

Techniques for improved forest management



Published by

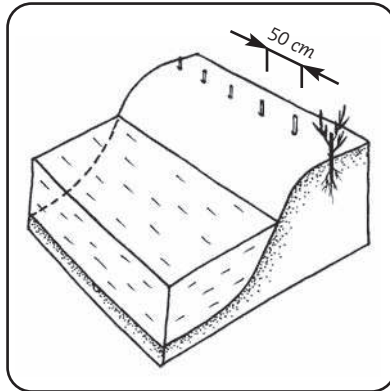
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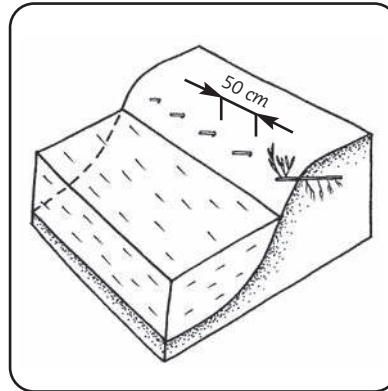
Embankment stabilization

With cuttings

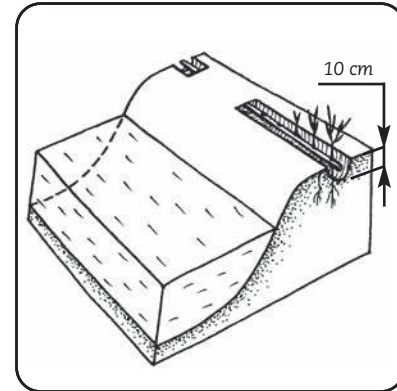
Short cuttings



Short cuttings



Long cuttings



Length of cuttings 30 to 50 cm. Cuttings will grow to trees and shrubs, their roots will stabilize the embankment. Use mainly willow, it can be mixed with sea buckthorn and poplar or other species.

Horizontal planting 10 cm deep; length of cuttings 250 to 300 cm

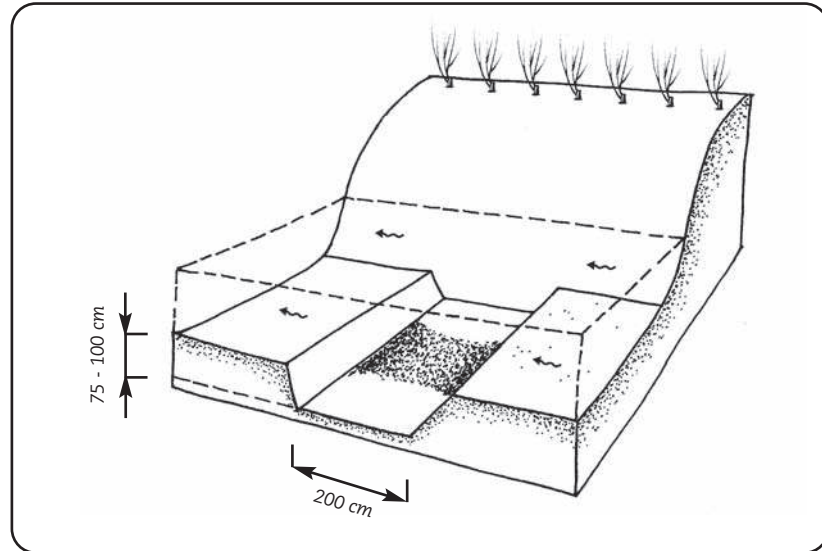




Silt trap

To decrease siltation of canals

In case the water carries a lot of sediments, the construction of silt traps might become necessary. Silt traps require permanent maintenance: they have to be emptied immediately when they are filled up. In case one silt trap is not sufficient, two or more can be installed into a channel.





Safety

Check and prepare the work area

- No person or animal should be in the felling area. Everyone has to keep a safety distance of at least two tree lengths!
- Identify hazards such as electricity or telecommunication lines, or other infrastructure!
- Never cut on days of high wind velocity!

Check the tree to be felt

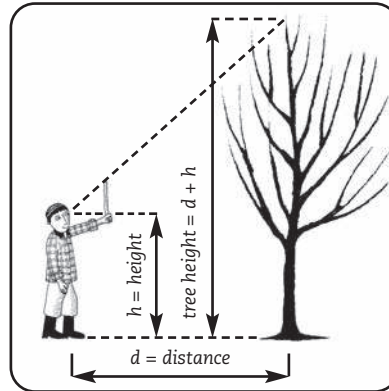
- Determine the felling direction and clear it if necessary!
- Clear the work area around the base of the tree!
- Establish an escape route!
- Look at the top of the tree for dead or loose branches!
- Cut off any low branches that may disturb the felling and falling!



