

# Sea Buckthorn

*Hippophae rhamnoides L.*



## ***Introduction***

Sea Buckthorn (*Hippophae rhamnoides* L.) is a hardy, deciduous shrub belonging to the family Elaeagnaceae. It bears yellow to orange berries, which have been used for centuries in Europe and Asia. The natural habitat of sea buckthorn extends widely in China, Mongolia, Russia, Finland, Sweden and Norway. It has attracted considerable attention recently in North America mainly for its nutritional and medicinal value.

Sea buckthorn is a unique and valuable plant currently being cultivated in various parts of the world, including Canada. It can withstand temperatures from  $-43^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$  and is considered to be drought resistant. However, irrigation is needed in regions receiving less than 400 mm (16") of rainfall per year. Sea buckthorn rapidly develops an extensive root system, and is therefore an ideal plant for preventing soil erosion. It also has been used in land reclamation for its ability to fix nitrogen and conserve other essential nutrients.

Sea buckthorn needs a period of 4 years from seeding to begin to set fruit. An orchard planting can yield up to 10 tons of berries per hectare. The leaves, berries, and seeds of sea buckthorn have high nutritional and medicinal values and contain vitamins C, B1, B2, E, F, K, P, provitamin A, sugars and organic acids. The vitamin C and E contents are as high as 600 and 160 mg per 100 g of fruit, respectively. Its pulp and seeds contain essential oil important for its medicinal value.

Sea buckthorn is a relatively new crop in Canada. Some important characteristics which need improvement in a future breeding program are yield, fruit size, thornlessness, fruit quality, early maturity, growth habit, mechanical harvesting and nitrogen-fixing ability.

Hippophae belongs to the family elaeagnaceae. There are total of four species based on morphological variations: *H. rhamnoides* L., *H. salicifolia* D. Don, *H. neurocarpa* Liu & He and *H. tibetana* Schlecht. *H. rhamnoides* L. was divided further into nine subspecies (spp.): *carpatica*, *caucasia*, *fluviatilis*, *gyantsensis*, *mongolica*, *rhamnoides*, *sinensis*, *turkestanica*, and *yunnanensis*.

# Special Crops FACTSHEET



BRITISH  
COLUMBIA

Ministry of Agriculture,  
Food and Fisheries  
162 Oriole Rd,  
Kamloops, BC V2C 4N7  
Phone: 250 371-6059  
Fax: 250 828-4631

Al Oliver  
May 2001

## *Description*

Sea buckthorn is a deciduous, dioecious shrub, usually spinescent, reaching 2 – 4 m in height. It has brown or black rough bark and a thick grayish-green crown. Leaves are alternate, narrow, and lanceolate with a silver-grey colour on the upper side. The sex of seedlings cannot be ascertained until they start to flower. Flower buds are formed mostly on one-year old wood, differentiated during the previous growing season. The male inflorescence consists of four to six apetalous flowers. The female inflorescence usually consists of one single apetalous flower with one ovary and one ovule. The plant depends entirely on the wind for pollination, neither the male nor the female flower have nectaries, so do not attract insects.

## *Propagation*

The most common methods for propagating sea buckthorn are by seed, softwood or hardwood cuttings, and layering and suckers. Micropropagation using meristem culture is now readily available as well.

**A. SEEDS.** Propagation from seed is relatively simple and produces a large number of seedlings at fairly low cost compared with other propagation methods. Long term storage affects seed viability, up to 60% after 4 – 5 years. Prior to sowing, the seeds should be soaked in water for 48 hours, discarding any floating seeds. For early spring direct seeding, seeds are seeded at soil surface and irrigated periodically to prevent seeds from drying out. If seeding in the late spring, seeds should be covered with very light layer of soil. Seeds should start to germinate within 5 – 10 days based on the condition of the seeds and the species of sea buckthorn. A number of seeds per planting site is recommended at spacing of 1 m within the row and 3 – 4 m between rows. Sea buckthorn seeds can be seeded indoors in pots in January or early February, one seedling per pot is allowed to grow for 3 months before transplanting to the field in early May.

