Sea Buckthorn Production Guide

"The following guide has been compiled and cross-referenced to the horticultural experience of growers and research scientists in Russia, Sweden, Finland, Hungary, Germany, Mongolia, China and in most parameters has been verified by experience in the Provinces of Saskatchewan and British Columbia, Canada."

Dr. Thomas S.C. Li
Pacific Agri-Food Research Centre
Agriculture & Agri-Food Canada
Summerland, BC V0H 1Z0

Colin McLoughlin
Canada Seabuckthorn Enterprises Limited
Peachland, BC V0H 1X5

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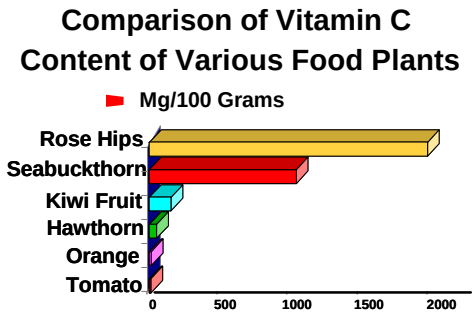
I. General Plant Information

Sea Buckthorn (*Hippophae rhamnoides* L.) is a unique and valuable multipurpose species currently being cultivated in various parts of the world, including Canada. It has considerable *in vita* economic potential; by definition, to the concept of food nutraceuticals in Canada, as being recognized as " a food or food ingredient which has health benefits, including the prevention and treatment of disease."

Quite remarkable and diverse growing conditions have been observed in wild and silviculture stands of sea buckthorn. However, from literature review and local experience gained in Saskatchewan and British Columbia, this production guide is presented to facilitate the growing and production capabilities for orchard management and the exploitation of the plants qualities.

Sea buckthorn is a hardy, fast growing deciduous tree-like shrub, between 2 to 4m tall, with yellow or orange berries. 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 under side. It is an ideal plant for soil erosion control, land reclamation, wildlife habitat enhancement, and farm shelterbelt protection, with nodule rooting capability of fixing nitrogen from the atmosphere.



Sea buckthorn needs a period of 4-5 years from the appearance of the first shoots from the seeds to the beginning of fruit and peaks at the 7-8th year of plant life, remaining productive for 30 years with intermittent pruning. An orchard planting can yield 10 tonnes of berries per hectare.

The leaves, berries and seeds of sea buckthorn have high nutritional and medicinal values, containing vitamins C, B1, B2, E, F, K, P, provitamin A, sugars and organic acids. An average protein content of 30%, with polyphenol activity, including such rare fatty acids and alkaloids as nervonic and serotonin, reputed to protect the human central nervous system from toxins such as radioactivity: with selenium included with 27 mineral elements.

Each berry contains one bony, ovoid seed. The fruit may be harvested on schedule of maturity defined to 25 days before the particular climate zones average first frost. The fruit is usually harvested by hand picking/stripping or flailed onto ground sheets from late fall to early spring.

The highly nutritional (vitamin C, etc.) leaves as a tea crop, should be harvested, from the male shrub only, during late June and mid July, so as not to interfere with the fruit set on the female shrub. The best nutritional time period is after fruit appearance (a minute green berry on the female shrub).

The species is dioecious, the sex cannot be determined in the seed, or prior to 3-4 years of growth, on or during budding of both vegetative and mixed (vegetative–generative) buds when initiated along shoots. The vegetative buds form primarily on plants which are not bearing fruit. On fruiting plants, the mixed buds are formed. These in appearance, according to the gender, on male plants the buds are larger, more protruding and have 6-8 covering scales.

On female plants the buds are smaller, more elongated, sensile on the branch, and have only two covering scales. At appearance, transplanting may occur to facilitate the establishment of the correct ratio (male/female), required for optimum production in the orchard.

Very small yellowish pistolate flowers appear, usually before the leaves, late April to mid May. Cross-pollination is by windblown action only. The yellow-orange, drupelike, clustered berries, pea-sized, appear mostly on the previous years growth; they ripen in the fall and frequently cling on the shrub until the following March/April.

