Forestry Commission Project Report 040 - Extended summary

Tractor Based Mechanised Harvesting in Sweet Chestnut Coppice

Summary

This study provided preliminary information on harvester working in sweet chestnut (*Castanea sativa*) coppice stands reflecting a common type of undermanaged woodlands in south east England, as an alternative to declining manual working. The mean diameter and number of stems were 8.2 cm and 4,333 per ha for the younger stand and 12.0 cm and 3,800 per ha for the older stand, coppiced 17 and 27 years respectively previously. Three products were cut from the stands; 4 m woodchip poles, 7 foot firewood logs and 1.5 m signposts.

A Valtra T160 tractor fitted with a roof-mounted crane and Keto 51 felling head was studied in neglected coppice stands. Volume yield was 202 m^3/ha for the younger stand and 305 m^3/ha for the older. Machine costs and outputs for the older and younger stands were 2.00 m^3/shr and £21.22/m^3, and 1.67 m^3/shr and £26.08/m^3 respectively.

The machine coped well with coppice working although a greater than normal number of chainsaw malfunctions were experienced due to the tendency for the densely packed stems to pinch the saw. The delays associated with this lead to suggest a conversion factor of cyclic to standard time[1] of 1.664 as opposed to the usual 1.416 factor used for grapple harvesters.

Machinery description and study method

The harvester studied was a Valtra T160 fitted with a Botex crane and Keto harvesting head, and bespoke guarding and hydraulic systems.

The Valtra T160 harvester conversion

Study data were collected using continuous sampling, over a duration of 2.5 to 3 hours of active working for each of the trial areas.

Product	Specification
Chip pole	4.0 m length, 18 cm max end diameter
Firewood	2.15 m length
Signpost	1.5 m length, 22.5 cm min top diameter

[1] This is a factor applied to observed cyclic time to account for non cyclic work (e.g. maintenance) and operator rest requirements

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Results

Area	Total basic time (hr)	Total standard time (shr)	Volume harvested (m^3)	Output (m^3/shr)	Hourly cost (£/h)	Cost (£/m^3)	Cost (£/t)
27 years old coppice	1.79	2.98	5.96	2.00	42.44	21.22	21.78
17 years old coppice	2.09	3.47	5.79	1.67	42.44	25.45	26.13

- The output of the machine of 1.67 m^3/shr to 2.00 m^3/shr is what might be expected for crops of such a small mean diameter and volume and difficult working conditions. The comparatively low unit cost of £21.78/m^3 to £26.138/m^3 reflects the low running cost of the Valtra of £42.44 per hour.
- Clearance of small stems required a large proportion of work time.
- Volume yield was close to that predicted by age and diameter regressions, suggesting the harvester is well capable of processing coppice material of small diameter and poor form, providing similar yields to motor manual working.
- The brittle nature of sweet chestnut meant that stems of <7 cm diameter tended to shatter during processing and so were routinely cut to waste, however these stems were also unlikely to yield a chipper pole so little commercial volume was wasted.
- The poor form of the sweet chestnut often required adjustment of the head during processing, splits leading from processing around bends and forks were relatively common in the smaller diameter chipper poles; however the majority of volume was generally maintained in the product and splits made no difference to the future processing of the poles.
- Bundles of small stems and cutting stems growing tightly against another caused a high number of chainsaw malfunctions including derailments and breakages, increasing the ratio of other work to cyclic work.

Conclusions and recommendations

- The relatively small size of the base machine makes it very manoeuvrable, capable of working around coppice stools without causing significant damage. Off-road capability is good, with good ground clearance and traction.
- The Keto 51 head was capable of dealing with the range of diameters and forms encountered in coppice working; its small size allowing it to manoeuvre around, and cut close into stools.
- It is recommended that the usual grapple harvester conversion factor of 1.416 from cyclic to standard time be increased to 1.664 to account for the high number of chainsaw malfunctions due to the nature of the crop.
- The risk of chainshot is also likely to be higher and harvesting site setup and management should reflect this.
- The power of the boom, capacity of the head and tipping witnessed when working at full extension, on cross slopes and with larger trees are likely to limit the tree sizes and terrain conditions where the harvester can operate safely and efficiently.
- Other suggested benefits of using a harvester compared to motor manual working are that a brash mat route is established in readiness for the forwarder, and that produce is presented in sorted drifts, potentially speeding loading.

Brash mat and produce left by the harvester

The work summarised here is part of an ongoing programme of research funded by the Forestry Commission aimed at improving the efficiency with which fuel is produced from sustainably managed forests in the UK. For further information on this project and related work:

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