills extended though.

Drive belts

From Wade's point of view, the drive belts are very simple. "Just a couple of V-belts with a 90 degree gearbox instead of a massive hydraulic system. They are very farmer friendly when you look at them. It's easy to put them on and take them off or adjust and change settings."

"The Seed Terminator fits to our existing John Deere S680 header. At the moment we have it on one header and the other one is dropping windrows. It's not a perfect solution but the idea is to get an additional one for the other harvester. We will do that as the technology improves."

"The gearbox and belt system on the first prototype we had two years ago just wasn't strong enough. They were out here all the time pulling it off and on trying to fix it so we probably only did 5-10% of our area last year because it wasn't quite ready. However, I didn't have any trouble with the belt or gearbox at all this year. The changes the team made worked really well."

Nick Berry concurs with Wade's thoughts. "We've gone through a lot of different drive systems to achieve what we have got today. We have changed gearboxes, and completely changed belt layout designs and belt types. In 2016 the prototypes were limited by the drive system. The design had three major iterations during the 2016 harvest and then a fourth complete design overhaul before we manufactured the 2017 prototype units. In terms of the drive we had 32 machines in total out in the field this year and they performed really well."

Nick says that it's important to him to keep working to make the machine better. "I think it will still take a concerted effort for a farmer to take on a Seed Terminator and maybe it will always be thought of as yet another process that must be done during harvest. We are doing everything we possibly can to minimize downtime because it is so costly. A farmer's crop is sitting out there waiting to be harvested and losing value every day and we understand that."

Mills

At this stage of development, Wade estimates that a farmer might only get a season out of the mills before having to replace them. "It is a cost that you don't want to incur." He estimates that cost to be in the range of \$5-10K.

"I know it won't be the case in the future because the mills we are working with now are still prototypes. Seed Terminator have promised that they will keep working on it until we can get 2-3 years out of the mills. I suspect by next harvest they will have a better option for us again and hopefully they will just keep on it till they get it right."

Nick Berry acknowledges that with soils like Wade's that are high in silica, farmers can end up with significant amounts of sand in the front of the harvester. This is more likely to happen on undulating ground and in crops like lentils.

“A proportion of it ends up in the mill and it’s just like being sandblasted at over 300k/hr. One of the things we are learning is that in those soil types there is a compromise that a farmer needs to be aware of about how low he or she cuts to the ground and the wear rate. When cutting low to the ground to capture more weeds you’re going to capture more sand in the machine and increase the wear rate. That is why we are working really hard on reducing the wear rates with a two pronged attack. We are reducing the amount of time that sand will stay in the mill itself through functional changes to the design and we are also using hard facing treatments and case hardening on the machine parts.”

“We have seen a big range in mill lifespan depending on region. With the standard setup we probably only achieved 2-300 hours out of it at the most, in country like Wade’s, maybe less. With coatings we expect to at least double that but with reduced residence time for the sand we are trying to get a few seasons out of the mills. We are still testing so I haven’t got a real gauge on what we can ultimately achieve.”

Green material blockages

There were occasions when green or wet material blocked up Wade Nickolls’ machine but he says that Seed Terminator have addressed that quite quickly with blockage sensors and cameras. “For example, reaping lentils that are pretty green can block the back of the header and by the time you realise it, it’s too late. However, if you have a sensor there you can just back off a bit and it’s a lot easier. Seed Terminator have that sorted now and say they work really well although we were done with harvest by the time they got to that stage. They are getting farmer feedback all the time and just trying to deal with issues as they come up. I’m confident they will sort it all out.”

Nick agrees, “We have prototyped blockage sensors to prevent problems but there are other improvements that we are making as well in just preventing blockages, because that’s better than cure. With some machines, without a blockage sensor you are really flying blind. It’s not so much the mill blocking but rather the back of the harvester becoming obstructed. We have some sensors that so far have worked really well so we just need to turn that into something that is a bit more robust and roll it out.”

Horsepower requirements

“The Seed Terminator definitely causes some loss of horsepower and productivity but it’s all a trade off. I’m more than comfortable with using a bit more fuel and going a bit slower if I can eliminate another job later on. The loss is not substantial but remember we have gone to bigger headers so they have more horsepower than they used to have. We have had our S680 class 8 header remapped for more horsepower to make it more like a class 9 size header. By using the Seed Terminator on the machine it probably goes back to more like a class 8 header in performance so I haven’t really lost anything, to be honest.”

