Reforestation Basics

Reforestation

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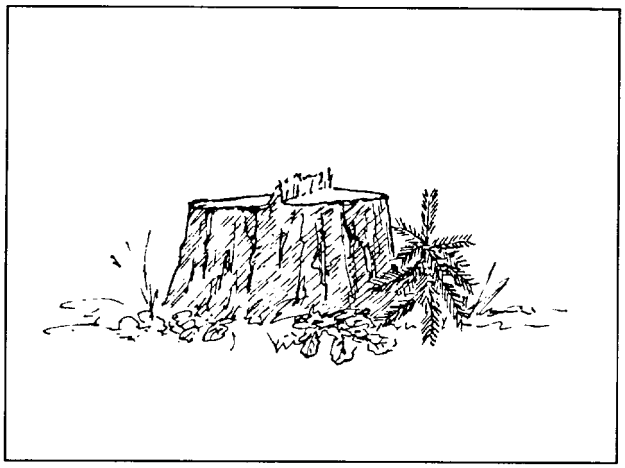
Introduction

Reforestation is the process of renewal during which a new stand of trees is regenerated on a forest site following a disturbance such as fire, windthrow, disease mortality or logging. Reforestation is an ongoing activity in a managed woodland following harvesting, and requires knowledge of the forest site, the species involved, risks and constraints and the establishment techniques available. Reforestation also requires advance planning, as well as follow-up monitoring and tending to be successful.



Afforestation is similar to reforestation but involves establishing trees on sites that have previously been used for other purposes such as farm fields, old pasture lands, or lands that have been degraded in the past or subject to natural soil disturbing processes such as landslides, floods or glacial activity.

There are a number of ways to approach reforestation.

1. You can let nature handle it (natural regeneration)
2. You can assist nature (seed tree selection, site preparation)
3. You can shortcut nature (artificial regeneration)
4. You can carry out a combination of the above methods.

The method you choose will depend on a number of things, including:

- your management goals
- the presence of a seed source
- the site capability and characteristics
- your ability to finance reforestation
- the time period in which you want to establish a new crop.

Site Assessment and Species Selection

The first steps in the reforestation process are site assessment and species selection.

Site Assessment

Reforestation strategies are determined on the basis of an ecological and silvicultural assessment of the site (called the silviculture prescription), which is normally carried out prior to harvesting. Site assessment looks at the physical and productive characteristics of the site including soil characteristics, drainage and moisture regime, and nutrient status and capability. The site assessment also looks at what species are currently growing on site as well as at any potential constraints to reforestation including brush hazard, forest health issues and wildlife concerns.

Handbooks that detail the procedures of site diagnosis, species selection and site preparation have been developed for most of the forest regions of the province, and are available for reference at local offices of the Ministry of Forests. A discussion with a forester is also strongly recommended to help formulate your reforestation strategy.

Species Selection

Species selection for reforestation will depend on your personal goals as well as on the moisture and nutrient capability of your site, the silvics (shade tolerance, growth rates, elevation range, site preferences) of the species involved, and by what is currently growing on site. Species selection guidelines for the full range of different site types and regional locations in the province are available through the Ministry of Forests, your local forest consultants, or your Woodlot Association.

The species you grow will be influenced, in part, by the stage at which you begin to manage your woodland property. Where the woodland is forested, you may decide to regenerate the area naturally, with species of the current stand. Or, you may decide to replace the crop, by planting with a species more suited to your personal goals.

Where you have inherited an area that is ‘tree-free,’ as pasture or as cleared land after harvesting or fire, the selection of tree species will be based on a number of factors, including the characteristics of the planting site, such as exposure, soil type, elevation and slope.

A quick survey of any stumps on-site, as well as the mature forest in neighbouring stands, will give you an idea of the species that have been nature’s choice for the area. Keep in mind, however, that the forces that cleared this site may have effectively pushed it to an earlier successional stage than that of neighbouring stands. For instance if your site formerly supported a very old climax stand of slow growing shade tolerant species, and was subsequently burned or site prepared, it may be apprpriate (and desirable) to replace the climax species with faster growing pioneer species, even if this species is not represented in the surrounding forest area.

Once the species suited to the area have been identified, you must consider your intermediate and end-product goals. Are the trees being produced for wildlife habitat? Soil stability and conservation? Streambank improvement? Windbreaks? Fuelwood? Sawlogs? Christmas trees? Is a mixture of species desired, such as hardwoods for annual

firewood harvest and softwoods for long-term investment? When these questions have been answered and the ideal species have been selected, the next decision is how to introduce them to the site.

Natural Regeneration

As openings appear in the forest, they are quickly filled with new growth that seeds in from other plants in the area. This new growth will include a variety of species of small plants, shrubs and trees adapted to the site.

In a managed forest, the openings are created with the next crop in mind. The silvicultural system includes a reforestation strategy to prepare the site for the species you select. For instance, you can influence natural regeneration by removing all trees except those of the preferred species, or enhance seedling establishment by preparing a seedbed.

