July 1989 FRDA Memo No. 099

Synopsis

Topic Summary for the Operational Forester

Disc Trenchers and Cone Scarifiers

Introduction

Disc trenchers are versatile and efficient site preparation machines suitable for use on extensive areas of forest sites throughout British Columbia. Major benefits of trenching include soil warming, improved microsite selection for planting, and reduced planting costs. Increases in crop tree height growth ranging from 15 to 30%, compared to untreated sites, have been recorded over the first 10 years of plantation life.

This summary will help you decide if disc trenching is an appropriate treatment option for your site. Information on disc trenching techniques and equipment and guidelines for planting trenched sites have been included.

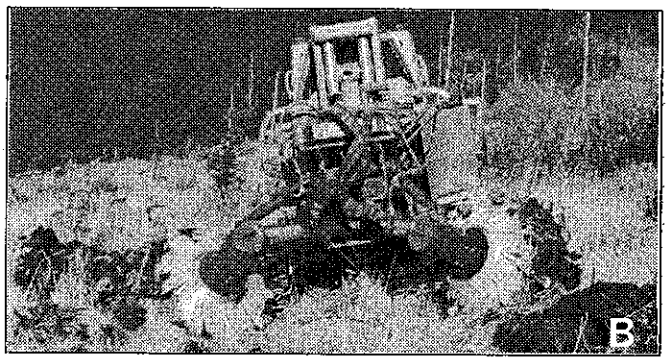
Types of Disc Trenchers

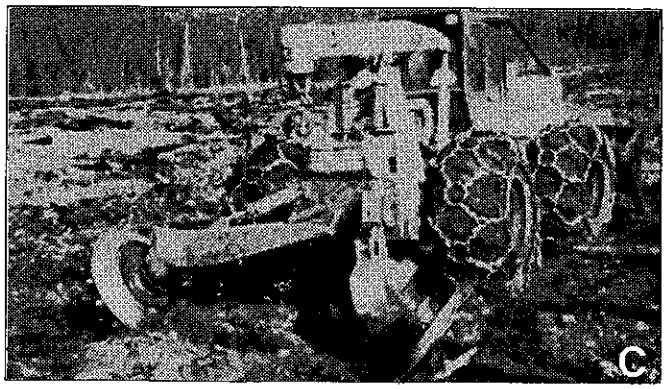
Three types of disc trenchers are available: passive trenchers, trenchers with hydraulic down pressure, and trenchers with powered discs or cones. Refer to *A Guide to the Use of Mechanical Site Preparation Equipment in North Central British Columbia*.

Passive disc trenchers (A) have spring-loaded, toothed discs that turn in the direction of travel and are activated by the forward motion of the prime mover. They are effective in low to moderate slash accumulations and forest floor layers of moderate depth.

Hydraulic down pressure disc trenchers have hydraulically activated arms that vary the down pressure on the passive discs. Each arm can work independently. The hydraulic arms allow automatic control while the trencher passes over obstacles, and easy cleaning of debris from the discs. Some machines also have the ability to create intermittent furrows, and to lift over patchy regeneration. They are effective in low to moderately heavy slash and duff layers.

Powered disc trenchers (B) and cone scarifiers (C) have hydraulically activated arms to vary down pressure on the discs and powered discs or cones. Powered disc trenchers have toothed disc's that are powered in the direction of travel. Powered discs improve slash and duff penetration and increase the amount of debris thrown away from the furrow. Powered cone scarifiers have powered, toothed cones that rotate opposite to the direction of travel. If used intermittently, they create small mixed mounds at the end of the trenches. Cone scarifiers are only effective on sites with light slash and thin forest floor layers.