Cultivars, (seeds etc.) recommended, have been evaluated on the various (nine) species morphological, phenological and production characteristics. For example, the production characteristics used were the yield, ability for harvest, organoleptical test of fruit, chemical analysis of ingredients and disease resistance. Hence the two cultivars recommended for the present time in Canada as being economical for production, are — *H. rhamnoides* cv. indian-summer and *H. rhamnoides* spp. sinensis.

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II. Ecosystem to Orchard Management

In natural conditions, sea buckthorn is found growing profusely on a wide range of soil types, but does better in soils with a light physical structure, rich in nutrient compounds, with a pH near neutral (pH 6.5-7.5). Best growth occurs in deep, well drained, sandy loam with ample organic matter.

Under cultivation, sea buckthorn has been grown on various types of soils: on chernozems, brown soils, grey forest soils, turf carbonates, turf-podzols, peaty loams and peaty-swampy soils with various physical structures such as sandy, semi-sandy, semi-clayey, and even clayey in all horizons. Keeping in mind conditions that best fulfil the needs of sea buckthorn root system regarding water and air relationships and soil pH near normal. Very light, sandy soils have low water carrying capacity and are also low in nutrient mineral elements; so without the previous addition of organic matter, are not appropriate. Similarly inappropriate are clayey soils, with high density and water retention characteristics.

Determining Soil Type

Draw a simple map of the area you intend to sample. This provides an important reference for soil preparation and planting.

*Special Features

Mark areas with special features on your soil sampling map and indicate the nature such as:

stoniness	scattered, medium, very stony
poor drainage	seepage areas
gravel ridges	
depth to water table if present	

*Soil Texturing Guide

1. Take a small handful of soil
2. Add small amounts of water while kneading soil until clods are broken down and soil becomes pasty
3. Determine texture by rubbing soil paste between finger and thumb, using the guide below

*Texture Guide

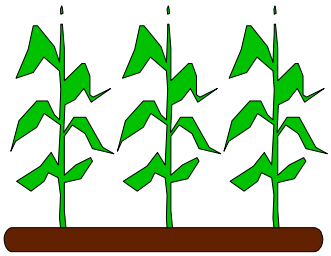
gravel	usually from peat to egg sized stones
sand	feels "gritty" and will not form a ball when pressed
silt	soapy or velvet like — will form a ball
clay	sticky — will form a tight ball
loam	mixture of sand, silt and clay

Soils rarely consist of pure sand, silt or gravel. Usually the soil is a mixture of these components and is described as:

SAND loamy sand, sandy loam	light or coarse textured soil
LOAM fine sandy loam, silt loam	medium textured soil
CLAY LOAM silty clay loam, silty clay, clay	Heavy, or fine textured soil

***1983 BC Ministry of Agriculture Irrigation Design Manual**

III. Cultural Management



1. Drainage and Irrigation

Sea buckthorn can tolerate a little drought but it is a moisture sensitive plant especially in the spring when plants are flowering and young fruits are beginning to develop. Planting in arid or semi-arid areas, water must be supplied for establishment. For economic reasons, sea buckthorn orchard plantings should be restricted to areas receiving a minimum of 400mm of annual precipitation, unless irrigated. It cannot tolerate over the crown, high water table or long term inundation (two weeks), therefore situating plants on sandy loam soil on slight slopes with good drainage is best. The optimal soil moisture for mature, sea buckthorn, depending on soil type, is around 70%, inadequate soil moisture causes a reduction of leaf area and fruit set.

Sea buckthorn has high requirements for nutrient mineral element content of the soil. The micro-element consumed in the highest quantity is phosphorus. It is indispensable for the normal life process of the nodules on the roots. The plant requires little nitrogen, and potassium is negligible.

2. Fertilizers and Lime

Soil testing: Results from a soil analysis are the most accurate guide to fertilizer and lime requirements. It is important to determine soil fertility and pH levels before planting, so that necessary lime and fertilizer can be applied to the soil.

Fertilizer recommendations: Sea buckthorn, just like any other crop, requires adequate soil nutrients for a high yield of good quality fruits. Sea buckthorn responds well to phosphorus fertilizer, especially in soils low in phosphorus. Fertilizer recommendations should be based on the results of soil analysis.