All the silvicultural systems can be used to obtain natural regeneration. Your choice of a system will be influenced mainly by the species you wish to regenerate. For instance, if you wish to regenerate a shade tolerant species, you may require a shelterwood, seedtree or selection system to produce the desired results. Conversely, if you wish to regenerate shade intolerant species, then a clearcut or patch cut may be required.

Your choice of species will likely be a trade-off between what you can get for 'free' as natural regeneration, and how well it will serve your goals, versus the benefits you would expect from a crop that costs you something to plant. Natural regeneration will likely be the most cost-effective means of reforesting a small-scale woodland property, especially in cases where you are able to undertake any follow-up stand tending yourself.

The success of natural regeneration relies heavily on an abundance of seed, so it is a good idea to monitor the cone crops of your seed sources. When the new crop is unevenly distributed throughout the area, it can be supplemented with the transplanting of wildlings (natural stock from other areas on the woodland) or nursery stock. Most tree species will regenerate naturally depending upon site conditions and seed source. If your natural regeneration is too successful, you actually have to reduce the density of trees through spacing.

The major consideration is often related to how long you are willing to wait for the next crop. It is a gamble: on one hand, natural regeneration is 'free,' the seedlings are genetically well adapted to the site, and there is no transplant shock. On the other hand, if you have a particularly rich site with the potential for a heavy brush competition, you may have to undertake expensive brushing and weeding treatments to release the natural seedlings two or three years post-harvesting. If you plant immediately after logging, the trees have some time to thrive before the brush recovers.

Increasing Natural Seed Production

There are methods by which a woodland owner can enhance the natural production of seed as well as timing the seed production to coincide with harvesting operations. There are several considerations in choosing possible parent trees:

- Are there trees of the desired species for regeneration within or adjacent to the block?
- Are they healthy and with desirable form?

- Are they upwind from the block?
- Are they windfirm and not on shallow soils or rock outcroppings?

It is important to know a bit about how trees produce seed. We will use Douglas-fir as an example. In early spring in year one, the tree is forming buds at various locations in the crown. There is a process called 'differentiation,' wherein the buds determine whether to become vegetative (needles) or sexual (male and female structures or cones). This choice to produce a majority of sexual buds can be influenced by the woodland manager by stressing the tree.

A common reaction of many plants to stress is to allocate maximum resources to reproduction. In conifers, if you make a thin kerf cut, like with a sharp lino knife, through the bark severing the cambium, the tree treats this as a fatal wound and forms many sexual buds. Once this decision is made by the tree, there is no turning back. The tree believes it is dying, and makes cone or flower buds. However, this thin cut soon heals over and nutrients and water are once more moving throughout the tree. The tree now has many flower buds which receive full nutrition. Over the summer of year one, the buds rest dormant. In the spring of year two, the flowers and pollen structures emerge and form cones which will release seed in the late summer of year two, eighteen months more or less, since your first knife cut.

There are other methods to enhance seed set. Root pruning by machine can also stress the tree to produce more seeds, but it may be inadvisable as it can compromise tree stability, and is impractical in the natural forest setting.

Preparing the Seedbed

Site preparation is carried out to ready the soil to receive seeds or seedlings, reduce fire hazard, and control pests or diseases. This may involve clearing, burning, or breaking up slash or windfall which create obstacles to natural seed in or planting. Removing competing vegetation, or exposing mineral soil creates a favourable seedbed.

The decision as to the appropriate site preparation method depends on the site conditions, silvicultural system, and management objectives for the area. The costs of site preparation must be weighed against the potential delay in regeneration if no preparation is done. Where natural regeneration is being relied upon, seeding-in may be spotty and seed germination may be poor on sites without advance seedbed preparation. On areas scheduled for planting, consideration must be given to the number and distribution of plantable spots, as well as the factors (such as slash) that will affect planting productivity.

The timing and method of site preparation is planned in coordination with the selection of regeneration method. Where natural regeneration is being encouraged, harvesting and site preparation should be done, if possible, to coincide with a good seed year of the favoured species. Planted stock performance can also be enhanced by the removal of competing vegetation. In general, site preparation is carried out in the late summer or fall of the year before planting.

Mechanical Site Preparation

Sites are usually mechanically prepared by piling slash, mixing, mounding or scalping the forest floor. The choice of treatment depends on the needs of the species you wish to regenerate as well as site, climate and cost considerations. These activities are carried out

manually with hand tools, mechanically with heavy equipment, or by the use of chemicals or prescribed burning.