Safety

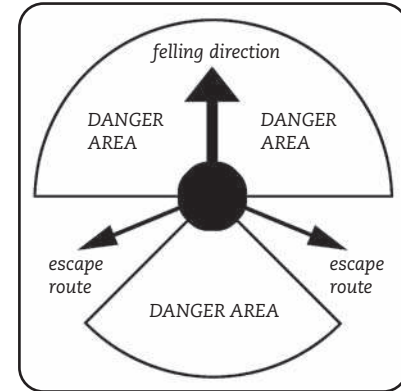
Height evaluation

Prepare a stick of the length of your arm. Extend your arm horizontally and hold the stick upright in front of your eyes. Move back (or forward) until you see the top of the tree at the top of the stick. Measure the distance between you and the tree. Add your personal height to the measured distance. The result equals the height of the tree.



Learn how to estimate the height of a tree to determine how far it will reach when it falls!

Escape route

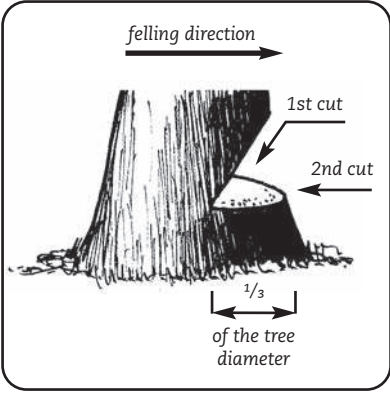


Before beginning to fell, always check for an escape route, diagonally away from the planned felling direction.



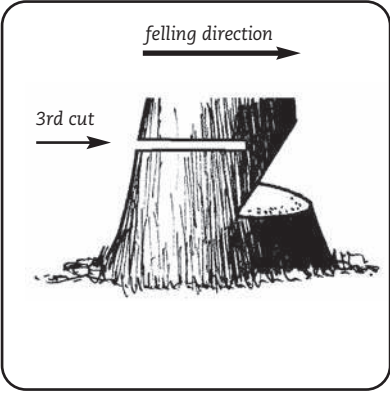
Felling operations

1 Notch



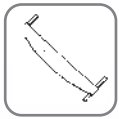
Cut a notch into the stem on the side of the direction the tree should fall.

2 Back cut



Make the back cut opposite the notch at the upper level of the notch. Do not cut stem completely through!

Leave sufficient wood between notch and back cut for a safer falling; otherwise the tree could kick back.



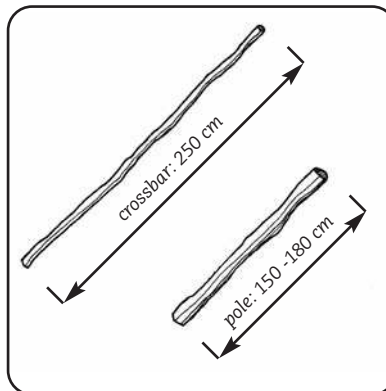


Fencing with one crossbar

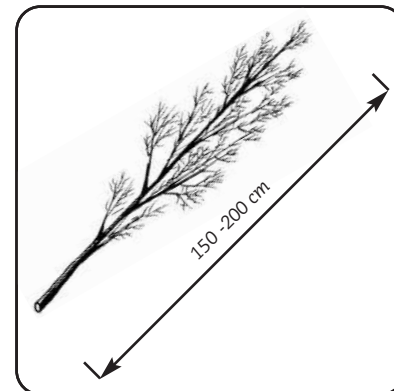
Preparation of material

For 1 fence element
you need:

- 2 crossbars / sticks
- 1 pole
- 1 m³ sea buckthorn
- 2 m wire



Prepare crossbars and poles from willow.



Cut sea buckthorn into pieces, each 150 to 200 cm long.





fencing

Fencing with one crossbar

Assembling of an element

1



Lay 1 crossbar on the ground and put sea buckthorn on top of it.

2



Then lay the other crossbar onto the sea buckthorn, parallel to the crossbar below.





Fencing with one crossbar

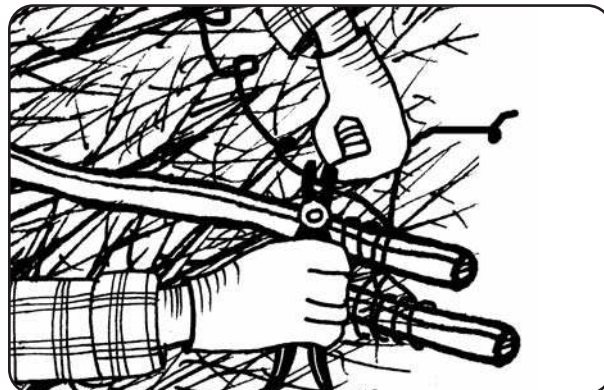
Assembling of an element

3



On 2 to 3 places connect the back and front crossbars with wire...