Method of fertilizer application: There are various methods of fertilizer application. It can be broadcast on the soil surface and incorporated into the soil with tillage. Top dressing method can be used when sea buckthorn is growing. Fertigation is another effective alternative way to apply fertilizer.

Lime: Sea buckthorn can tolerate a wide range of soil pH, but a pH level between 5.5-7.0 is ideal. Soil acidity can be corrected by the application of lime. Use of some dolomitic limestone is recommended since it contains a significant quantity of magnesium which is an essential and often deficient plant nutrient. Quick lime, caustic lime, and burned lime are not recommended on agricultural land.

Manure or compost: Manure or compost supplies plant food over a period of time, cow and poultry manures are commonly used. Maximum application rates of dairy manure should be about 45 tonnes/ha and poultry manure should be applied at no more than 20 tonnes/ha on cropped land.

Cover crops: A cover crop before the land is to be planted with sea buckthorn is valuable in increasing organic matter in the soil and preventing nutrient losses and erosion

by wind and water. Barley, oats or winter cereals such as winter wheat and fall rye at the rate of 80-150 kg/ha can be seeded in the fall and plowed under in the early spring to allow decomposition before sea buckthorn planting.

Nutrient deficiencies and corrective treatments: There is very limited information in the literature regarding the nutrient deficiencies on sea buckthorn. Some of the information is based on other crops, fertilizer recommendations are quoted from other countries research institutes publications as follows:

Symptom	Deficiency	Treatment
Foliage is pale green or yellowish and later leaf senescence and dehiscence are accelerated, plants are smaller than normal, leaf area is reduced	Nitrogen and/or phosphorus deficiency	Nitrogen and phosphorus fertilizer should be applied early in the spring in the forms of ammonium nitrate around 20g/m^2 and phosphate fertilizer (superphosphate) should be added in the fall at a rate of 20-30g/m^2, the rates should be based on the results of soil analysis.
Pale leaf colour, marginal chlorosis, scorch, shortening of stem internodes, death of the terminal bud	Potassium deficiency	Potassium fertilizer should be added with the phosphorus at 20-25g/m^2 of potassium chloride.
Terminal leaves normal, basal leaves marginal chlorosis with V pattern, this symptom occurs when potassium is high or soil is acid, especially in young, vigorous trees and defoliation begins from the base of shoots and progressively affects the leaves above	Magnesium deficiency	As required Custom blend
Delayed opening of flower and leaf buds in the spring, small chlorotic leaves, shortened internodes and little leaves along the shoot, reduced growth and small fruits	Zinc deficiency	As required Custom blend
Loss of chlorophyll and leaves become chlorotic, interveinal areas become yellow but the veins remain green, symptoms develop first on young leaves	Iron deficiency Iron deficiency can result when there is insufficient iron in the soil, sufficient but unavailable iron or sufficient and available iron that is not properly utilized in the plant	As required Custom blend

Other symptoms caused by physiological factors

Symptom	Factor
Smaller crowns and lower yields	Result of shading effect. Sea buckthorn can only be grown on well-lit unshaded areas
Poor growth and beginning of rot at the root zone	Too much water or ground water level is too high. Plant sea buckthorn on slight slopes or sandy loam soil with good drainage
Small leaf area and low fruit set	Lack of adequate soil moisture. Sea buckthorn is a moisture loving crop which needs irrigation regularly especially in the summer
Die back of branches with late emerging small leaves	Winter or frost damage
Breakage of branches	Heavy damp snow clings to branches
Leaves wilt, turn yellow and drop	Lack of moisture

IV. Planting

1. Sterilization and Fumigation of Soil

Normally soil fumigation is not needed before sea buckthorn planting unless the field is known to be infested with disease in previous crops which may affect sea buckthorn, an example would be root type crops.

2. Land Preparation

Ideally, soil preparation should begin at least a year before planting. Planting site should be well cultivated, removing all the roots of perennial weeds. Depending on soil analyses, a good cover crop, such as rye or green vegetable, before planting is recommended to increase organic matter in the soil. Light sandy soil has low moisture retention capacity and may be improved by the addition of organic matter, manure or various composts. If the soil pH is too low, liming the entire surface is necessary, also clay and heavy loam without mineral improvements are unsuitable for sea buckthorn.