**Note:** Seeds do not come true to the parent so every seed is different genetically, often up to 30%. All other methods produce plants identical to parent.

**B. CUTTINGS.** Cuttings produce rooted plants with the same genotype as the parent plant. The cuttings will bear fruit 1 – 2 years earlier than seed-propagated trees. Sea buckthorn can be propagated using either hardwood or softwood cuttings.

**1. Hardwood cuttings.** Hardwood cuttings should be chosen in Jan. – Feb. from healthy, well developed plants in fruiting stage, so the sex can be determined. Cuttings (15-20cm long) should be taken from the previous year's

growth during dormancy in the early spring. Bundles of cuttings are soaked in water (room temperature and changed once a day) and covering 2/3 of their length until the beginning of formation of roots. Cuttings can also be treated with IBA (50mg/L) or rooting hormone and placed in pots filled with peat in a bottom heated propagation box (15-20° C). Cuttings can be transplanted when the roots are 1-2 cm long directly to the field. Note: Rooted plants grown under controlled environment for 1-2 months before transplanting will give better results.

**2. Softwood cuttings.** A softwood cutting (15-20cm long) from sexed trees are taken when shoots begin to become woody, remove the lower leaves, leaving 2-4 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 media. Rooted should be planted in pots for 1-2month before transplanting to field.

**C. LAYERING AND SUCKERS.** Root cuttings also can be an effective propagation method for sea buckthorn. Root cuttings were planted in pots and placed in a greenhouse for six weeks before being transplanted to the field at a spacing of 8x20cm. Cuttings need to be acclimatized to field conditions prior to planting by placing pots in a shady area for one week. The best results were obtained in sandy loam at pH 6-6.5 with medium humus content. Sea buckthorn easily produces suckers within a few years of planting which is a good source for propagation of plants where the sex is known. Make sure you get the proper ratio of male and female plants within each plantation.

**D. TISSUE CULTURE/MICROPROPAGATION.** In the last few years techniques have been developed for the micropropagation of many plants, including sea buckthorn and they are now available commercially. This process, like cuttings and suckering, give plants identical to the parent, while seeds do not.

## *Cultural Management*

Sea buckthorn normally is transplanted or direct seeded in the spring and water must be supplied for establishment. For commercial production in orchard like plantations, cultural management is clearly important and should include fertilization, spacing, pruning, irrigation and weed control.

**A. LAND PREPARATION.** Ideally, soil preparation should begin at least a year before planting, generally the site is sprayed to kill perennial weeds, then the planting site must be well cultivated at least twice. A cover crop before planting is valuable to increase organic matter in

the soil. Barley, oats, winter wheat or fall rye at the rate of 80 –150 kg/ha can be seeded and plowing under in the fall to allow decomposition before sea buckthorn is planted next spring. Sandy loam is the most suitable soil for sea buckthorn planting. Light sandy soil has low moisture retention capacity and may be improved by the addition of organic matter or various composts.

**B. SOIL TEXTURE AND pH.** In its natural environment, sea buckthorn plants are found on slopes, riverbanks, and seashores in a wide range of soil texture. Soil acidity and alkalinity, except at extreme levels, are not limiting factors, however, the most favorable range is pH 5.5 – 7.0. If the soil pH is too low, it can be corrected by application of lime such as dolomitic limestone. Clay and heavy loam without organic improvements are not suitable for sea buckthorn.

**C. PRECIPITATION AND SOIL MOISTURE.** When planting sea buckthorn in arid or semi-arid areas, water must be supplied for establishment. It can tolerate a little drought, but it is a moisture sensitive plant especially in the spring when plants are flowering and starting to set fruit. It can not tolerate high levels of ground water, therefore situating plants on soil with good drainage is essential. The optimal soil moisture for sea buckthorn is around 70%, inadequate soil moisture causes a reduction of leaf area and fruit set.

