SITE PREPARATION METHODS

Mixing
Appropriately executed mixing can control competing vegetation, increase soil temperature and aeration, decrease soil bulk density, improve soil water relations, and retain nutrients stored in surface organic layers immediately available to crop seedlings. However, inadequate mixing can stimulate competing vegetation and introduce air pockets.

Coarse Mixing
Coarse mixing is accomplished using large discing implements that heap clods of surface organic and mineral soil layers into a bed. Coarse mixing provides little control of competing vegetation, but is beneficial where low soil temperatures and/or high soil water tables inhibit seedling growth.

On sites with high competing vegetation potential, coarse mixing must be followed by planned brushing treatments.

Eden Bedding Plow
SITE PREPARATION METHODS

Mixing

Fine Mixing

Fine mixing is used on sites with high competing vegetation potential, where high rotovation speed is required to chop propagating plant parts small enough to control resprouting. Fine mixing requires slow travel speeds to allow sufficient time to chop up the soil and vegetation.

Fine mixing is suitable on fine-textured soils, with few cobbles or boulders. It is unsuitable on sites with the following conditions:

- Stony or bouldery soils.
- Coarse-textured soils with a thin humus layer.
- Wet sites (unless they can be subsequently bedded or mounded).

Fine mixing will result in shrubby vegetation complexes, such as willow or aspen, being replaced by herbaceous vegetation and grass. This shift in vegetation complex may not be desirable on certain ecosystems.

Spot Mixing

Spot mixing is prescribed for sites where mixing is biologically appropriate, but where slash, stumps or other obstacles prohibit use of strip mixing implements. Spot mixing is also used on sites where minimal soil disturbance is required.

Spot mixing implements are usually mounted on excavators, as excavators are able to work on a wide range of sites.
SITE PREPARATION METHODS

Ripping - Plowing

Ripper plows are essentially modified standard ripper teeth, on the back of a crawler tractor, and were specifically designed for treating wet ground when it is frozen. The most common plow design is a double mouldboard type with replaceable cutting edges, which attaches to the ripper shank of the crawler tractor. The ripper tooth digs into the soil, while the plow attachment displaces soil on either side.

**Wet sites — prepared in the winter when frozen**

The ripper plow is recommended for the following conditions:
- Wet spruce sites with thick duff layers.
- Muskeg sites (with deep organic soils) that must be planted and cannot be burned.

The ripper plow is not suited for the following conditions:
- Broken or rugged terrain.
- Slopes >25%.
- Dry sites with thin humus layers.
- Unfrozen ground.

Seedlings are planted on acceptable, raised microsites. However, a clearly defined berm is not always produced (depending upon snow conditions during treatment). Plowing does not control competing vegetation such as grass. The deep furrow associated with this treatment can cause asymmetric root systems, as roots will not cross the dense, often wet, fine-textured soils at the bottom of the furrow.

**Dry sites**

Smaller, two-row ripper plows were designed to create planting furrows on dry sites in the Southern Interior of the Province. Seedlings are planted in the bottom of the furrow and benefit from some degree of frost protection due to reradiation of heat from the soil at nighttime, less winter damage and increased moisture availability. However, seedlings are prone to trampling damage as cattle will travel down plowed furrows. Plowing too deep (i.e., down to unfavourable substrates) will result in poor seedling performance.

*Sanders-Araki Plow for use on dry interior sites.*
SITE PREPARATION METHODS

Marttiini Plowing (Northern Alberta*)

This technique is used to create elevated planting sites on heavy clay soils subjected to periodic high water table conditions. The Terrace models of Marttiini plows (KLM-190, KLM-240, A-200) create continuous berms, 50-60 cm in depth, on either side of a flat profile. The heavy clay cap is necessary to compress thick organic horizons to eliminate air pockets and potential drought conditions. A central depression, lower than the planting site, is also created which protects seedling roots from periodic flooding. **Shallow plowing is recommended at all times.**

Marttiini plowing effectively controls vegetation, retains nutrients, increases soil temperatures, and creates more favourable soil moisture conditions. **Marttiini plows are not effective drainage implements** as ditch slope continuity cannot be maintained.

