

Forestry Commission Project Report 043 - Extended summary  
**Energy Forestry Operational Research in England**

## Summary

Work carried out by Technical Development during 2009-2011 on Short Rotation Forestry (SRF) establishment operations in England. Operational trials into SRF establishment were carried out at the Energy Forestry trial site at Carlshead Farm, North Yorkshire on: mechanised sub-soiling for ground preparation, pre-planting herbicide application and manual planting of *Eucalyptus nitens*.

Sub-soiling studies were carried out on previously ploughed and unploughed ground. Sub-soiling outputs of 0.340 ha/shr (£78.67 /ha) were achieved on unploughed ground and 0.668 ha/shr (£40.06 /ha) on ploughed ground. Manual herbicide application achieved an output of 0.215 ha/shr (£56.58 /ha). Planting output was 0.0648 ha/shr (£154.33 /ha).

## Operations description and study method

Subsoiling was carried out by a PTO driven TP rotary subsoiler with four oscillating tines pulled by a 160 hp John Deere 6920 tractor. Each tine on the subsoiler was preceded by a cutting wheel and the tine assembly was followed by a solid roller. The tractor PTO provided power to each tine causing them to oscillate as they moved through the soil. Ripping at 90 degree to a depth of c. 45 cm was prescribed to reduce soil compaction, maximise disruption of the lower soil horizons and integrate a waste paper layer within the soil to improve structure. Outputs were gathered using time study and fuel consumption was assessed by repeated dipping.

Before planting, the operational area at Carlshead Farm was given an overall herbicide spray with glyphosate to suppress ground vegetation using knapsack sprayers. The product rate use was 41 l/ha the concentration used 200 ml per 15 l tank. Outputs were gathered using rated activity sampling.

Planting was carried out manually by three operators using shoulder bags, planting spades and aligning rods to position planting rows perpendicular to the direction of the rotary subsoil rip. The target stock density was 2,500 plans per hectare. Outputs were gathered using rated activity sampling and stocking density was assessed using the Forestry Commission Operational Guidance Booklet 4.

TP Rotary Subsoiler



Positioning spraying marker posts



Planting in progress



## Observations

Rotary subsoiler:

- Soil lift during subsoiling was approximately 10 cm.
- Paper used for soil structure improvement was brought to the surface during subsoiling, leading to improved incorporation of the material through the soil profile.
- The tines' oscillating motion aided the passage of the tines through the soil; the operator commented that without the oscillation the 160 HP tractor would have provided insufficient force to pull the subsoiler.

## Spraying:

- Spraying was carried out manually in response to the need to quickly treat the vegetation on the site in the absence of available machinery.
- Operators followed the rip lines of the rotary subsoiler and referenced their position using marker posts, however, a follow-up site visit to Carlshead showed that the operators had sometimes veered off the line of their row, leading to a small proportion of the area not being treated. This has potential to increase localised weed competition with the SRF crop.

## Planting

- Planting was perpendicular to the subsoiler rip, requiring the use of aligning rods to maintain appropriate spacing.
- A return site visit was made six months after planting; during this period the trees had grown from c. 15 cm high to c. 45 cm. Some mortality and missing trees in the rows were observed, likely due to predation.
- A small number of plants had been blown over or snapped by the wind, due to considerable branch and foliar growth combined with site exposure. In response to stem snap some trees had re-shooted from their base, which is likely to lead to multi-stemmed trees which may cause issues for future access.

Areas missed by spraying



Healthy tree showing good growth



Snapped tree re-shooting



## Results

### Sub-soiling

	Hourly cost (£/h)	Output (ha/shr <sup>1</sup> )	Cost (£/ha)	Fuel use (l/ha)
Unploughed ground	26.78	0.340	78.67	43.3
Ploughed ground	26.78	0.668	40.06	21.6

### Spraying

Hourly cost (£/h)	Output (ha/operator shr <sup>1</sup> )	Cost (£/ha)
12.15	0.215	56.58

### Planting

Hourly cost (£/h)	Output (ha/operator shr <sup>1</sup> )	Cost (£/ha)
10.00	0.0648	154.33

Mean plant stocking density assessment (trees/ha)				
Total live trees	of which beat up trees	Total dead trees	Total trees	Empty planting positions
1,571	614	71	1,642	857

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<sup>1</sup> Outputs are shown per standard hour (shr) including allowances for rest and other work