Report on SRC machinery operated by Gunnar Henriksson: Austoft 7700/240 Salix harvester, Claas harvesters with HS2 and HS1 headers, and Austoft planter

by Raffaele Spinelli

Introduction

The Austoft 770/240 Salix harvester is owned by Gunnar Henriksson, a farmer and machine contractor operating in Southern Skåne - Sweden.

He manages two farms, covering app. 1000 ha. Most of this land is rented, and it is grown with grain. 150 ha are planted with SRC willow.

In winter, Mr. Henrisson works as a contractor. To this purpose he has hired a number of machine operators, as he can no longer operate the machines himself - having to manage such a large business.

The Austoft harvester

Austoft Ltd. is an Australian company manufacturing sugar cane harvesting equipment. Their machines are used mainly in Australia and America. At present, Austoft Ltd. is part of the CASE-International Harvester Group.

Austoft machines are very sturdy and comparably simple.

In the early 90s, Austoft welcomed the idea of adapting their harvesters to SRC. Mr. Henriksson played a major role in scouting the potential of Austoft sugar cane harvesters and in adapting them to SRC willow. He imported his machine from Australia in 1991, after visiting the factory and organizing a short SRC trial with eucalyptus saplings.

The Austoft 7700/240 Salix harvester is basically a standard sugar cane harvester, fitted with the optional swinging blade chopper and a modified cutting system.

Normally, sugar cane harvesters use a double-drum chopper to turn cane stems into 20-25 cm long billets. As the Swedish market required smaller chips, Austoft engineers decided to replace the double-drum chopper with the optional swinging blade. After slight modifications of the hydraulic circuit, this device was geared to produce 3-5 cm long chips.

The standard cutting device could have taken willow, but it would have badly damaged the stools. Therefore, it was modified to achieve a better cut quality.

Finally, Austoft removed the external crop gathereres, the topper and the leaf separator - all redundant when harvesting willow.

So far, this is the only Austoft harvester used in European SRC.

Considerations on the Austoft harvester

Mr.Henriksson has successfully operated his machine for 10 years, without any major complaints. At the time of my visit the engine meter showed 2590 hours. Considering that SRC harvesting gained momentum from the 1993-94 season onwards, this makes 2590 hours/8 seasons $\cong$ 320 hours/season.

During my visit I ran two time studies, confirming that the machine is still going strong. I recorded the same productivity levels that I had recorded during the 1994-95 season, under the same conditions.

The machine is also extremely mobile. The climate in Skåne is comparably mild, and one can seldom count on any frost to stabilize soft ground (abundant there). The tracked carriage of the Austoft allows it to travel on soft ground without any problems. Just to give readers an idea, I may mention that all the accompanying tractors used by Mr. Henriksson are equipped with wide tyres - and even so, they occasionally bog down and are rescued out by the Austoft. In fact, Mr. Henriksson has fitted all his tractors with *Trelleborg Twin* tyres. These are old-fashioned wide tyres, available in several sizes. *Trelleborg Twin* tyres are a cross-ply design - not a radial one - which makes them very stiff. Although they may be too stiff for many agricultural jobs, they are ideal for SRC as they never get punctured. Their main drawback is that they are very expensive.

Mr. Henriksson says that the only weakness of the Austoft is the comminuting device, which requires much maintenance. Blades have to be re-sharpened after producing app. 200 m^3 of chip - and to re-sharpen them one needs to take them out and use a portable honer. This problem again arises from the fact that the Austoft was designed to mount a double-drum chopper, and that the swinging blade is just a factory adaptation - but not the comminuting device the machine was built around.

Mr. Henriksson declared that if one kept the standard chopper, the machine would reach a higher productivity and it would use less fuel. These statements are compatible with engineering theory, as the specific chipping energy declines with increasing chip size.

Besides, the action of the double-drum chopper contributes to correct feeding, as the double drum actually pulls the stems into the machine. The swinging blade, on the contrary, applies a shearing force perpendicular to the feeding direction.

The Austoft harvester was born as a billeter, not as a chipper.

Austoft rates the 7000 series sugar cane harvesters to a theoretical maximum output of 90 tons of fresh sugar cane billets per hour.

Austoft offers several power units as optional, and one can ask for the installation of a more powerful engine than the 240 hp unit mounted as standard. This is important to know, if further analysis will prove that available power is the main limit to the increase of the harvester's productivity. Besides, using a larger power unit would reflect the trend already set by Claas - who are mounting their SRC headers on increasingly powerful foragers. Austoft have a similar expanding capability.