Marttiini plowing is recommended on boreal forest sites with the following conditions:
- Thick organic horizon.
- Heavy clay content in the soil.
- Soils rich in nutrients.

Marttiini plowing is not recommended on sites with the following conditions:
- Nutrient-poor soils.
- Poorly formed or immature soils.
- Coarse-textured soils.
- Well-drained soils.

Erosion from downhill plowing can be eliminated by leaving unscarified breaks.

**Planting**

On moist, wet sites, seedlings should be planted on the flat terraces abruptly against the berm. On very wet or high water table sites, seedlings should be planted directly on the berm. **Side slope planting is not recommended.** At least one summer or winter of settling should be allowed prior to planting.

**Deep planting is recommended to avoid potential frost heaving.**

*Information provided by Dave Patterson, Alberta Forest Service, Reforestation Branch*
CHOOSING THE SITE PREPARATION METHOD

Planning
The site preparation method should be considered as part of the logging planning.

Matching the Method to the Site
Specific prescriptions similar to the general example given below should be developed for your operating areas.

<table>
<thead>
<tr>
<th>Method</th>
<th>Coarse to medium-textured soils</th>
<th>Fine-textured soils</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Slash/Obstacles: Heavy</td>
<td>Light</td>
</tr>
<tr>
<td></td>
<td>Humus Layer: Thick</td>
<td>Thin</td>
</tr>
</tbody>
</table>

- **Spot scalping**
  - Dry site
  - Medium site
  - Wet site

- **Disc trenching**
  - Dry site
  - Medium site
  - Wet site

- **Mounding**
  - Dry site
  - Medium site
  - Wet site

- **Coarse mixing**
  - Dry site
  - Medium site
  - Wet site

- **Fine mixing**
  - Dry site
  - Medium site
  - Wet site

* Recommended method  Recommended method  Recommended method  Recommended method
* Acceptable method  Acceptable method  Acceptable method  Acceptable method
* Unsuitable method  Unsuitable method  Unsuitable method  Unsuitable method
* Not applicable  Not applicable  Not applicable  Not applicable

* Strip mixing equipment is limited by heavy slash. Mixing with an excavator is acceptable on these heavy slash sites. On sites subject to frost heaving, always plant on turned humus soil.
SPACING

Plantable Spots

When determining the number of spots to be created for an area, the appropriate regional stocking standards should be considered. Regional stocking standards are based on correlated ecosystem descriptions, knowledge of moisture and nutrient regimes, and site capabilities. Target and minimum stocking standards are reduced for extremely dry and wet ecosystems to reflect site specific carrying capacities. An example of free growing stocking standard guidelines is given below.

**ESSFd (ESSFxc) – Kamloops Forest Region**

<table>
<thead>
<tr>
<th>Ecosystem Association /Site Series</th>
<th>Free Growing Stocking Standards (well spaced/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Target</td>
</tr>
<tr>
<td></td>
<td>1200</td>
</tr>
<tr>
<td>01 Bl-Grouseberry-Valerian</td>
<td>600</td>
</tr>
<tr>
<td>02 Pl-Juniper-Lupine</td>
<td>1000</td>
</tr>
<tr>
<td>05 Bl-Grouseberry-Cladonia</td>
<td>1000</td>
</tr>
<tr>
<td>08 Bl-Horsetail-Glowmoss</td>
<td></td>
</tr>
<tr>
<td>09 Bl-Bluejoint-Sedge</td>
<td></td>
</tr>
</tbody>
</table>

Stocking standards do not establish planting levels directly; rather, they set the standard for the number of well spaced trees required at free growing. A free growing plantation must be at least 5 years old. “Free growing trees” are healthy, undamaged, and free of above-ground competing vegetation. When determining the actual number of plantable spots required on a site, plantation mortality and “fill in” by naturals must be considered. Stocking standards may also be modified on a site specific basis to accommodate integrated resource management or other issues.