3. Propagated by Seeds

Propagation from seed is relatively simple and produces a large number of seedlings at fairly low cost compared with other propagation methods. Seeds can be stored up to 3 years before lost viability.
(**Figures I & II**)

Manual of Woody Plants, 1927

A. Seed treatment before seeding

Hot water: Prior to sowing, the seeds should be soaked in water for 48 hours and at this time seeds that are floating should be discarded. Other reports indicated that soaking seeds at a temperature of 70 ?C and stirred intermittently until the temperature drops to 10-15 ?C then leave standing 48 hours may improve germination rate. The results from our experiment indicated that the water temperature did not show any significant differences for germination rates, but seed soaking before seeding shortened the days required to start and complete germination compared to non-soaking seeds.

Chemical: Experimentally, seeds were treated with GA_3 and KNO_3 (rooting hormone) for 48 hours before seeding which did not improve germination rate significantly among species tested.

Bleach Solution: to prevent fungal infection of cotyledon on emergenge, we recommend a 20 minute soaking in 10% bleach solution before planting. (Figure I & II) The ratio of 10 parts water to 1 part bleach is based on 5.25% sodium hypochlorite content, which is the normal concentration in household bleach.

B. Direct-seeding outdoors - Seed depth and germination

The results from our experiments indicated that seeding at soil surface has significantly higher emergence rates than the depth of 1 and 2 cm. Soil should be irrigated (mist) periodically to prevent seeds drying out. If seeding in late spring, seeds should be covered with a 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 4 m. between the rows.

C. Seeding indoors and transplanting

Sea buckthorn seeds can be seeded indoors in pots, in sterilized soil, in January or early February, one seedling per pot is allowed to grow for 3 months before transplanting in early May. Manufactured tree seedling trays can be used for early greenhouse mass production. Size recommended is 2"-4" diameter - 12" deep.

Spring is the best time for planting sea buckthorn. On light sandy soil, the root is buried 6-8cm. deep to encourage the development of another tier of roots. They should be watered once every week after transplanting. In orchard planting, a spacing of 1m. within the row and 4m. between rows is recommended, although high density planting of 1X1m. is being considered in Europe. Rows should be oriented in a north–south direction to provide maximum light.

4. Propagation by 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, layering and suckers.

Hardwood Cuttings

Hardwood cuttings should be chosen from healthy, well developed plants in fruiting stage. Cuttings (15-20cm. long) should be taken from the previous year's growth during dormancy in the late fall or in the early spring. One week before planting, bundles of cuttings are soaked in water (room temperature and change once a day) and covering 2/3 of their length until the beginning of root formation. Cuttings can be transplanted when the roots are 1-2cm. long. Rooted cuttings can be directly planted outdoors in the field, but planting in pots, under a controlled environment for 1 to 2 months before transplanting will give better results.

Softwood cuttings

The advantage of softwood cutting propagation is its high success rate. Softwood cuttings (15-20cm. long) 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 rooting in media such as sand or perlite. Pay special attention to the moisture of the media [*mist*]. Rooted cuttings should be planted in pots for 1-2 months before transplanting to the field.

Root cuttings and suckers

Root cuttings also can be an effective propagation method for sea buckthorn. Root cuttings are planted in pots in a greenhouse for 6-8 weeks before transplanting to the field in spring. Sea buckthorn easily produces suckers within a few years of planting, which is a good source for propagation, but sometimes do not carry the good genetics of the mother plant.

5. Male/female ratio ? ?

For economic reasons, the ratio of male to female plants is important, as the number of female trees in each planting directly affects the total yield. If seedlings of unknown sex are planted, it may result in an uneven 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 vegetative propagation from mature plants of known sex.

