

# Propagation Methods of Seabuckthorn in Canada

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## SUMMARY

Seed propagation is the simplest and least expensive method of propagating seabuckthorn. Seed dormancy may exist in some species or cultivars, however treatments such as placing seeds in water and soaking for 48 hours at room temperature works well. Seeds sown on the soil surface have higher emergence rates than sowing at the depths of 1 and 2 cm. Because the species is dioecious, seed propagation will produce both male and female plants in equal quantities. Plants of similar genetical characters can be prepared from hardwood cuttings of 15-20 cm long. The best time for planting seabuckthorn cuttings is the mid to late spring. Cuttings are planted in a prepared field in twin rows of 70 x 20 cm at 5 to 7 cm spacing in the row, and at the rate of 360 to 400 thousand per hectare. Soil moisture content should be monitored throughout the growing season and maintained at 80 to 100 per cent of field capacity while the cuttings are initially rooting. This can be achieved by irrigating once a day during dry sunny weather. However, this method is prone to environmental changes.

The advantage of propagation from softwood cutting is its high successful rate. Cutting length should be 10 to 15 cm. The cutting usually includes more than two nodes, and the foliage is removed from the lower portion of the cutting. Cuttings are placed in poly or moist burlap sacks immediately after cutting. Rooting hormone is applied by dipping the base of the stem in rooting hormone (0.1 per cent IBA). Cuttings require 80 to 90 per cent humidity to remain turgid during the rooting process. Propagation beds include a rooting media base, heating cables and mist or fogging systems. The mist bed is covered by a polyethylene tunnel, placed on 7 to 10 cm of coarse gravel. Cuttings can be rooted in any substrate providing good air/water relationships. Media mixes such as a 2:1:1 by volume peat:vermiculite:perlite or 3:1 peat:perlite moss mixtures have provided good results. Humidity can be controlled in a number of ways but the most reliable is with automatic misting units.

Keywords: Seabuckthorn (*Hippophae rhamnoides* L.), Propagation from seeds, Hardwood cuttings and Soft wood cuttings, Hormone, Media and Mist.

## INTRODUCTION

Seabuckthorn (*Hippophae rhamnoides* L.) is a hardy, deciduous shrub belongs to the family *Elaeagnaceae* (Rousi, 1971). It bears yellow or orange to red berries, which has been used for centuries in Europe and Asia due to the medicinal and nutritional properties (Bailey and Bailey, 1978). The natural habitat of seabuckthorn extends widely from cold regions of China, Himalayas, Mongolia, central Asia to Russia, Great Britain, France, Denmark, Netherlands, Germany, Poland, Finland, Sweden and Norway (Singh, 2003). Seabuckthorn develops extensive root system in a short period of time, therefore it is planted for soil conservation and erosion, strengthen sandy slopes. It also has been used in soil reclamation for its ability to fix nitrogen and conserve other essential nutrients (Li and Schroeder, 1996; Lu, 1992). Seabuckthorn is a unique and valuable plant currently being cultivated in various parts of the world, including Canada. It can withstand temperatures from -43°C to +40°C and is considered to be drought resistant (Lu, 1992). However, irrigation is needed in regions receiving less than 400 mm of rainfall per year (Li and Schroeder, 1996; Myakushko *et al.*, 1986). Almost all the seabuckthorn berries are harvested from natural

habitat in Asia and Europe. In view of increasing local and global demand of seabuckthorn, propagation methods of seabuckthorn have been standardized in Canada, which are described below.

## **PROPAGATION FROM SEEDS**

Seed propagation is the simplest and least expensive method of propagating seabuckthorn. This method is commonly used when growing seedlings for wildlife, reclamation or erosion control. Because the species is dioecious, seed propagation will produce both male and female plants in equal quantities and there is no way of distinguishing the sexes until they begin fruiting three to four years after planting. Also, there is considerable variation in growth and fruit characteristics among plants.

### *Seed Collection*

Fruit can be collected from late August to mid-winter. Strip fruit or clip off clusters of fruit. Protect hands from thorns with gloves. Fifty kilograms of fruit will yield 4-5 kilograms of cleaned seed (30,000 to 40,000/kg; 33,000 average).

### *Seed Extraction*

Seeds are best extracted from fresh, ripe fruit; alternatively fruit can be frozen. Seed is separated by maceration and floating off the pulp and juice. After extraction, seed is surface dried. For small quantities, seed can be extracted using a blender set at low speed and with dull blades or the blades wrapped with masking tape. Store seed dry (6 per cent moisture) in sealed containers at -18°C.