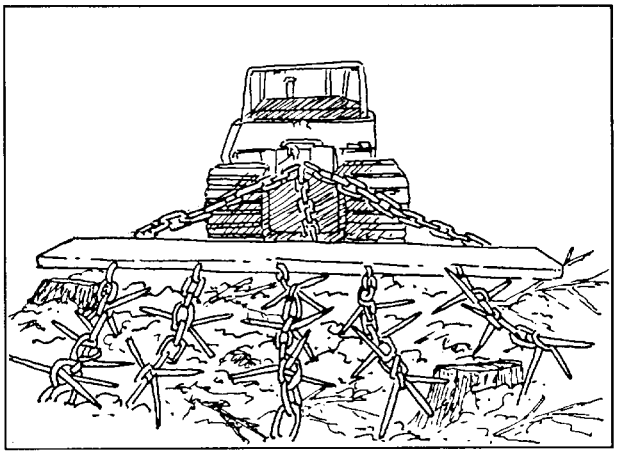
Specialized equipment has been developed for site preparation on large timber production areas. For the small-scale woodland owner, it is also possible to move slash and expose mineral soil by fitting special blades or chains to tractors or skidders.

A hoe (excavator) is an excellent site preparation tool. Fitted with a rake and a thumb, a hoe can treat large areas with less ground compaction than a wheeled machine due to the reach of the arm. Given adequate hydraulic capacity, a hoe can be fitted with a 'brush hog' (heavy-duty mower) to grind the slash and stumps into mulch. Such a treatment often reduces the re-sprouting of some brush or undesired hardwood species such as alder or poplars. A hoe can also pile slash at the edge of a reforestation block where it can decompose, providing a 'compost pile' which slowly releases nutrients and conserves moisture.

Scarification

Drag scarification, a process which scrapes off the surface of the site to expose mineral soil, can be achieved by dragging heavy chains or drums behind a tractor or skidder This technique is commonly used to promote natural pine regeneration in the interior of BC. Dragging aligns and crushes slash, exposes mineral soil and brings cones close to the ground where they release their seeds onto the freshly prepared seedbed.

Drag scarification units, whether commercially produced or 'home-built' are somewhat cumbersome and best suited to large, relatively *flat* areas with low stumps and light slash. More maneuverable equipment, such as disc trenchers, can be used to prepare a mineral soil seedbed in partially cut stands. Other machines use blade attachments to move slash and loosen top soil. This type of scarification is better suited to areas of heavy slash accumulations or large piece sizes. For small areas of your woodland, there is a tool that can be fitted to a power saw for removing duff. It is marketed as a 'Power Screefer.'



Factors such as soil type, slope, stumps, the volume and size of slash and the amount of brush on site must be considered when selecting site preparation equipment. Brush rakes or V-plows should not be used on sites where stumps are large and more closely spaced than the width of the attached blade. Dry sites with slopes below 20% are the favoured conditions for mechanical site preparation. On steeper slopes, equipment productivity diminishes while site preparation costs go up.

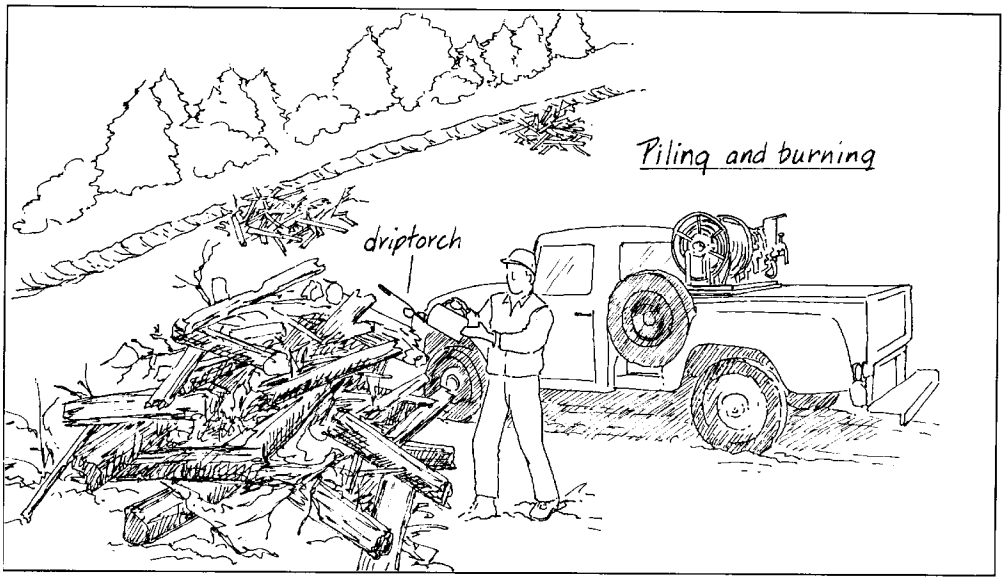
In some cases the action of skidders during the harvesting process can provide sufficient scarification to produce an adequate seedbed. However, heavy traffic can compact the soil and impair seedling establishment. Where scrub growth occurs on small areas or heavy equipment cannot be used, brush and weed trees can be cut manually with brush

hooks, brush saws or power saws. Wet sites which will not support heavier equipment may also require hand clearing.