Recommendations for male and female ratio vary from 6 to 12%. A report from Siberian Institute of Horticulture in Russia indicated that one male:female mixed row for every two rows of female plants and in the mixed row every fifth plant is male. This design gave significantly higher total yield than other designs. **(Figure: III)**

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Figure III disposition of Pollinisers

According to this disposition, between every two lines of female plants there is a mixed line. In this mixed line, after every four female plants there is a male plant. This means the pollinisers account for 6-7% of the total plants. Generally, the distance within which the female plant can be pollinated is about 100m. Investigations have shown that as the distance from the female plant to the male plant (polliniser) increases (64m or so), the yield of the female plant decreases. Therefore, for balanced pollination, the disposition of pollinisers illustrated above is suitable.

Lu Rongsen, 1992

Our estimate of orchard planting with 4,000 trees per hectare and a 1:6 male and female ratio, should yield approximately 10 tonnes.

6. Pruning

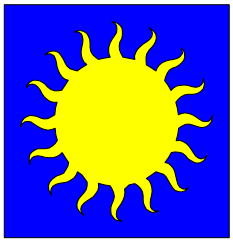
The purpose of pruning sea buckthorn is to train branches, promote growth and facilitate harvesting. Moderate pruning will increase the yield and fruiting life of the plants. The crown should be pruned to remove overlapping branches, and long branches should be cut to encourage development of lateral shoots. Mature fruiting plants should be pruned to allow more light penetration. Pruning is also recommended to eliminate thorns on the mature wood to facilitate harvesting.

7. Mulches and row covers

In an orchard planting, it is ideal to have row covers such as grass between rows to reduce loss of soil moisture. Mulches between trees within the row will reduce the cost of weed control and keep soil moisture and temperature to

promote better growth. The use of black plastic during first 3-4 years from seed is ideal for moisture conservation and weed control.

V. Temperature and Light Requirements



Irrespective of the plants' winter hardiness, sea buckthorn has high requirements to temperature. Vegetation begins at average daily air temperature of 5-7 ?C. It flowers at temperature10-15 ?C and requires total effective temperatures, spring to harvest time, of 1445 ?C to 1750 ?C, depending on latitude/elevation and species.

It is considered by biochemists that higher air temperatures facilitate the accumulation of carotenoids, while cool, rainy weather, favours ascorbic acid formation.

Frost hardiness, i.e., resistance of the plant tissues and organs to low negative temperatures, is the highest in deep dormancy November-December. At this time, negative temperatures of -50 ?C may be tolerated. However, warm spells may cause lessening of the frost resistance of buds, especially the male plants, due to their more advanced stage of development. Therefore, in the less dormant period of January to March, the critical temperature drops in air temperature for the male to -30 ?C to -35 ?C and for the female, -40 ?C to -45 ?C. However, in Saskatchewan, a period of 3 days in early March 1996, when the temperature was -70 ?C, including the wind-chill factor, no damage to the plant was observed. Wet heavy snow conditions should be avoided due to breakage of branches. South-east sloping terrain is recommended to facilitate the maximum sunlight exposure, with orchard row alignment North to South. With optimum pruning, spacing is 3m between rows and in rows at 1m. The heat availability during the growing period plays an important role in productivity. Indications are that higher air temperature during June and July facilitate the accumulation of fats and sugar in fruit, while cool, rainy weather favours ascorbic acid. Latitude and altitude also increases carotene content, within limits, the higher the better.

Sea buckthorn can only be grown in well-lit, unshaded areas. Starting from its very earliest stage of development, it cannot tolerate shade. If seedlings or rooted cuttings are shaded by weedy plants during the first year of growth, seedlings or cuttings will die out within a single vegetative period. Shaded mature plants produce smaller crowns and lower yield than plants without shade.?????

VI. Pest Management

1. Insects, diseases and others

At present time, sea buckthorn has relatively few pests and diseases. In tea production (leaves) the most damaging of insects is the green aphid (*Capithophorus hippophae*), which can be controlled with an insecticide soap. The most serious diseases in sea buckthorn is verticillium wilt, scab, damping-off and fusarium wilt.

Mice and rats are other pests which can destroy and girdle the trunk or chew up roots. Game birds, such as pheasants or grouse eat berries during the winter months, ordinary birds do not touch. There are no insecticides and fungicides registered in Canada for sea buckthorn. Growers are advised to read Fruit Tree Production Guide or to consult with local horticulturist in the Saskatchewan or BC Ministry of Agriculture, Food and Forest.