### *Pre-Seeding Treatment*

Seed dormancy may exist in some species or cultivars, however treatments such as placing seeds in water and soaking for 48 hours at room temperature (add fresh water several times to prevent stagnation) works well. The seeds should have expanded (imbibed water) and will germinate in five to 10 days. Fungal problems can be minimized if the seed is surface-sterilized in a solution of household bleach (one part bleach to nine parts water) for five minutes. Experimentally, treating seeds with GA<sub>3</sub> and KNO<sub>3</sub> for 48 hours before seeding did not improve germination rate significantly.

### *Direct-Seeding Outdoors*

Seabuckthorn seed can be sown outdoors in the field although success may be limited due to environmental factors and soil conditions. Seeds sown on the soil surface have higher emergence rates than sowing at depths of 1 and 2 cm. The soil must be irrigated periodically to prevent seeds from drying out. If seeding in the late spring, seeds should be covered with a very light layer of soil. Seeds should start to germinate within five to 10 days.

### *Seeding Indoors and Transplanting*

Seabuckthorn seeds can be seeded indoors in pots in January or early February. The stratified seeds are planted in vermiculite:peat moss mixture (40:60) in containers. The containers are placed in a greenhouse environment of 16 hours daylight and 8 hours of dark at a constant temperature of 25°C to 27°C and 70 to 90 percent relative humidity. Immediately following germination and prior to the formation of true leaves. An application of fungicide may be necessary to control damping-off.

Maximum growth may be obtained by using bright full-spectrum fluorescent or high-pressure sodium lighting. A soluble starter fertilizer (10-52-10; N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O) is applied with each irrigation for the first 3 weeks following planting. After this, a complete soluble fertilizer (20-20-20; N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O) is applied in the same manner. A moderate amount of air movement is necessary to provide adequate ventilation. Seedlings grow rapidly and need to be acclimated before transplanting outdoors. This involves restricting water, switching to natural lighting and reducing the temperature.

### Outdoor Nursery Practice

Seeds are sown 1 cm deep at the rate of 150 seeds/meter. Non-stratified seed should be sown in late September. Alternatively, sow pre-treated seed in the spring. Best growth is on loam soils with soil pH 6.0 to 8.0 and organic matter level of three to four percent. Trifluralin is applied prior to sowing for weed control. Linuron applied to dormant one-year-old seedlings controls most winter annuals. Seedlings are lifted after one or two growing seasons. Size standards are: height >25 cm and root collar diameter >4.0 mm, roots should be well nodulated. Lift once seedlings reach vegetative maturity and have defoliated. Seedlings must be placed in storage as quickly as possible following lifting. Roots desiccate rapidly resulting in reduced seedling quality. Store at -2°C in poly bags.

### VEGETATIVE PROPAGATION

Cuttings produce rooted plants with the same genotype as the parent plant. Plants propagated from cuttings are used for fruit production orchards. Seabuckthorn can be propagated from both hardwood and softwood cuttings. Propagation of seabuckthorn by cuttings has two main advantages. First, genetic characteristics generally reproduce exactly so the cutting is a clone of the mother plant. Second, cuttings can often flower and produce fruit in less time than a seedling.

### HARDWOOD CUTTINGS

#### Collection of Hardwood Cuttings

When propagating seabuckthorn it is very important to create cutting beds for the production of cuttings. Because seabuckthorn is a dioecious plant, the female varieties must be planted at least 300 metres from the males to avoid fruit set. Under this arrangement the plants do not bear fruit and high-quality cutting material is obtained. Cutting beds allow the grower to manipulate the plants to improve the number and quality of the cuttings by using specific pruning techniques, and/or growth regulator application. The material removed for cuttings can have a greater ability to root due to increased vigour.

Table 2.1: Propagation Methods for Seabuckthorn

<b>Propagation Method</b>	<b>Comments</b>
Seed	Inexpensive and simple procedure. Seeds contain a mix of genetic material from two parents, consequently, seedlings are not identical to their parents. It is impossible to distinguish between male and female parents from seed propagated plants until the plants start to flower 5 years following germination. Also, desirable characteristics common to the parents may be lost.
Softwood Cuttings	Inexpensive, simple, highly successful procedure but requires some initial capital expenditure. May fruit earlier than sexually propagated plants. Produces genetically uniform plants. Initially, availability of propagation material may be limited.
Hardwood Cuttings	Inexpensive, simple procedure, but rooting success rate is not as high as softwood cuttings. May fruit earlier than sexually propagated plants. Produces genetically uniform plants. Initially, availability of propagation material may be limited.
Suckers	Simple, inexpensive technique but available material may be limited. Suckers have poor root mass and may be susceptible to transplant shock.
Tissue Culture	Complex and techniques are not well developed at this time. Produces genetically uniform plants. Potential quick production of large numbers of plants.