FOREST RESOURCE DEVELOPMENT AGREEMENT

Canada BC

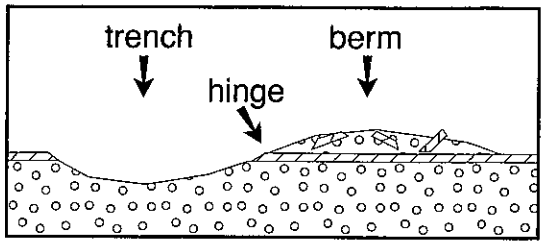
COMPARISON OF TRENCHERS

Equipment Type	Trencher Adjustments	Site Conditions: Slash Loading	Site Conditions: Forest Floor	Site Conditions: Soils and Terrain	Planting Spots
Passive Disc TTS35 CFE MM	– change weight of box – disc angles	– low to moderate	– can remove up to 15 cm	– slopes to 20%	– 1.8 – 3.0 m between discs – 10 – 15 cm depth of trench
Hydraulic Down Pressure TTS 35H M+M C7 TTS Delta	All machines – down pressure Some machines – disc angle – intermittent trenching – disc spacing	– low to moderately heavy	– can remove up to 20 cm	– slopes to 30%	– 1.4 – 3.0 m between discs – 15 – 20 cm depth of trench – better at making plantable berms
Powered Disc TTS Delta Donaren 180D Donaren 180L Donaren 280 Percheron H2M	All machines – down pressure Some machines – disc angle – intermittent trenching – disc spacing – disc speed	– low to moderately heavy	– can remove up to 25 cm	– slopes to 30%	– 1.4 – 3.0 m between discs – 15 – 20 cm depth of trench – better on large diameter slash – better root disturbance
Powered Cone Silva-Wadell CPFP	– down pressure – cone angle – intermittent trenching	– low	– can remove up to 15 cm	– best on SiL and coarser-textured soils – poor on wet sites – slopes to 30%	– flatter trench, less berm – possible to create small, mixed mounds – limited hinge or berm available for planting

Machine adjustments to obtain site objectives. To meet site preparation and planting spot requirements, the machine operator can alter the disc angle and change the down pressure, disc spacing, machine speed, and the spacing between passes.

Desired Results	Machine Adjustments	Comments
Increase slash penetration	• passive: increase weight of box • powered: increase down pressure of the arm • narrow disc angle • add a V rake or brush blade to the prime mover	• more slash removed, but in heavy slash disc may ride over the slash • effective in fine-matted slash with a wide angle. • use the blade intermittently, as skidders are not designed for pushing heavy loads
Increase mineral soil exposure	• reduce spacing between discs • run machine passes closer together • increase down pressure • narrow disc angle • widen disc angle	• requires good operator visibility and accessible terrain • increases soil penetration • on sites with thick forest floors more soil is removed from the trench • effective on sites with thin forest floor layers, on deep, fine-matted slash, and on heavy grass sod
Keep the berm close to the trench	• reduce machine travel speed to <2 km/hr • narrow disc angle	• better berm formed
Improve trench cleaning	• increase disc rotation speed • narrow disc angle	• more forest floor layer and debris removed • more soil removed
Increase machine ground contact	• reduce machine travel speed to <2 km/hr	
Change furrow depth and width	• increase down pressure • narrow disc angle • wide disc angle • moderate disc angle	• increases trench depth • deep, narrow trenches • wide, shallow trench • required for penetration on heavy soils

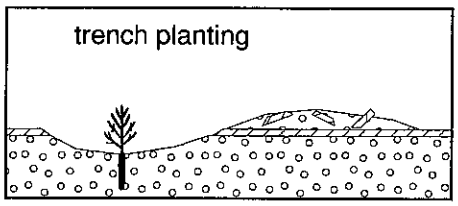
Planting Trenched Sites



Disc trenchers produce two parallel trenches with a sidecast of mixed materials. The continuous furrows provide easily recognizable planter access trails and ample opportunity for microsite selection, allowing higher productivity and reduced planting costs (savings of up to $0.08 per tree). Most trenching operations recoup half or more of the treatment costs through reduced planting costs.

There are three planting positions available: the trench, the hinge, and the berm. After disc trenching, an average 10-30% of the site is trench, 10-20% is hinge, 10-30% is berm, and 40-70% is undisturbed ground. Trenching produces good quality depressed and level planting spots in the trench and hinge positions. Poorer quality raised microsites with mixed soil layers are produced at the berm position. On most sites, the hinge position is favored. However, the choice of an appropriate planting spot depends on microsite conditions and the biological objectives of the planting site. Planting supervisors must ensure that planters know which planting position is appropriate for different site conditions within an opening.

Planting Position



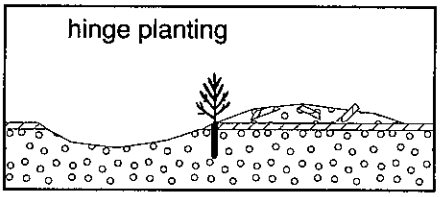
TRENCH

Advantages – increased soil temperature
– reduced vegetation competition
– increased soil moisture
– may reduce root collar weevil damage (*Hylobius* spp.)