Burning

Burning is another common and effective means of disposing of competing vegetation and logging slash prior to planting. Prescribed burning is usually the easiest and least expensive method of site preparation, though on small areas it can be difficult to control. Applied properly, it can accomplish a number of objectives, including:

- the removal of debris
- reduction of fire hazard
- removal of pests and competing vegetation
- the exposure of mineral soil.



Used improperly, burning can destroy many of the nutrients available in the small fine twigs and needles and, unless carefully planned and monitored, can create big problems very quickly.

An alternative is to pile the slash on stumps or other non-productive areas within, or adjacent to the harvesting area. You may be surprised how quickly the pile decomposes. A brush pile can provide habitat for small mammals and insect-eating birds as well as slowly releasing nutrients and moisture.

A combination of windrowing or piling of slash and burning is used on sites with unevenly spread slash, or where other site values must be protected. This form of site preparation is commonly and successfully applied to small woodland holdings. Broadcast burning is used on sites with high slash loads, deep soils ad a thick litter or humus layer. This technique is used less often as it is harder to implement and more difficult to control.

The district office of the Ministry of Forests should be consulted when any burning is being considered for an area. Burning permits are required for provincial lands (Crown and private).

Artificial Regeneration

When more control over the species, spacing or timing of regeneration is desired, areas are regenerated artificially. The regeneration process includes species selection, site preparation and either direct seeding or seedling production and planting. Although you may only be actively involved in the site preparation and seeding or planting stages, an understanding of the whole process will help you make decisions regarding things such as stock type, seedling age and the supervision of on-site activities.

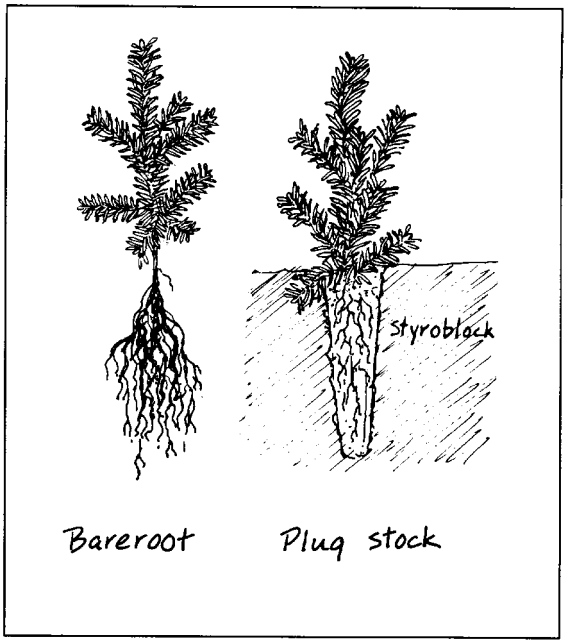
Direct Seeding

In general, direct seeding is not a recommended form of forest regeneration. Although it may at first appear to be a very inexpensive means of reforestation, the toll taken by predators such as rodents, birds and insects, can drastically affect the regeneration success. Further, the method can often lead to significant follow-up costs for fill-in planting, brushing and juvenile spacing.

On a special project basis, direct seeding may appeal to woodland owners interested in the process of forestry, who would also like to become involved in cone collection, extraction and the treatment of seeds. An instructional unit on seed collection and germination entitled 'Forest Nursery Studies' is available from the BC Teachers' Federation (see references at end of chapter). As an experimental or educational method, direct seeding may be appropriate, but for ensuring the regeneration of a forest crop in the minimum time period, planting is the better method.

Planting

Planting not only allows you to select the favoured species. but gives it a one to five-year head start on other plants that will sprout from local seed. Planting stock comes in two basic forms. *Bareroot* stock, as it sounds, is grown in nursery seedbeds from which the seedlings are 'lifted' and transplanted to field sites. *Plug* stock is grown in containers, and removed from the container prior to outplanting in the field. The stock is often grown in large styrofoam blocks and when removed from these containers the seedlings retain the nursery soil bound up in their roots. This acts like a packed lunch to help sustain them while they get settled in their new forest land environment.



There are also *transplants*; seedlings grown for one year in a container, then transplanted to an open field for an additional year or two growth. These 'jumbos' are cursed by tree planters, but loved by foresters trying to establish a crop on a brushy site.

Choosing Your Stock

The type and size of planting stock you choose will depend on the amount of brush competition, soil characteristics, and potential for browse by domestic livestock or wildlife on the site. The choice of stock should be based on the best performance at the least cost. Where competition from other plants is a problem, larger stock outperforms smaller stock. Where site conditions are severe, plug stock can give the seedling the extra nutrients and protection that may ensure its survival. Plugs can be planted at a very young age since their roots are protected and fed by the rich soil in which they were seeded. Bareroot seedlings must be a little larger before planting in the field since their roots are not surrounded by a protective and nutrient-rich layer of nursery soil.