A drawback of the Austoft harvester is operator comfort. The cab is very basic, and operators who have tried Mr.Henriksson's new Claas prefer riding the German machine rather than the Australian. However, one must remember that we are comparing a 10-year old design with a new one: certainly the Austofts produced today are equipped with better cabs and seats.

The Austoft is also available in the wheeled version, either 2 WD or 4 WD - just like the Claas. The wheeled version is substantially lighter and cheaper than the tracked one. Both on the Austoft and on the Claas, the powered rear axle mainly provides assisted steering: weight distribution is such that the rear wheels can actually give "a little push" more than a decisive tractive effort.

Even in its wheeled configuration, the Austoft may have some advantage over the Claas. Indeed, the Austoft has a narrower hull, which would allow mounting wide tyres without extending too much the overall width of the machine. This means that mounting wide tyres on an Austoft does not require extending row spacing to 150 cm - as necessary when using a Claas. In other words, a wide-tyred Austoft can harvest the old plantations that a wide-tyred Claas cannot - and since old plantations with a 125 cm row spacing constitute most of the SRC surface available today, this makes all the difference.

Claas HS2

At the end of year 2000, Mr.Henriksson bought a new Claas harvester: a Jaguar 860 forager with HS2 header. He says the reason for buying the new harvester was not dissatisfaction with the old Austoft. It was rather the need to expand his business and maintain good relationships with the main fuel chip buyer - Agrobränsle. It seems that Agrobränsle have the virtual monopoly of the chip market in Sweden, and since they are also the Swedish Claas dealer, Mr. Henriksson thought it to be good policy to buy a Claas harvester instead of duplicating his Austoft.

At present, Mr. Henriksson doubts the wisdom of the decision.

He has operated the new harvester from December to mid-March, totalling 120 ha or 250 hours. During this time he has spent app. 120,000 SEK in repairs - i.e. 1000 SEK/ha! This contrasts with the <100 SEK/ha repair fee he has calculated for the Austoft. The new Claas has experienced one major breakdown every 8-10 hours of work and is now almost destroyed.

To make it worse, many of the broken parts are specially manufactured by Claas for their headers and are not readily available, but must be ordered from the Claas main depot. So, breakdowns can really disrupt the operation and generate a domino effect on a contractor's schedule.

Mr. Henriksson thinks that such bad record depends on the much larger size of the willows grown in Southern Sweden as compared with the size of those found further North. Individual stems are much larger in Skåne, and they are not as flexible. The new HS2 header was designed for Central Sweden, where stem size is not a problem - but snow is. The finger-rake crop collectors have great success in letting the snow drop, but they are not flexible enough to absorb heavy impacts. In Central Sweden the willows are small and flexible, and it is them who bend. In Southern Sweden, stems are too large to bend and the shock is transmitted through the fingers to the transmission that powers the crop collectors. Here, everything - chains, right angle drives and the bearings - has broken at least once.

I could observe the header in Mr. Henriksson's workshop and I partially disassembled it to analyze damage - which was clearly visible. The external crop-gathering augers also showed extensive damage. The butt lifter and the front feed rollers had been damaged, too.

Mr. Henriksson had tried to beef up the weakest parts, with the result that the damage moved upstream towards the prime mover. When I was there, we welded back the mount of the upper feed roller that is placed in front of the chopper - i.e. on the prime mover, beyond the connection face plate that is the boundary between the header and the carrier!

Limited capability to handle large stems may prove a serious handicap to the introduction of the HS2 header to SRC operations in Italy and in the US.

Mr. Henriksson blames this result to a large extent on the mechanical transmission. This has neither the elasticity nor the pressure-relief system characterizing hydraulic transmissions: if the strain is too high, something has to yield.

On the contrary, all the functions on the Austoft are hydraulically powered. Each feed roller has its own hydraulic motor. Concerns about overheating may be dispelled by the consideration that sugar cane harvesters are designed to operate in very hot climates and their hydraulic systems are designed accordingly. However, Mr. Henriksson says that the adapted swinging blade chopper - which turns faster than standard to produce smaller chips - may occasionally generate some excessive heat. The problem is very limited in Sweden, but it may not be further south. However, this problem could be solved with additional coolers. No overheating would ever occur if the machine was used as a billeter - as it was designed to be.

Claas HS1

Answering Mr. Henriksson's complaints, Claas decided to send him a second header for a test - this time a HS1 model, which is rightly considered more suitable to treating large stems. The header was a second-hand unit, coming from Denmark.