**D. SOIL FERTILITY.** Although exact nutrient levels required for sea buckthorn are not established, it is important to determine soil fertility and levels before planting, so that necessary lime and fertilizer can be applied to the soil. Just like any other crop, sea buckthorn requires adequate soil nutrients for a high yield with good quality. It responds well to phosphorus fertilizer, especially in soils low in phosphorus. Fertilizer recommendations are based on the results of a lab analysis. Manure or compost can also be applied before planting. Remember that sea buckthorn is a nitrogen fixing plant.

**E. PLANTING AND SPACING.** Spring is the best time for planting sea buckthorn. On light sandy soil, roots are buried 6-8cm deep to encourage the development of another tier of roots and they should be watered once a week after transplanting. In orchard planting, a spacing of 1 m within row and 3 to 4 m between rows is recommended. Rows should be oriented in a north-south direction to provide maximum sun exposure.

**F. MALE/FEMALE RATIO.** Since Sea buckthorn is a dioecious shrub, male and female plants have to be adequately distributed. For economical reasons, the ratio of male to female plants is important, as the number of female trees directly effect the total yield.

Recommendations for male and female ratio vary from 1:6 to 1:8. Reports from the Siberian Institute of Horticulture in Russia indicated that one male:female mixed row for every two rows of female plants is sufficient, and in the mixed row every fifth plant is male. This design gave significantly higher total yield than other designs.

If seedlings of unknown sex are planted, it will result in a 50/50 distribution of male and female plants within each planting. There are two approaches to avoid this problem, remove male plants and replace with female plants, or top graft on to the male plants once sex is established.

**G. PRUNING.** The purpose of pruning sea buckthorn is to train branches, promote growth and facilitate harvesting. Sea buckthorn may grow up to 2-3 m in four years. In an orchard-type planting, the tree should be pruned annually to remove overlapping branches, and long branches should be headed to encourage development of lateral shoots. Mature, fruiting plants should be pruned to allow more light penetration if the bush is dense. To prevent sea buckthorn from premature senescence, three year old branches should be pruned in the early winter for rejuvenation.

**H. WEED CONTROL.** Weed control is very important in sea buckthorn plantings. Proper weed control promotes growth of newly planted seedlings. Cultivation in new plantings should not disturb the soil 8-10 cm below the surface so that shallow roots are not damaged. Several chemicals are registered in Canada for weed control in sea buckthorn shelter belts, such as Linuron, Triflurelin, and Metribuzin. Low rates of simazine and lenacil applied 10 days after planting and again two months later gave effective weed control and increased survival rate and growth. In an orchard planting, it is ideal to have row covers such as grass between rows to enable harvesting and reduce erosion. Mulches between trees within the row will reduce the cost of weed control and keep soil moisture and temperature to promote better growth.

**I. PEST AND DISEASES.** At the present time, sea buckthorn has had relatively few pests reported. Of the insects, the most damaging is the green aphid (*Capithophorus hippophae*). The most serious diseases in sea buckthorn are verticillium wilt, scab, damping-off and fusarium wilt. Birds and mice are other pests which can destroy berries and girdle the trunk or chew up roots. Birds in B.C. don't seem to be a problem. There are no insecticides and fungicides registered in Canada for sea buckthorn at the time of this writing.

## *Harvesting*

Harvesting time varies with variety and planting location and each has about a two-week window for best quality. Fruit should be harvested when it has attained the necessary ripeness. There is about a two-week window for optimum fruit quality. The relatively small fruit size, short pedicel, force required to pull of each fruit, the density of fruit on the branch, and the thorniness of the plant are all disadvantages. Berries persist on the branches all winter, due to the absence of an abscission layer. This results in an attractive ornamental plant in winter but is an undesirable trait for harvesting. The total labour cost for harvesting an orchard of 4 ha was estimated to be 58% of the total cumulative production cost over 10 years. Therefore, one of the most important factors for the success of sea buckthorn as a viable cash crop is a better and more economical harvesting method. More research is needed to minimize the cost of labour for harvesting.