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2. Weed control

Weed control or vegetation management is very important in sea buckthorn plantings. Proper weed control promotes growth of newly planted seedlings. Only low concentration of herbicides should be used. Several chemicals are registered in Canada for weed control. As stated, black plastic may be used to control weeds during orchard establishment, also to retain standards for organic production.

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VII. Harvesting

1. Options to Harvesting

Fruit harvest is the most time consuming operation in growing sea buckthorn. The relatively small fruit size, short pedicel, force required to pull off each fruit, the density of fruit on the branch, and the thorniness of the plant, are the disadvantages during harvesting.

Time for harvesting varies with variety and planting area. Fruit should be harvested when it has attained the necessary ripeness. High ascorbic acid is common in unripe fruits when they are harvested too early. A good rule of thumb is 25 days before the orchard regions historical first recorded frost to commencement of harvesting.

There are many harvesting methods available, including mechanical harvesting and harvesting devices for sea buckthorn at the present time. An average harvester can hand pick, 7kg of berries in one hour.

Observations in the ripening process indicate the berry cluster ripens evenly, hence the decision to begin harvesting is to a large degree dependant on the grower and intended use of the farm gate product.

It can be expected that 15% of the berries burst during harvest, even by hand picking. However this loss is only the juice. The pulp and seed remain as a valuable product for oil producing market.

During the maturing, fresh fruit harvesting period, some of the active ingredients vary in quality and quantity within the juice, for example – ascorbic acid (Vc) could vary from 15mg/100g to 250mg/100g. Whereas in the pulp and seed, even over winter, very little variance in active ingredients is noted.

The option to harvest therefore as stated, depends on the grower and customers requirements. Methods of harvesting include U-pick, hired hand-pick, or mechanical, again a customer requirement.

Hand Harvesting

U-Pick: this method passes on to the customer all labour and costs associated with harvesting, cooling, storage and transportation. Small operations, especially close to population centres can best use U-pick. Growers can use U-pick at maturity, and what is left can be harvested, when frozen, over winter, to a processing plant. This method is good before yields are large enough for paid labour or cost of mechanical harvester.

Hired Pickers: the availability of labour to harvest could pose a problem. Growers should consider contracting out, experience has shown that three people are required to harvest one acre, at 5000kg. per acre over the 25 day

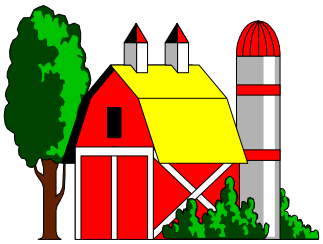
period, giving careful instructions to ensure a clean, top quality product, for example, to the grocery shelf. If farmgate product is used for the processing plant then some leaf contamination may be acceptable. Picking shoulder harness trays may be utilized or stripping to ground sheet collection. Note that minimal damage to shrub is experienced by this method, ensuring a harvest the following year.

Mechanical Harvesting

Except when frozen on the shrub, fresh fruit mechanical harvesting is still in the development stage. Principally this is due to the difficulty in separating the stem(pedicel) from the berry (pericarp). The mechanical harvesting method usually eliminates the necessity for maintenance pruning, leaving a hedge that has been uniformly cut back. This method results in a two year harvesting cycle but increases harvesting productivity to 600 kg/hour in comparison to 7kg/hour by hand picking, with crop waste of 10%. This method is only justified on large acreages. A trunk clamp-on vibrator harvester may be used when the fruit is frozen on the shrub. Contamination is high, requiring berry cleaning equipment.

Note that with all above options, the removal of woody contaminants is the primary cleaning job. Leaves, depending on customer use, when included in the processing (jams, concentrate or oils), contain valuable active ingredients including up to a 24% protein content; enhancing the constituents of the fruit.