“SAGIT funded a project this year where Sam Trengrove came out and we ran the machine at full load with the Seed Terminator both on and off. I haven’t seen the results yet but I suspect that we are using 5-10% more fuel at least.”

Nick says the horsepower loss can be significant but that it depends on the crop type. “We find that in a barley crop or even potentially canola, depending on how fast you are able to harvest, you often don’t even know it’s there. In wheat you will definitely know it is there and it does rob horsepower. We are trying to reduce that quite a bit and early indications are we can get 15-20% reduction in horsepower without fundamentally changing what we are doing. Ultimately, there will be a loss of somewhere between 10-20% of your capacity in wheat.”

“Farmers who are running Class 7 machines will certainly notice it more than those using bigger machines but they are making it work. You just can’t put another operation on to the harvester and not have some reduction in capacity. Our aim is to minimize the effect on the harvester in terms of its capacity, to keep the harvester moving and slow it down as minimally as we can.”

Weed control

When all is said and done, it’s really about weed control. What percentage of weed seeds is actually destroyed in the mill? The original data from testing by the University of Adelaide showed that at 2700rpm the Seed Terminator gave a 90% reduction in annual ryegrass germination.

“Since then we have had a SAGIT funded project that’s been run by Sam Trengrove Consulting and that data is not released yet. The important thing to note is that we don’t run at 2700 rpm any more. We have dual speed, 2850rpm and 2950 rpm, so we are actually pulverizing a lot more material than we were originally. We have also made some functional changes to improve that too. We won’t know until Sam’s results are out but it is quite likely that the germination reduction will be well over 90%.

Overall impressions

Wade Nickolls is confident that using the Seed Terminator has been a good move. “You can’t just walk out into the paddock and see how well it’s working because it can take years. You’d have to look at weed counts. I’m confident it is killing weeds and now that it is working more consistently from a mechanical perspective, I feel like it is adding value to our system. I’m now quite confident going forward that it will be good for us. If you’d asked me 12 months ago I was sitting on the fence a bit more.”

Of course, getting the weed seeds into the header is the first step to success. Wade says it doesn’t matter whether you are windrow burning or using a Seed Terminator; that is still important.

The most important thing with a chaff cart or a Seed Terminator is that you are able to clean the weed seeds out of the straw. You can’t leave them on the straw

because the straw still goes back in the paddock. You have to make sure that the rotor is smashing it out well enough. Again, it's pretty hard to pick that.

"When you burn windrows you are burning everything –all the straw – so there's probably less chance of escapes but all that goodness is lost from the paddock. With windrow burning sometimes the weeds sort of fall out the side and you don't always burn the seeds near the edge of the rows. That's not a problem with the Terminator. More importantly, the Seed Terminator leaves the entire residue in the paddock and over ten or twenty years that's a fair amount of good nutrients to be gained in that way. Realistically, it's probably doing the same job as chaff carts and windrow burning but it's leaving your paddock in better heart."

"A new chaff cart is around \$70-80k now. The Seed Terminator is around \$100k. An Integrated Harrington Destructor is approximately \$160k. It would be difficult for us to buy two of them. However, I do know of people in WA who have three of them fitted to their three headers and are doing thousands of hectares."

"Our header was four years old so I wasn't scared to do some modification. I might not have been so keen to pull apart a brand new header with a warranty to fit the Seed Terminator. I'm comfortable now but at the time it seemed a bit radical I suppose."

Dr Nick Berry's message is that no matter what weed control you do at harvest it has got to be a good thing. It doesn't make a lot of sense to spend all year trying to control weeds and then harvest the crop and spread them all back on the ground. It makes sense to do something with them while they are captured. To me, the Seed Terminator seems like the most appropriate choice for the broadest range of farmers if maintaining soil cover and returning nutrients to the soil is important. Another important benefit probably doesn't get mentioned enough is maintaining moisture in your soil. That is probably where most of the money is in residue retention."

"There are people that are able to burn a windrow in cereals effectively but sometimes they can lose all the stubble if a fire gets away. Even if you don't lose all the stubble you are still taking quite a bit that would have been protecting the soil from moisture loss. Chaff carting is somewhere in the middle because you are not taking all the material away but you still remove a good proportion."

It sounds like Wade Nickolls has finally found a good and cost effective alternative for his harvest weed control and that his choice, the Seed Terminator, will continue to improve over time.