The development of mechanical harvesting techniques for sea buckthorn has attracted considerable attention. However, most have disadvantages, such as fruit and bark damage and low efficiency. The use of hormone treatments to facilitate fruit release is promising. Ethylene treatment, for example, may induce the formation of an abscission layer which could make harvesting more efficient. Long term breeding programs offer the best hope to reduce harvesting costs.

## *Yield*

Like any other crop, yield of sea buckthorn is affected by various factors such as genotype, soil condition, annual precipitation, temperature, crop management, numbers of fruit-bearing branches, and time and methods of harvesting. Yield data for sea buckthorn is scarce, since most fruit collection is from natural habitats, plantations for controlling soil and water erosion, and field shelter belts. In Germany, it was reported yield of 5 t/ha from an orchard plantation. In Saskatchewan, fruit production in shelter belts yields 4 – 5 t/ha. It was estimated that an orchard with 4,000 trees/ha and a 1:6 male and female ration, should yield approximately 10 t/ha. Detailed study is underway in Canada on the effects of crop management on yield.

## *Multi-purpose use*

**A. ENVIRONMENTAL VALUE.** The wide adaptation, fast growth, strong coppicing and suckering habits coupled with efficient nitrogen fixation make sea buckthorn particularly suitable for planting in degraded soils. Sea buckthorn can control soil erosion and water loss

effectively, and increased land reclamation. In Saskatchewan, sea buckthorn has proved highly beneficial for enhancement of wildlife habitat, farmstead shelter belts, erosion control, and land reclamation.

**B. CHEMICAL COMPONENTS.** Sea buckthorn fruit is rich in carbohydrates, protein, organic acids, amino acids and vitamins. Fruits contain 16-28mg carotenoids per 100g fruit which can be used as food additives. Flavonoid content in leaves and fruit ranges from 310-2100mg/100 g air dried leaf and 120-1000mg/100 g fresh fruit, respectively. Total volatile oil from the fruit is 36mg/kg, and essential oil extracted from seeds ranged from 8-12% w/w.

**C. NUTRITIONAL VALUES.** Sea buckthorn berries are among the most nutritious and vitamin-rich fruits known. The fruit, including seeds, contains large amount of essential oils and vitamin C. The vitamin C concentration in berries varies depending on species, geographical location, and physiological maturity, from 100 mg/100 g to 500mg/100 g. Sea buckthorn is also high in protein, especially globulins and albumins, and also carotene, fatty acids, and vitamin E. The leaves of sea buckthorn contain many nutrients and bioactive substances, similar to *Urtica dioica*, *Vaccinium myrtillis*, and *Berberis vulgaris*, which are all suitable for animal feed.

**D. MEDICINAL VALUE.** Medicinal uses of sea buckthorn are well documented in Asia and Europe. Sea buckthorn oil is approved for clinical use in hospitals in Russia. In China, it was formally listed in the "Pharmacopoeia" in 1977. More than ten different drugs have been developed from sea buckthorn in these countries and are available in different forms (eg., liquids, powders, plasters, films, pastes, pills, liniments, suppositories, aerosols, etc). The most important pharmacological functions of sea buckthorn oil can be summarized as diminishing inflammation, disinfecting bacteria, relieving pain, and promoting regeneration of tissues. It also can be used for skin grafting, cosmetology, and treatment of conical wounds.

## *Sea buckthorn products*

The basic value-added sea buckthorn products are juice, jam, preserves, compote and tea. Essential oil from seeds are the most valuable product and has medicinal value. High content of vitamin C in the fruits is another valuable natural product.

---

*T.S.C. Li Pacific Agri-Food Research Centre, Agriculture and Agri-Food Canada, Summerland, British Columbia, V0H 1Z0 and A. Oliver, B.C. Ministry of Agriculture, Food and Fisheries, Kamloops, British Columbia V2C 4N7*