2. After Harvest Handling and Storage

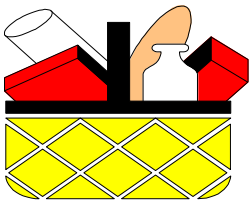


After harvest the berries should be placed in shaded area in flats no more than 6 inches (15.24cm) deep. Pre-cooling for storage is advisable if high temperatures (+20 ?C) at harvest, especially if breakage occurs at harvest and before cleaning. Fresh market berries, after cleaning, should be delivered and sold within five days. After cleaning, residue (burst berry etc.) can be included in fruit shipment for processing (jams, oils, etc.), where quick frozen, remaining at -18 ?C until required in processing plant. Sea buckthorn does store very well. Respiration is very minimal in comparison to other berries such as saskatoons or raspberries. During storage at 20 ?C, the respiration rate comparison is — saskatoons 100, raspberries 200 and sea buckthorn 50.

If berries are to be shipped to a processing plant, growers should build a pre-cooler on their property, relative in size to yield. A walk-in type cooler/wind tunnel is relatively inexpensive to construct. Maximum containment in cooler of ten days is recommended before shipment in cooler transport, to the processing plant. Shipment should be contained (once fruit is cooled) in plastic wrapping, and then placed in cold storage at the processing plant at a temperature below freezing (-1 to -2 ?C) if processed within 30 days. Fruit can

be frozen to -18 ?C for long term storage (1 year) without further loss of ingredients.

VIII. Sea Buckthorn Products



The basic processed sea buckthorn products are juice, beer, wine, jam, preserves, compote and tea (from leaves). Essential oil from seeds and berry pulp are the most valuable product which has medicinal values. High contents of Vitamin C and carotenes are another valuable natural product. Considerable research is currently being conducted into the pharmaceutical, cosmeceutical and nutraceutical applications of sea buckthorn. The following table outlines the major constituents of sea buckthorn.

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The Principal Biochemical Constituents in Sea Buckthorn

Main Components	Contents
Fruit juice extraction rate	65%–75%
Oil in fruit pulp	8.44%
Oil in seeds	10.37%
V_C in fruit juice	1161.1–1302.5mg/100g
V_A in fruit juice	0.75mg/100g
Carotenoid in fruit juice	7.2–7.4mg/100g
Soluble solids in fruit juice	15.92–17.66
Carotenoid in fruit pulp oil	764mg/100g
Carotenoid in fruit residue oil	1570mg/100g
V_E in seed oil	101.5–277.6mg/100g
V_E in fruit pulp oil	255-435mg/100g
Total flavone in fruit juice	365-885mg/100g
Total flavone in fresh fruit	354mg/100g
Total flavone in leaves	876mg/100g
Protein in leaves	17.43-24.13%
Protein in seeds	21.66%
Protein in berry	34.6%

International Sea buckthorn Conference, 1989

Note: All values calculated from analytic results in weight/weight component content.

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Glossary

basal leaves	leaves growing at the bottom of plant, closest to soil
chlorosis	yellowing of leaf due to reduction in chlorophyll level
defoliation	loss of leaves (shedding)
dehisence	opening or splitting of plant part to shed pollen or seed
drupelike	divided pericarp, i.e. skin, seed, fleshy pulp
fertigation	introduction of fertilizer into water in irrigation system
fumigant	a chemical used to kill pathogens in the soil
GA_3	rooting hormone
hardwood cutting	previous year's plant growth
interveinal	leaf area between veins
KNO_3	rooting hormone
morphological	structure of fruit - anatomy
nervonic	mono-ethenoid acid, usually found in fish oils. obtained from brain cerebrosides
organoleptical	fruit development - bloom etc.
ovoid	shape of an egg
pathogen	disease causing agent
phenological	interaction of fruit to environment
propagate	divide, sow, take cuttings - "how to", needs for plant growth
respiration rate	moisture expelled per ?C rise
root cutting	cutting from root: minimum 15 cm.
senescence	the period between maturity and death of a plant
sensile	organs receiving ability to stimuli from internal or external environment
serotonin	neurotransmitter of amino acids
softwood cutting	present year's plant growth
stem internodes	the length of the stem which lies between the two leaf joints (nodes)
sucker	turions - plant growth, usually from lateral roots
terminal bud	situated at the tip (apex)

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Sources of Information and Assistance