4



...to fix the thorny material inbetween.





fencing

Fencing with one crossbar

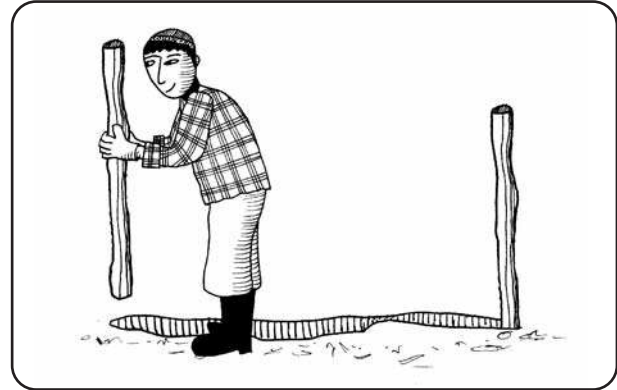
Set up of elements

5



Dig a narrow ditch similar to the length of the fence element.

6



Dig deeper holes for the poles and fix them in the ground.

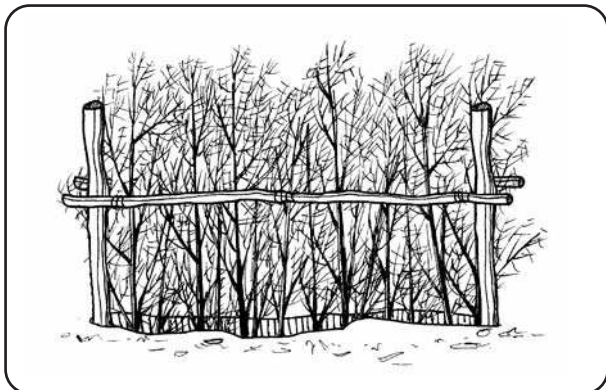




Fencing with one crossbar

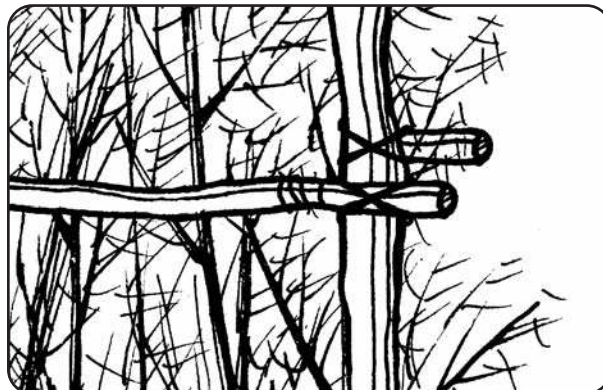
Set up of elements

7



Stick the fence element upright into the ditch between the poles.

8



Fix the crossbars with wire to the poles.





fencing

Fencing with one crossbar

Set up of elements

9



Fill the ditch with soil...

10



...and compact it by stepping.

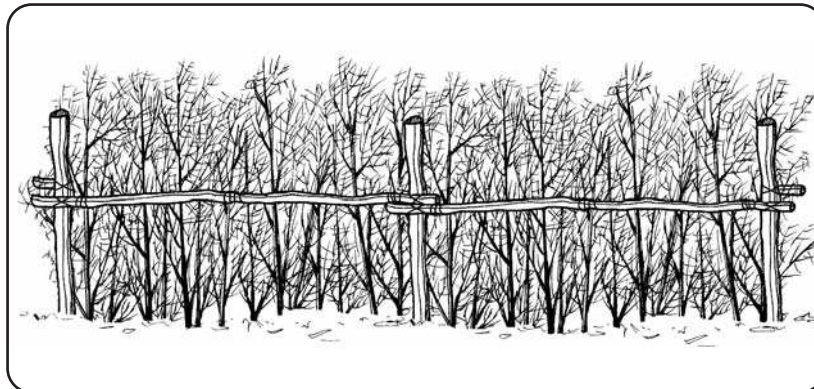




Fencing with one crossbar

Connecting elements

11



Combine fence elements...