Once the required number of planting spots has been determined, the need for creating or improving microsites by site preparation must be established. Some sites have a sufficient number of acceptable planting spots available without site preparation, while other sites require site preparation to create the required number of acceptable planting spots.

**Before site preparation begins, the acceptable planting spot or microsite to be created must be clearly defined.** Contract spacing will be determined by the number of microsites that must be created.

### Plantable Spots

<table>
<thead>
<tr>
<th>Density (spots/hectare)</th>
<th>Contract Spacing (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td>3.1</td>
</tr>
<tr>
<td>1400</td>
<td>2.9</td>
</tr>
<tr>
<td>1600</td>
<td>2.7</td>
</tr>
<tr>
<td>1800</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Contract spacing is the specified normal distance between prepared microsites. A minimum contract spacing (i.e., the minimum allowable distance between prepared spots) will also be specified. Minimum spacing must be consistent with the minimum spacing specified in the pre-harvest silvicultural prescription. Occasional reductions in spacing must be offset with increases elsewhere to maintain the correct density.
SPACING

Plantable Spots

Row site preparation
(e.g., disc trenching, Bräcke patch)

Fixed settings on certain types of equipment or difficult site conditions may make uniform spacing impossible. Under such conditions, the total number of prepared planting spots may still be created if “in-row spacing” is reduced to compensate for wider spacing between rows. However, “in-row spacing” must never be closer than the minimum contract spacing and the distance between trenches should not be greater than twice the row spacing.

The number of rows per 100 metres depends on the distance between acceptable planting spots within the row.

<table>
<thead>
<tr>
<th>&quot;In-row Contract Spacing” (metres)</th>
<th>Number of Planting Spots/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>1.9</td>
<td>19</td>
</tr>
<tr>
<td>2.1</td>
<td>21</td>
</tr>
<tr>
<td>2.5</td>
<td>25</td>
</tr>
<tr>
<td>2.7</td>
<td>27</td>
</tr>
<tr>
<td>3.0</td>
<td>30</td>
</tr>
</tbody>
</table>

Disc trenching

With disc trenching, the desired contract spacing within a row can generally be attained. The number of rows required to attain the appropriate density can then be read in the table.

Spot scarification and mounding

The following is an example of how the table is used when setting the adjustments of the spot scarifier mounder.

- The desired number of planting spots is 1400/ha.
- The scarifier is set at 2.1 m.
- The table reads 29 rows per 100 m.
- After a few passes, the number of acceptable planting spots is recorded at 80%.
- The correct number of rows per 100 m is then 29 divided by 0.80 = 36 rows per 100 m.
MATCHING THE SITE PREPARATION METHOD TO THE SITE

Over a small geographic area (even within one cutover) conditions may vary (e.g., moisture, soil type, slash loading, humus depth, and other factors). To obtain the best result, the site preparation method must be matched to these conditions.

Practical Application

First, the equipment operator must be aware of the opportunities of using a site preparation machine in more than one way. For example, an excavator can scalp as well as mound.

It is essential that the operator knows the objectives of the different site preparation methods to be used, and has been trained to recognize where to apply the different methods.

In some cases the area of differing conditions may be large enough to consider using an additional machine.

Seed tree system
Disc trench for naturals

Dry to medium site
Disc trench

Productive wet area
Ditch and mound
MATCHING THE SITE PREPARATION METHOD TO THE SITE

Cost Considerations

The cost of a more expensive site preparation method, or of using several methods on the same cutover, must be weighed against the risk that the planting may fail on parts of the cutover, resulting in expensive replanting. It is cost effective to spend more to avoid failures. However, to switch from an acceptable to a better site preparation method may not be cost effective.

Site prepare only those parts of a cutover where the machine being used will give an acceptable result.