### *Planting in Beds*

The cutting beds must be planted with healthy foundation stock. The plants are spaced 0.5 m apart in rows 2 metres apart. This design requires 10,000 plants per hectare. In Canadian conditions the best time for planting seabuckthorn is in spring. The plants should be planted 4 to 6 cm deeper in light soils and 6 to 8 cm deeper in heavier soils than they were in the nursery. During planting, the planter should be adjusted so that the plants are in a furrow 5 to 8 cm below the surface. The furrow is gradually filled in and another tier of roots form on the plants. Proper pruning will allow for optimum production of cuttings.

### *Harvesting Hardwood Cuttings*

One-year-old shoots are removed from the cutting bed plants. The maturity of the shoot and physiological condition of the cuttings are important for root formation. Lignified shoots have a large reserve of nutrients and can, therefore, easily form roots. The upper part of the seabuckthorn shoot is not lignified and cannot form roots, so it should not be used for cuttings. At the base of the one-year-old shoot there are tiny dormant buds, which may not develop for several years. These buds put forth very weak small shoots, which are unsuitable for cuttings. To avoid this, stubs with 2-3 well-developed buds should be left on the cutting bed plants when harvesting the one-year-old shoots. This ensures good growth continues on the parent plants.

Hardwood cuttings are harvested in spring just before budding. The plants grown from cuttings harvested in winter, often have poorer growth so the yield of good quality transplants at the end of the growing season is lower. Sharp knives or pruning shears should be used for harvesting the one-year-old shoots. Using pneumatic pruning shears doubles production. To avoid drying during harvesting and transport to the storage facility, cuttings should be covered with damp burlap. The shoots removed from the parent plants are bundled and labeled to show the name of the variety and stored at -4°C until processing.

One of the main factors determining the quality of the shoots and the rooting ability of the cuttings, is the age of the parent plant. The growing period of shoots on old seabuckthorn trees is shorter than for young trees and the shoots are usually shorter (from 7 to 20 cm) with short internodes. The cuttings from older trees are less likely to root. On parent plants, up to five years old, one-year-old shoots can reach a length of 30 to 100 cm depending on the cultivar. Normally, one to three cuttings 15 to 20 cm in length, can be obtained from each shoot.

Depending on their age, each cutting bed yields from 10 to 100 cuttings. A total of 5 to 10 cuttings are available in the second year after planting, 15 to 30 cuttings in the third year, 30 to 60 cuttings in the fourth year, and 50 to 100 or more in subsequent years. If cutting bed nurseries are not available, the cuttings can be obtained from high-quality fruit trees. Up to 30 per cent of the shoots can be removed from a tree 3 to 7 years old while at the same time harvesting fruit from each tree, but as indicated earlier, the rooting rate of these cuttings will be lower than for those obtained from cutting beds.

### *Preparing Cuttings*

Cuttings are prepared from one-year-old whips removed from cutting beds. The harvested one-year-old whips may be stored whole or cut up (15 cm long cuttings). Make the lower cut under the bud and the upper one above the bud. Use pruning shears or cut mechanically. Mechanized cutting increases production several-fold. The main factor in cutting is that the blade must be sharp and the cut smooth. Rough cuts do not heal quickly and often decay.

Discard the tip portion of the shoot and divide the remainder into cuttings 15-20 cm long. After this, place the cuttings in bundles of 100, dip the cut ends in paraffin wax, affix a label bearing the name of the cultivar and store the bundles at -4°C or in a snow cache. If a snow cache is used dig a trench in the middle of the cache and stack the bundles of cuttings in several rows and layers with the tips up. Cover each layer and row with snow, 10-15 cm deep and a 1 cm layer of sawdust. Cover the

cache with straw or sawdust. Make sure that the snow does not melt while the cuttings are in storage, otherwise they will die.