Limitations – decreased initial nutrient availability
– seedling planted into denser soil
– can act as a catch basin for vegetation, smothering the seedlings
– flooding can occur on wet sites
– on fine-textured or compacted soils, it is hard for roots to penetrate, frost-heaving is increased, and aeration is reduced
– cattle and wildlife tend to follow the path of trench and trample seedlings

Sites – dry sites
– medium to coarse-textured, well-drained soils

Planting – in the centre of the trench
– can be difficult on rocky sites



HINGE

Advantages – increased soil temperature
– increased nutrient availability
– easy planting spot

Limitations – unstable planting spot if trench has steep side slopes
– seedling roots may grow assymetrically

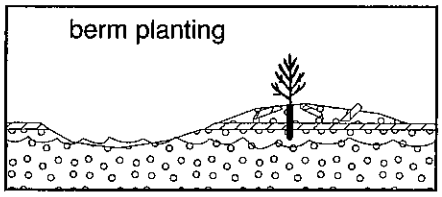
Sites – appropriate for most ± mesic sites

Planting – use the upper slope of the trench
– ensure the roots are covered
– use a foot screef to create a flat spot for planting

Comparing Planting Positions

Biological Objectives	Planting Position: Berm	Trench	Hinge
Providing plantable spots	▽	●	●
Increasing soil temperature	◆	◆	●
Competition control	▽	◆	◆
Improving soil aeration	●	×	▽
Improving soil drainage	●	×	◆
Increasing soil moisture availability	×	◆	▽
Improving nutrient availability	◆	×	◆

Most effective ..... ● Least effective ..... ▽
Moderately effective ..... ◆ Not appropriate ..... ×



BERM

Advantages – improved soil drainage
– increased soil temperature
– improved soil aeration
– reduced vegetation competition
– increased nutrient availability
– reduced frost-heaving

Limitations – often insufficient mineral soil capping, too much debris, or an unsuitable mixture of materials (<50% mineral soil)
– berm may consist of loose, not compacted material
– poor moisture retention
– more exposed microsite
– more difficult to find plantable spots

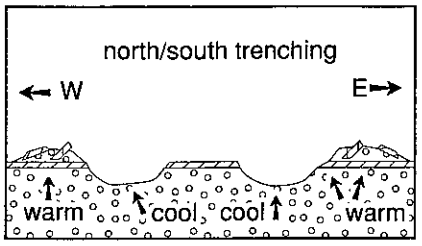
Sites – wet sites (high water table)

Planting – ensure the berm is composed of acceptable material (>50% mineral soil preferred or well decomposed organic horizons)
– plant seedling roots through to the underlying mineral soil to ensure moisture is available

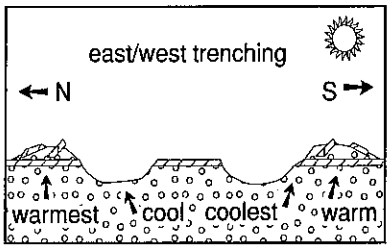
Trench Orientation

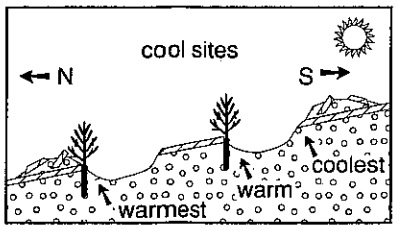
Because the sun lies in the southern half of the sky, the direction in which trenches are oriented can have an effect on microsite conditions.

North/south trenches create consistent biological conditions with minimum shading.

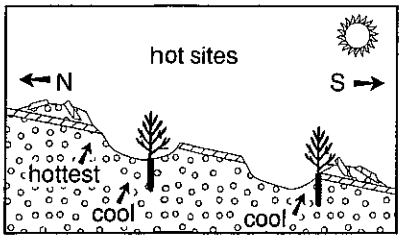


Within **east/west trenches**, the south-facing hinge is the warmest position, while the trenches shaded by a southern berm are the coolest.





On cool sites where soil warming is desired, trenches should be oriented in a north/south pattern. Where east/west trenches are unavoidable (e.g., on steeper, north-facing slopes), planters should select south- or southwest-facing microsites if possible.