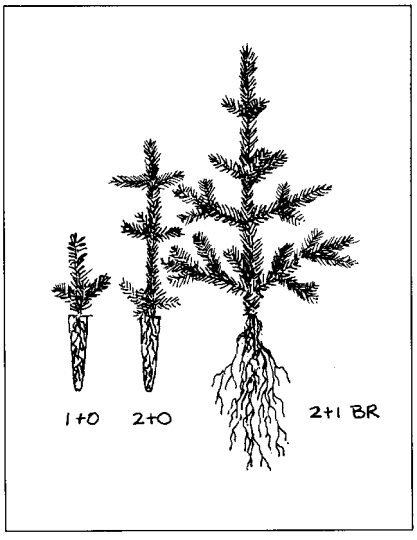
The age of planting stock is identified by a two number code. The first number indicates the number of years the seedling has grown in a container or nursery seedbed, the second number gives the number of years the seedling has grown in a transplant seedbed. Added together these numbers give the age of the seedling. A 1+0 plug is one year old, a 2+0 is two years old. If the plug is transplanted into a field to grow larger, it can be a 1+1 - a two year old seedling with one year in the container greenhouse and another in the field.

The example below explains the label:

Sx PSB 412A 1+0 Sp

Sx	**I**nterior Spruce
PSB	the container type is a Plug Styrofoam Block
412A	the growing cavity is 4 cm diameter by 12 cm deep, 77 cavities per block
1	age is one year
+0	it is not transplanted
Sp	planting season in Spring

Where site conditions are favourable, less expensive bareroot or smaller (1+0 or 2+0) plug stock is recommended. Such stock is also cost-effective when a ‘shot-gun’ approach (planting lots of small seedlings) has a higher chance of attaining a desired stocking level than does the planting of fewer, larger seedlings. However, since site conditions are not always ideal, the following table indicates the conditions that affect the choice of stock type.



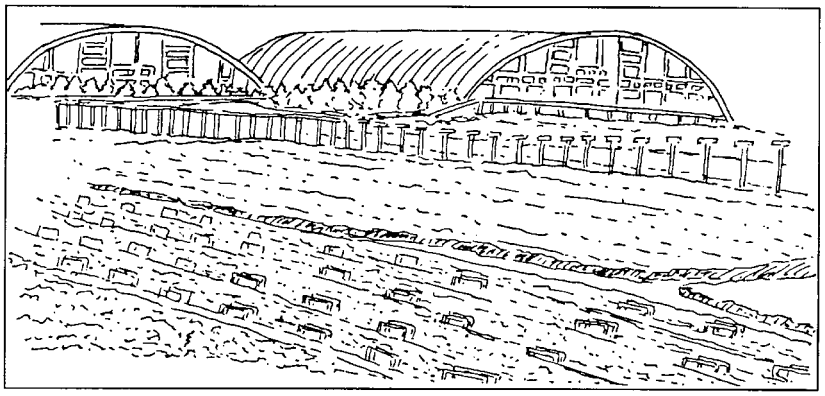
This table indicates, in broad terms, the stock type most suited to general site conditions. However, the ‘best’ choice of species and stock for your site is not always straightforward. Large transplant stock is often planted on sites that have competing vegetation since the larger size gives it an advantage over the competition. It is strongly recommended that you seek the advice of the Ministry of Forests, your local woodlot association, or a local tree nursery when choosing the species and stock type for your reforestation program since it sets the stage for the forest you (and your children) will be working with in the years to come.

Site Conditions and Choice of Stock					
	Bareroot		***Plugs (PSB)***		
Site Conditions	2+0	Trans-plants	211	313	415
1. Limited moisture			✓	✓	
2. Heavy vegetation competition		✓		✓	✓
3. Heavy slash			✓	✓	
4. Organic layer 15+ cm	✓	✓		✓	
5. Soils – shallow			✓	✓	
6. Soils – rocky			✓	✓	
7. Soils – loose	✓	✓			
8. Soils – compacted			✓	✓	

Planning Ahead

Since seedlings take a year or more to produce, it is necessary to register a sowing request with the nursery from which you will be obtaining stock. The request should be made in advance, usually before harvesting begins, and at minimum, about a year and a half prior to planting. For instance, if you harvest this fall, you may prepare the site next fall, and plant the following spring.

Though surplus seedlings may be available once all orders are filled in the spring, in general it is not worth the risk. Planting is expensive, you only want to do it once, and it is worth the effort of planning for. The stock must be grown from seed suited to the characteristics of your woodland. The source of a seed is called its *provenance* and should closely match the planting site in terms of climate, elevation and geographical location. Do not use seed or seedlings from high elevations if you are establishing a low elevation forest or *vice versa.*



Seedlings must be purchased by the operator. It is common for nurseries to require a down payment with the sowing request, a progress payment on inventory, and the final payment on lifting. If you have given the nursery your target specifications for the seedlings (height, diameter), examine the seedlings closely and only pay for them if they realistically meet your standards. The price of seedlings will vary with the size and type of stock.