In Russia, cuttings are preconditioned in a specially constructed snow cache. This storage method keeps the basal portion of the cutting warm and the distal end of the cutting cool and stimulates the early stages of rooting. The method involves digging a pit or constructing an insulated box. In early March the pit is filled with packed snow. At the end of March cuttings are bundled and placed on the snow basal (bottom) end facing upwards. It is important that the bundles are packed tightly together. A 2.5 centimeter layer of slightly moist peat moss is placed over the top of the cuttings. The layer of peat moss is then covered with a polyethylene film. Overnight, the film is covered with a layer of insulation. After two to three weeks the cuttings are ready to plant.

Before planting, soak the cuttings in water at a temperature of 18-25°C for 5-7 days until the buds swell. Immerse the cuttings in water leaving 2-3 buds exposed above the surface. Water must be changed daily to prevent stagnation. With male cuttings all buds except for the top two should be removed.

#### *Planting the Cuttings*

The cuttings are planted in the nursery's cuttings field. The field should be protected by shelterbelts, receive plenty of sunshine, have light soil rich in organic nutrients with a neutral pH and weed free. Summer fallow the field for one year prior to planting. During the year of planting, spring preparation of the field involves working the soil with harrows, discing to a depth of 5-8 cm and packing. If the soil is dry (soil moisture below 70 per cent of field capacity) it should be irrigated 3-5 days before the cuttings are planted.

The best time for planting seabuckthorn cuttings is the mid to late spring. Autumn planting of seabuckthorn cuttings usually gives poor results. Cuttings are planted in a prepared field in twin rows of 70 x 20 cm at 5 to 7 cm spacing in the row, and at the rate of 360 to 400 thousand per hectare. When the young plants are to be grown in small quantities, the cuttings can be planted in raised beds 1 m wide in a 10 x 10 cm grid. The cuttings are planted vertically; otherwise they grow to one side. They should be planted out so that 2 to 3 well-developed buds are visible above the surface. The soil around the cuttings is thoroughly compacted after planting and then irrigated immediately. By the end of the first growing season most of the young plants are ready for planting, while a few may require another year of growth.

Soil moisture content should be monitored throughout the growing season and maintained at 80 to 100 per cent of field capacity while the cuttings are initially rooting. This can be achieved by irrigating once a day during dry sunny weather. In overcast weather, the frequency of irrigation can be reduced. After the cuttings have rooted, the soil moisture content can be maintained at 70-80 per cent of field capacity. When managed in this way, a rooting and survival rate of 75 to 90 per cent at the end of the first growing season is possible.

#### *Greenhouse Production of Hardwood Cuttings*

Hardwood cuttings should be chosen from healthy, well-developed plants. Cuttings (15 cm long) are taken from the previous year's growth during dormancy in the early spring. The cuttings can be stored in sealed plastic bags at 1°C until planting or for up to one month. Cuttings are planted in containers filled with peat moss and perlite (3:1 mix). The pH of the media should be adjusted so that it is greater than 6.5. When planting, leave 2 buds above the media surface. With male cuttings all buds except the top two are removed. The media is kept moist but not saturated. For optimum rooting, greenhouse temperature is maintained at 5°C during the night and 25°C during the day. Once shoots are growing, photoperiod is set at 16 hour light and 8 hour dark. When shoots are 2.5 to 3 cm long, remove the shortest shoot. Rooting normally occurs within two weeks of planting. When roots are 3 to 4 mm long, the plants are fertilized with a soluble fertilizer (20-20-20) once per

week. Rooted cuttings are grown in the greenhouse for 6 to 8 weeks after which they can be transplanted in the field. After transplanting, the rooted cuttings need to be irrigated periodically.

## **SOFTWOOD CUTTINGS**

The advantage of softwood cutting propagation is its high successful rate. A softwood cutting (15-20 cm long) is taken when shoots begin to become woody. Remove the lower leaves, leaving two to four leaves at the tip and dip into rooting hormone before rooted in media such as sand or perlite and keep special attention to the moisture of the media. Rooted cuttings should be planted in pots for one to two months before transplanting to the field.

### *Collection*

Softwood cuttings are collected from selected plants in late spring when shoots are no longer growing but slightly lignified. This is usually late June to mid-July. Cuttings are collected from terminal or side shoots. Cutting length should be 10 to 15 cm. The cutting usually includes more than two nodes, and the foliage is removed from the lower portion of the cutting. Collect cuttings, preferably on cool, dull days in the morning or late afternoon. Cuttings are placed in poly or moist burlap sacks immediately after cutting. The key to success is to transport the cuttings as quickly as possible from the field to the mist bed and to keep the cuttings turgid during the period from collection until they are well rooted in the propagation facility.