Areas with acceptable natural regeneration should never be site prepared unless specified by the project supervisor.
Follow up is the responsibility of both the operator and area supervisor. In order for the operator and his supervisor to agree on the quality standard of the site preparation, there must be good communication between the two. This requires both parties to put in sample plots. The first check should be done after about five minutes of work on a cutover. Thereafter, the quality of work should be spot sampled as required throughout the day. New checks should always be carried out when the conditions are changing on the cutover.

Sampling Method

In British Columbia, where mechanical site preparation is used to create microsites for planting, a 50 m² (1/200 ha—3.99 m radius) plot is usually used to assess treatment quality. Where planting densities are to be below 900 trees/ha, plots of 100 m² (1/100 ha—5.64 m radius) are allowed. For samples to be statistically accurate, a sample of one 50 m² plot/ha is usually sufficient for larger units. The number of plots on any one payment unit must never be less than 20. The circular plot is particularly applicable for work that tends to be more random; for example, work with an excavator. Using the circular plot, the operator lays out a random circular sample plot with a 3.99 m radius and records the number of acceptable planting spots within the circle. The average number of planting spots from several plots multiplied by 200 gives the average number per hectare. (Where the larger 5.64 m radius plot is used, the average number of planting spots from several plots should be multiplied by 100.)

Where the site preparation method is less random in nature (for example, relatively uniform rows) a quick check may be used by the operator to ensure that contract spacing is being maintained.

Spot Scarification and Mounding

Record the number of rows per 100 metres. Next, select one row by random; for example, the last one on the 100 metre stretch. On this row, check the number of spot-making attempts for 30 metres and the number of attempts that resulted in acceptable planting spots.

Disc Trenching and Plowing

Record the number of trenches per 100 metres. Next, check the number of acceptable planting spots along 30 metres of trench. The standard contract spacing should be used to assess plantable spots. A spot is not acceptable if it is closer than the minimum contract spacing.
OPERATIONAL CONSIDERATIONS

Treatment Patterns

Concentric pattern
This pattern is used when you want to minimize time spent turning, or when turning is difficult; for example, drag scarification. The operator begins along the outer edge of the cutover and continues to go around and around until the whole area is treated.

Back-and-forth pattern
Use this pattern when other considerations, such as planter access or aspect, take priority over productivity. The operator begins at one end of the cutover and drives back and forth in parallel runs, usually perpendicular to the road. The runs should be longer than 150 m to keep the turning time in proportion with the total time spent working.

Fire Safety

During dry periods, sparks can fly from the prime mover, or implement, and ignite ground vegetation or logging debris. Site preparation operations should be equipped with the following safety equipment:

- Two-way radio or mobile telephone.
- Two hand-held fire extinguishers (chemical).
- Light water pump extinguisher.
- Axe and spade.
- Other firefighting equipment specified by the B.C. Ministry of Forests.

Welding, cutting, and metal grinding should not be carried out in the cutover.

During periods of high fire hazard, personnel with firefighting equipment should be posted to watch over the workplace after treatment has ended, or repair work completed.

Complete directions for firefighting must be supplied by the supervisory staff.
OPERATIONAL CONSIDERATIONS

Operating in steep terrain
For safety reasons, equipment should not be operated on areas beyond the safe slope capacity of the prime mover. The maximum slope that can be safely traversed will decrease with increasing stump height, slash loading or ground roughness. Extra caution must be exercised on slopes, resulting in reduced productivity. Ground workers must not work below equipment on slopes.

Wheeled skidders
Travelling parallel to the contour on slopes greater than 15% should not be attempted. Slopes up to 25% may be treated downhill, but only with spot scarification or intermittent disc trenching. Six- or eight-wheel forwarders may treat slightly steeper slopes. Wide tires provide better stability on side slopes but are prone to slipping on wet slash.

Crawler tractors
Travelling parallel to the contour should only be attempted on slopes up to 35%. This can vary depending upon equipment size and type. Soft-track FMC’s may treat slopes up to 40%. Slopes up to 45% may be treated downhill, but again only with spot scarification or intermittent disc trenching.

Excavators
Excavators can treat slopes up to 50%. Short slopes > 50% may also be treated depending upon boom reach or skid trail access.
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