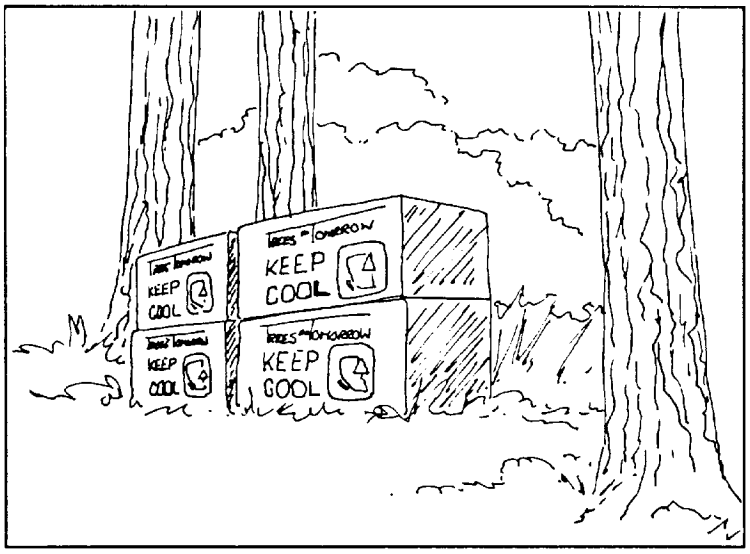
If your reforestation area is small, you may consider the transplanting of wildlings. Some woodland operators have found this a successful and relatively inexpensive way of redistributing seedlings in an area, especially helpful in situations where natural regeneration has come in unevenly. You may even consider setting up a 'bush nursery' on your woodland to grow your own stock for special purposes or fill-planting.

Often a used gravel pit, or exposed roadside adjacent to a stand of trees of the desired species will be covered with natural regeneration. Since you will be "bare-rooting" the seedlings, it is important to preserve as much of the root system as possible. For this reason, you will have better survival with seedlings less that two years old. More established older seedlings will have deep and spreading root systems which will be unavoidably damaged in transplanting.

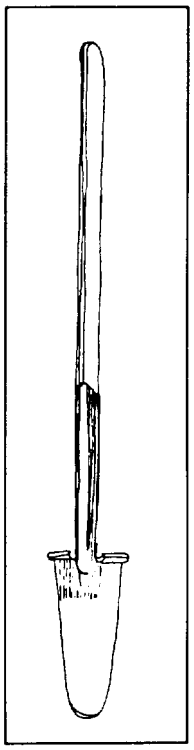
Planting With Care

Planting is carried out with the best success in the spring, when temperatures are moderate and soil moisture is up. Spring planting should begin soon after snowmelt to maximize the amount of time the seedling has to become established before the summer dry season. The southern and western exposures should be planted first since these are the areas that receive the greatest amount of sun and usually dry out first.

Seedling care, between the time the stock leaves the nursery and is planted, is extremely important. One of the biggest causes of seedling death is from overheating. In transit, stock should be kept cool and ventilated and protected from direct sunshine and wind. While stock is on-site awaiting planting, it should be stored in a shaded place out of the wind. With plug stock, open the tops of the shipping cartons to prevent overheating, and water lightly if necessary. Roots should be kept moist at all times. Bareroot stock is especially vulnerable to roots drying out, and should be planted as soon as possible after lifting. Where planting stock has been frozen, thaw slowly. Keep boxes sealed and in cool, shady conditions and monitor temperature closely to prevent overheating. Seedlings "breathe and perspire" just like you and me, and if there is no way to replenish the moisture lost through respiration, will be mortality or at least weakened trees.



The number of seedlings planted per hectare will reflect the management objectives of the woodland operator. Wide spacing, with 3 metres between seedlings, ma*y* be prescribed where juvenile spacing is not planned. However, where sawlogs are the desired end-product, closer spacing may be desirable to keep branch size down and encourage natural pruning. Spacing must also take account of seedling mortality. If trees are planted at a wide spacing, it may be necessary to carry out subsequent fill-in planting



in areas where original stock fails to survive. Recommended stocking levels are set for each of the Forest Regions. Check with the district office of the Ministry of Forests.