On hot, dry sites, where lack of soil moisture and high temperatures may harm seedlings, east/west-oriented trenches are preferred, and planters should select cool positions if possible.

Scarification Pattern

The pattern of the passes of the prime mover is restricted by the terrain and previous site preparation methods. On broken terrain, blocks must be treated in sub-units. On slopes up to 30%, trenches can be contoured with the slope. With contouring on steeper slopes, it is difficult to maintain uniform spacing between passes since the tendency is to go down when going around obstacles. Ponding in contoured trenches may occur, though usually the trenches have enough interruptions so that drainage effects are not large. Erosion potential is higher if perpendicular passes are used on steep slopes. Perpendicular passes should be limited to coarse-textured soils and combined with intermittent trenching to reduce site degradation.

SITE CONDITIONS

SUITABLE SITE CONDITIONS FOR DISC TRENCHING	UNSUITABLE SITE CONDITIONS FOR DISC TRENCHING
WEATHER	**WEATHER**
– May to October in the Interior; April to December on the coast	
– unfrozen soil with no snow cover preferred	
– lightly frozen soil (<5 cm depth acceptable)	– frozen soil (>15 cm in depth)
– snow-covered sites (<15 cm)	– snow-covered sites (>15 cm)
TERRAIN	**TERRAIN**
– perpendicular passes across the contours up to 40% slope (with low slash loads and coarse-textured soils)	– over 40% slope (less if high slash loading, fine-textured or moist soils are present)
– along the contour up to 30% slope	– rugged terrain with a high density of surface obstacles
– deep soils; site and machine damage may occur if soil depth is 30 cm or less	– shallow soils with an erosion risk and low site stability
SLASH/STUMPS	**SLASH/STUMPS**
– passive disc trenchers will work in light to moderate slash conditions	
– powered disc trencher will work in moderately heavy slash conditions	
– patchy fine slash: passive disc trencher; <20 cm depth; <60% coverage	– continuous fine slash > 60 cm depth
– continuous, matted, fine slash: powered disc trencher; <50 cm depth; <80% coverage	
– older, partially decomposed slash	– accumulations of large diameter and long slash
– slash can be reduced using a front-mounted V blade; effective on 1.5 m high piles of large slash	
– stumps <50 cm tall, up to 1100 sph	– stumps >75 cm more than 1100 sph
– a few large diameter or tall stumps are easy to manoeuvre around and beneficial in arresting slash	– very dense small diameter stumps
SOIL TEXTURE	**SOIL TEXTURE**
– best on coarse to moderately fine-textured soils (SiL)	– very poor in heavy clays
– sites with <50% stones and gravels; rockier soils result in more wear on the machine	– sites with >80% stones and gravel
SOIL MOISTURE	**SOIL MOISTURE**
– best on moist to dry sites	– limited by the prime mover on wet sites
ORGANIC LAYERS	**ORGANIC LAYERS**
– passive trenchers are effective to 15 cm depth; powered trenchers are effective to 20 cm depth	– >25 cm results in no mineral soil exposure and an organic berm
– deep organic layers can be reduced using a front-mounted V blade or brush blade	
– more effective on loose forest floor (mormoder)	– reduced penetration on matted forest floor (mor)
VEGETATION	**VEGETATION**
– effective on moderately brushy sites	– heavy brush sites
– effective on grassy sites (sod depths to 20 cm)	
– effective in 5000 sph hardwood regeneration	– very dense aspen stems (>10 000 sph)
– can manoeuvre around standing mature residuals to 150 sph	– mature residuals >150 sph

Alternatives to Trenching

On some sites, different site preparation methods may be more appropriate:

- Patch scarifiers operate more effectively on terrain with high surface obstacles (e.g., stumps, boulders), but are poor when they encounter slash.
- Mounding on wet sites with heavy slash and windrowing on other heavy slash sites are more effective.
- On thin humus or on sites where natural pine regeneration is possible, drag scarification is more effective.
- On high slash sites with large stumps, broadcast burning is preferable.
- On steep slopes (>40%), consider broadcast burning or planting without site preparation.
- On heavy brush sites, brush blades are required to reduce vegetation.
- V blades are more effective on sites with moderate to heavy slash and deep duff.
- Mounding or plowing is more effective on very cold or very wet sites, as trenches produce smaller increases in soil temperature and microsite drainage.

For More Information

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Queen's Printer for British Columbia©
Victoria, 1990

MR-1939