The machine arrived on Friday 16th, and we immediately proceeded to unload it. On Saturday 17th, Mr.Henriksson and I inspected the machine and started working on it, checking, adjusting and replacing missing parts.

This head definitely looks sturdier and heavier than the HS2. It is longer, which is bad for visibility but may help correct feeding and relieve some tension strain from the prime mover. Indeed, the old HS1 has two pairs of horizontal feed rollers instead of one as on the HS2. This arrangement forces the stems horizontal before passing them to the chopper feed rollers on the other side of the connection face plate. Lacking a pair of feed rollers, the HS2 transfers much tension strain to the upper chopper feed roller - and that may explain why we earlier had to weld back its broken mount.

Mr. Henriksson considers carrier damage a much worse evil than header damage, because the carrier has a much higher value - especially when sold back at the end of the depreciation period. Its conditions must be the best if one wants to get some money for it.

The HS1 header looks extremely complicated, as all moving parts receive power through a complex mechanical transmission - except for the saws. A main drive shaft exits the carrier on its left side, entering a conversion box inside the header. Two horizontal shafts depart from this box: one to the left and the other to the right. The one to the left powers a transmission chain that leads up to a right angle worm-and-pinion powering another transmission chain that moves the left vertical feed roller. The right shaft goes to a double sprocket powering two transmission chains going to the two upper horizontal feed rollers. This same right shaft crosses the head just above the throat and goes to other side of the header to supply power to the two lower horizontal feed rollers and the right vertical feed roller. The transmissions for these rollers are similar to those for the upper horizontal roller and the left roller.

Although complex, this transmission seems comparably trouble-free as I have not read of any major compaints against it in the reports published so far. Probably it requires much preventive maintenance. Ing. Weigelt at Claas declared that they used a mechanical transmission to limit power losses.

Mr. Henriksson still thinks that a mechanical transmission is too rigid for this kind of work and allows no relief to peak loads. In particular, when one needs to clear a feed jam by reversing the feed roller motion, this will be obtained through a mechanical reverse that may cause a major strain to the transmission - especially to the conversion box that channels all the power to the header.

In the early afternoon we finally mounted the head on the prime mover and drove to a new field for a test-run. The test lasted a good hour, until dusk, and it proceeded without any problem. We resumed work the following morning and eventually bogged down while trying to take trees on a wet spot. The header worked well, however - it was just the mobility of the prime mover that proved its limits.

Claas 800 chopper drums

V10 and V12 are not a new generation of German rockets, but the two chopper drum options offered for the Claas 800 series foragers. The two numbers describe how many knives are carried by each respective model. Since Claas SRC harvesters are used with half of the knives the choppers are designed to carry, a SRC V12 will mount 6 knives and a V10 only 5.

The 695 series foragers would only mount V12 choppers and produce a maximum chip size of 28 mm. An 800 series forager with a V10 chopper can produce a maximum chip size of 34 mm - a further step towards producing better chip. In fact, Claas SRC harvester users are only partially satisfied with the quality of the chip, which is deemed a bit too small for good storage.

Planter

I also visited a field planted by Mr. Henriksson with his Austoft sugar cane planter.

He had just tried transferring the sugar cane procedure to the willow - and with success, judging from the field.

The new planting procedure would consist in harvesting a seed stand with the Austoft harvester, adjusting the swinging blade to produce the longest possible billet size - 5-10 cm: these are the cuttings. They can even be discharged directly into the planter running alongside, if the two fields are near. The planter then drives to the field to be planted and can do its job at a very high speed - up to 10 km/h.

Dr. Kristensen in Upssala is studying this new system with promising results.

However, the planting trial carried out for ETSU in UK failed completely: Mr. Henriksson blames it on the very bad planting material he had received from a Danish nursery - also hired by the British for a comparative trial against him. Chivalry belonged to the middle ages.

The field I visited looked very good, and if this planting system can be known well enough to obtain reliable results, it may have great success. Indeed, it is much cheaper than any other planting system used so far with willow. A good idea would be to check with Dr. Khristensen.

The field I visited had been planted in single rows, 2 m apart. Mr. Henriksson prefers single rows because they leave more space for the wheels and are easier to harvest with an Austoft: one has a better central flow and more room to "center" zig-zagging rows.

The lower crop density resulting from the single-row system as compared to double-row system can be counteracted by decreasing the intra-row spacing - Mr. Henriksson says.