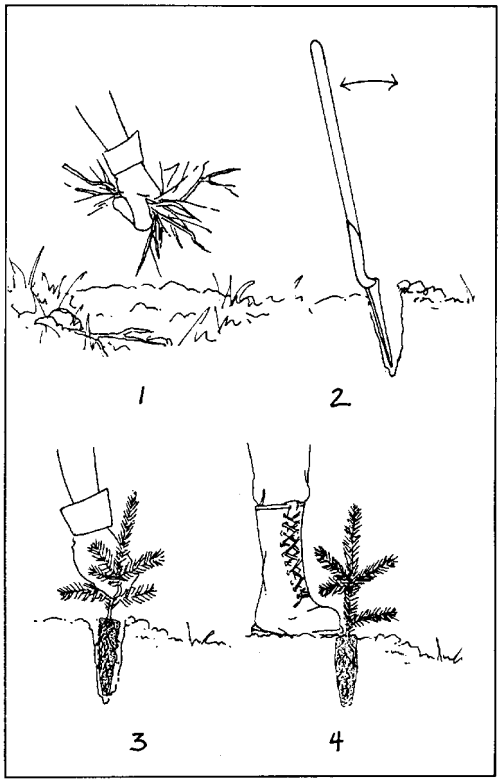
Though a variety of tools (mattocks, dibbles, and seedling 'guns') have been used to plant trees in the past, most stock is currently planted with a special shovel. Planting bags strap around the waist with shoulder/chest straps to help carry the weight. You should keep some damp material such as moss or cloth in the bottom of the bag to keep the seedlings moist until planting.

Successful planting depends on starting with good quality, healthy stock suited to the conditions of the site, followed by good stock handling procedures, careful selection and preparation of the planting hole, and proper planting of the seedling.

'Screefing' is carried out at individual planting sites to clear the area surrounding the seedling and to reduce cornpetition for moisture and soil nutrients. The planting hole should be large enough to accommodate the full length of the roots. If the roots are bent or J-rooted, the tree may grow for several years, then fall over due to the instability of the supporting root structure. The tree should be planted firmly and tightly without air pockets that could dry out the roots.

Tree Planting Guidelines:

- choose planting spots carefully, depending on species' needs
- clear immediate area of debris and competing vegetation
- make planting hole deep enough to accommodate roots without bending
- plant tree upright, and to the root collar
- fill soil in and around roots to remove air pockets
- tamp down soil firmly around planted seedling.



Reforestation costs will vary with the number of trees per hectare, the degree of site preparation needed, and the size and type of planting stock. All these will affect the productivity of the planters, as will slope, access and ground conditions.

Quality means everything in planting. The quality of your reforestation plan from the choice of species and stock, to the selection of individual planting sites will influence the cost-effectiveness and final success of your reforestation program. The condition of the seedling when it goes into the ground, and how well it is planted are the final keys to survival.

How Many Trees Do I Plant?

The number of seedlings planted depends on your management objectives. Less trees per hectare provides more room and nutrients for each tree but will result in larger branch size. Wider spacing may allow brush species to gain height, possibly overtaking the seedlings before the tree canopy can join. If you are interested in agro-forestry applications, such as grazing or Christmas tree production your spacing may be wider.

Too many stems will be expensive, and will require juvenile spacing in the near future. Packing them in can also cause stand stagnation from inter-tree competition. The positive aspect is quicker site domination by preferred species, greater **initial** height growth, and smaller branches with earlier self-pruning on shade intolerant species.

Tree/ha	Trees /plot*	Triangular spacing inter-tree spacing (m)
2500	12.5	2.15
2400	12	2.19
2300	11.5	2.24
2200	11	2.29
2100	10.5	2.34
2000	10	2.40
1900	9.5	2.47
1800	9	2.53
1700	8.5	2.61
1600	8	2.69
1500	7.5	2.77
1500	7	2.87
1400	6.5	2.98
1300	6	3.10
1200	5.5	3.24
1100	5	3.40
900	4.5	3.58
800	4	3.80
700	3.5	4.06
600	3	4.39
500	2.5	4.81
400	2	5.37

* Plot Radius: 3.99 m = 50 m^2; Plot Multiplyer = 200

Monitoring The New Crop?

Reforestation does not end when regeneration has been achieved. That is, reforestation means more than putting trees back in the ground; it means re-establishing a forest. A stand cannot be considered to have successfully reestablished until the trees within it reach what is known as the free-growing stage, having survived infant mortality and early competition from other vegetation.

Therefore, following natural or artificial regeneration, a number of check-ups must be carried out on a stand to see that it has been properly established, and to monitor how it is progressing. There are many factors that can affect the success of the regenerated site, and it is important to identify any problems as early as possible in order to protect your investment and save you time and money down the road.

These check ups are are known as silviculture surveys, and usually involve collecting information to assess the stocking, plantability, regeneration performance and free-growing status of the site.

During and After Planting

During planting it is important to check on the quality of the planting job on a continuous basis. Check that:

- the right mix of species has being planted
- the spacing is according to the specifications (it is easy to plant too many trees which can end up being very costly)

- the seedlings are being properly planted (in the right soil, with the right root position – you will have to dig some up to check this).

One to Two Years After Planting

Within the first two years after establishment you will need to check on the survival of your regeneration and the stocking of the site.