### *Cutting Preparation and Planting*

Prior to sticking, the cuttings are re-cut and the sufficient leaves are removed so that the lower leaves are not in contact with the medium after sticking. Cuttings should be planted so that at least two leaf nodes are below the surface of the media. Rooting hormone is applied by dipping the base of the stem in rooting hormone (0.1 percent IBA).

### *Propagation Facility*

Cuttings require 80 to 90 percent humidity to remain turgid during the rooting process. Propagation beds include a rooting media base, heating cables and mist or fogging systems. The mist bed is covered by a polyethylene tunnel, placed on 7 to 10 cm of coarse gravel. The mist control box is an on and off mechanism which controls the frequency of misting with a solenoid. Mist nozzles supply a fine spray of water that maintains the high humidity. Basal heat is provided with a heating cable. Adequate ventilation is required. Temperatures in the rooting tunnel should not exceed 30°C.

### *Media*

Cuttings can be rooted in any substrate providing good air/water relationships. Media mixes such as a 2:1:1 by volume peat:vermiculite:perlite or 3:1 peat:perlite moss mixtures have provided good results.

### *Mist Systems*

Leaves of seabuckthorn cuttings wilt and die if not kept turgid. Intermittent mist reduces the volume of water applied to cuttings and alleviates excess moisture accumulation in the media. Humidity can be controlled in a number of ways but the most reliable is with automatic misting units (i.e. brass mist nozzles controlled by electronic time clocks and a solenoid). The mist system is on day and night for the first 4 weeks. Initially, 10 seconds of mist is supplied every 30 minutes. Use the minimum amount of mist necessary to keep the foliage turgid. Gradually reduce the amount of mist after roots begin to form, until misting is eliminated. It will take approximately 4 to 6 weeks for the cuttings to root. This prepares the plants for transplanting into small pots or for placing them directly into the nursery.

### *Rooting*

To ensure vigorous plant growth, fertilize the root zone with a weekly application of 20-20-20 (N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O) fertilizer at 1000 ppm (1g/L), starting as soon as root initials are formed and continuing throughout the growing season. Preparing the cuttings early in the summer, thereby allowing time for their establishment before winter, also helps the plants to overwinter successfully. Rooting seabuckthorn directly into containers, although more costly, reduces the amount of transplant shock upon outplanting.

### *Post-Rooting Treatment*

Over wintering cuttings during the first winter sometimes presents a problem especially on the prairies, regardless of whether the cuttings have been transplanted in the field or stored indoors. They must be acclimated and hardened off prior to planting outside the propagation bed. The best method is to overwinter the rooted cuttings in the propagation bed (covered with microfoam or mulched with peat moss or wood chips) or remove them and store in poly bags at -2°C. The cuttings also may be transplanted to the field in late August when roots are well developed. This method works well if cuttings have been rooted directly into containers. Transplants should be kept moderately well irrigated until late summer. Weeds should be controlled but deep cultivation close to the plants must be avoided.

## **ROOT CUTTINGS AND SUCKERS**

Root cuttings with nodes (15 cm long, 5 mm diameter) can be an effective propagation method for seabuckthorn. Root cuttings are planted in pots in a greenhouse for 6-8 weeks before transplanted to the field in spring. A sucker is a shoot that arises on a plant from below ground rhizomes which are underground stems. Propagation using suckers is a form of dividing the plant. Suckers are dug out and cut from the parent plant. In some cases part of the old root may be retained, although most new roots arise for the base of the sucker. It is important to dig the sucker out rather than pull it, to avoid injury to its base. Suckers are usually removed with the aid of a pruning knife or and/or shovel. Try to obtain as large a root mass as possible, and do not allow the root mass to dry out prior to transplanting. Suckers are best dug in early spring while still dormant.

## **CONCLUSIONS**

Seabuckthorn may be propagated using seeds, softwood and hardwood cuttings, suckers or tissue culture. The easiest, most successful method of propagating seabuckthorn plants is with seed. Seed propagation is well adapted for propagation of plants for conservation plantings or orchards that are not intended to be intensively managed. Seabuckthorn is a dioecious species, therefore vegetative propagation methods are the most appropriate for plants utilized in commercial orchards. Vegetatively propagated plants have a single parent only and, therefore, are genetically identical to the parent plant. Vegetative propagation includes softwood and hardwood cuttings, suckers and tissue culture. Vegetative propagation from softwood cuttings has been found most successful and economically beneficial.

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