British Columbia

? ? Pacific Agri-Food Research Centre, Agriculture and Agri-Food Canada, Summerland British Columbia
250.494.6375 Tom Li <LiT@EM.AGR.CA>

? ? District Agricultural Offices, BC Ministry of Agriculture, Food and Fishery

Abbotsford	604.556.3029
Kelowna	250.861.7211
Vernon	250.260.3000
Kamloops	250.828.4552
Creston	250.428.3255

? ? Similkameen-Okanagan Organic Producers Association
250.498.2785

? ? BC Nursery Trades Association
604.574.7772

? ? Department of Plant Sciences, University of British Columbia
604.228.2430

? ? Soil Testing Laboratory
Griffin Laboratories Corp.
Kelowna, BC 250.765.3399

? ? Canada Seabuckthorn Enterprises Ltd.
RR2 S33 C24, 4154 Ponderosa Drive
Peachland, BC V0H 1X0
250.767.9188 Fax: 250.767.9156
smclough@awinc.com Website: www.seabuckthorn.com

? ?? ?? ??

Saskatchewan

? ? Shelterbelt Centre, Prairie Farm Rehabilitation Administration, Agriculture and Agri-Food Canada, Indian Head, Saskatchewan
306.695.2284

? ? Department of Crop Science, University of Saskatchewan
306.966.5855

? ? Saskatchewan Fruit Growers Association
306.771.2823

? ? Fruit/Berry Specialist
Clarence Peters
306.787.4666

? ? Marketing Specialist
Barbara Cox-Lloyd
306.787.5966

? ? Soils Specialist
Brandon Green
306.787.0556

? ? Horticulture Research Centre, Alberta Agriculture, Brooks, Alberta
403.362.3391

? ?? ?? ??

Useful Publications

The following publications are generally available through the district offices of the British Columbia Ministry of Agriculture and Fisheries or from Agriculture Canada, Publications Branch, Ottawa, ON. However, some publications may be in short supply or may even be temporarily out of stock as they are currently being revised.

? Drainage and Irrigation

? 1. Farmland Drainage
? 2. Drainage Through Ditches and Surface Grading A Checklist for the Maintenance of Irrigation Systems

? Economics and Marketing

? 1. Sources of Farm Credit in BC
? 2. Taxation and the BC Farmer
? 3. Producers Consensus Costs and Returns (request list of publications)
? 4. Farm Business Management Factsheets (request to be on mailing list)
? 5. Vegetable Marketing Guide

? Horticulture

? 1. Horticultural Recommendations: (applies to different regions of BC)

? Soils and Fertilizers

? 1. Boron
? 2. Soil Testing Methods and Interpretations
? 3. Green Manuring Crops
? 4. Management and Nutrient Value of Manure (Engineering Notes)
? 5. Soil pH
? 6. Soil Sampling
? 7. Lime in Agriculture
? 8. Soil Erosion by Water - (Ag Canada #1083)
? 9. Soil Management Handbook For the Fraser Valley

? Storage

? 1. Commercial Storage of Fruits & Vegetables (Ag Canada #1532)
? 2. Storage of Fruits and Vegetables

? Production Guides

? 1. Berry Production Guide
? 2. Tree Fruit Production Guide
? 3. Grape Spray Chart & Guides
? 4. Nursery Production Guide
? 5. Field Crops Guide

? Plant Pests and Control

? 1. Major Insect and Allied Pests of Vegetables in BC
? 2. Clubroot of Crucifers in BC
? 3. Description, Life History and Control of Leatherjackets
? 4. Bird Damage Control for Agricultural Land in BC: Central and South Interior
? 5. Mole Control in British Columbia
? 6. Rodent Control on Agricultural Land in BC
? 7. Field Sprayers (Ag Canada # 1482)
? 8. Field Spraying Equipment (Engineering Notes)
? 9. Pesticide Notes:
? - Pesticide Spills on the Farm
- Emergency Procedures for Pesticide Poisoning
- Disposal of Unwanted Pesticides
- Disposal of Pesticide Containers
? 10. Handbook for Pesticide Applicators and Pesticide Weed Dispensers
? 11. Weed Control Leaflets

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