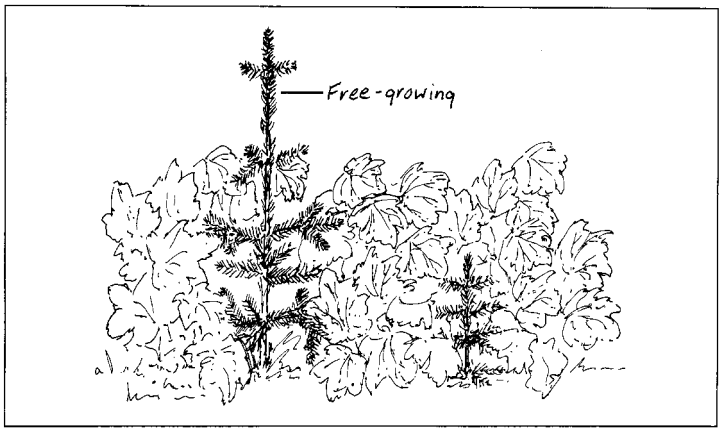
- Check whether any parts of your plantation have failed and try to assess why (site factors, environmental factors, seedling handling or quality factors, inadequate natural seed in).
- Check whether there are any gaps in the stocking of the site that may require fill planting.
- Check whether brush competition poses a risk to the survival of your seedlings or natural regeneration.
- Check whether animal browsing or stem damage (i.e., voles or insects) is a problem.
- Decide whether you need to take action such as fill planting, brushing, browse protection.

Every Two to Three Years Until Free to Grow

Check on the performance of your regenerating stand until it is well established and is '*free to grow*' on its own without the need for further intervention.

- Check survival and health.
- Check performance by measuring leader growth and comparing to standards for the site.
- Check brush competition.
- Check stand density (naturally regenerated stands that are too dense can stagnate).
- Decide whether you need to take action such as fill planting, brushing or spacing.

Free-growing status is considered to have been achieved when the individual trees are as high as, or higher than the neighbouring brush competition and that they have approximately 1 metre of free space surrounding their crowns. This may take from five to ten years depending on the site and the severity of brush competition. At this point, they are firmly



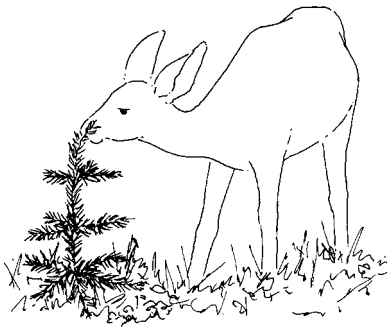
established and are part of a system of interrelationships with their neighbours. This system of connections forms a balance and an identity which we define as a stand of trees.

Other Considerations

Browse Protection

In many parts of the province, browsing by ungulates (deer, elk and moose), or even beaver, hares, mice or voles, can destroy overnight the planning, expense and labour invested in reforestation. Consequently, if there is a significant risk of aniumal damage to your plantation then you need to consider taking protective measures during the reforestation process.

There have been many experiments to deter browsing: chemicals applied either on the foliage and through the roots (systemic), predator scents, and physical protection. At this time only a physical barrier is considered worthwhile. These can take the form of solid plastic cones (Sinocast), plastic mesh (Vexar), wire mesh (stucco wire) cages net tubes or plastic tubes. Your choice will be determined by:



- cost and availability
- labour to apply, monitor and remove
- access to site
- type of browsing animal
- size of seedling during the susceptible stage
- wind or snow accumulation.

Wire cages, while possibly the most expensive initially, can offer the best protection, largest growing space and the ability to be re-used several times. Often one can purchase rolls of ‘seconds’ from a supplier at a lower cost.

Solid plastic tubes or shelters are quite popular as they make a ‘greenhouse’ type microclimate for the tree inside which results in faster initial growth. However, because the tree is supported by the cage it may not have developed adequate stem strength once the tube is removed making it more susceptible to wind and snow. Once the trees grow out the top, the cage often needs to be moved up.

Protection of Brush and Weed Competition

One last treatment you might consider before walking away from a planting project is the use of brush blankets or mulch mats to keep grass and weeds away from the newly planted seedlings. Grass and brush competition, especially for moisture during the dry summer and fall, can have significant and even crippling impacts on the growth of planted seedlings.

These fabrics are permeable to air and water, but suppress the growth of competing vegetation. They come in various sizes but the one meter square seems to be standard. Be inventive: use old paper feed sacks, dog food bags, or newspapers for small jobs. Do not use anything with plastic layers as this impermeability may cause localized drought or fungus build-up.

If you suspect that you will have to return to the site to undertake brushing and weeding, consider flagging or somehow marking the seedlings. This will assist productivity and preserve seedlings. Plastic or wire stake flag markers are available from most forestry supply dealers.

Recommended References

Small Woodlands Program of BC
A comprehensive 'Small Woodlands Library' is available on the web [www.swp.bc.ca]

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Minimum Safety Guidelines for Tree Planter, MOF Silviculture Branch FS419 1994
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