12



...by fixing them to the joint poles

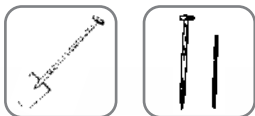


Planting of living fence

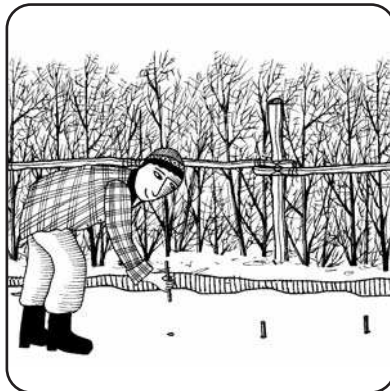
1



Dig a little canal for watering alongside the fence inside the fenced area.

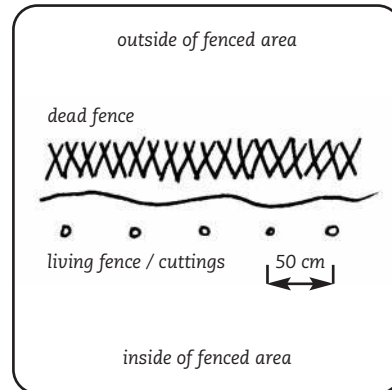


2



Plant a female sea buckthorn cutting every 50 cm along the canal.

3



Schematic view (as seen from above)



Local Species

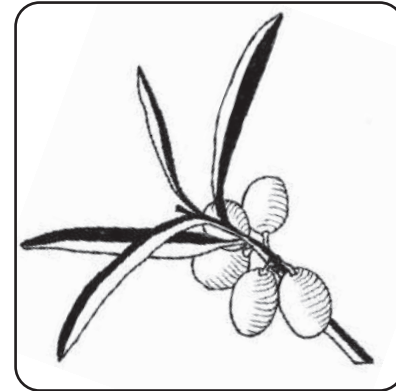
Willow



Poplar



Sea Buckthorn





Sowing

Direct Sowing

1



Prepare the sowing area by hoeing and / or by removing grass and weeds.

2



Sow seeds directly onto the soil.





Sowing

Direct Sowing

3



Cover the seeds with soil or sand; max 10 mm.

4



Soil should be irrigated (mist) periodically to prevent seeds drying out.

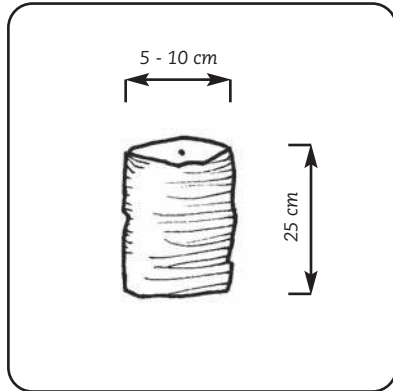




Sowing

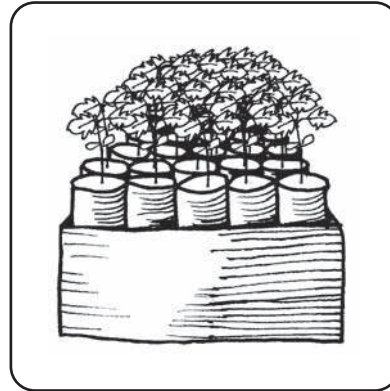
Seeding indoors and transplanting: Poly bags

1



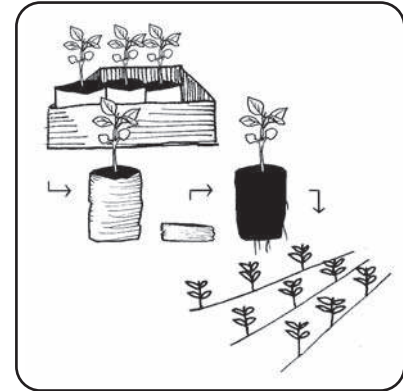
In January / early February seeds can be sowed indoors into poly bags, in sterilized soil.

2



Put poly bags into transport boxes and let the seedlings grow for up to three months...

3



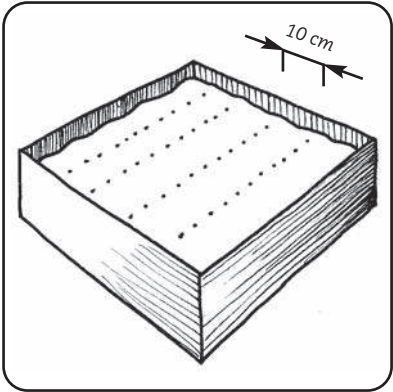
...before transplanting them directly onto the planting area in May / June.



Sowing

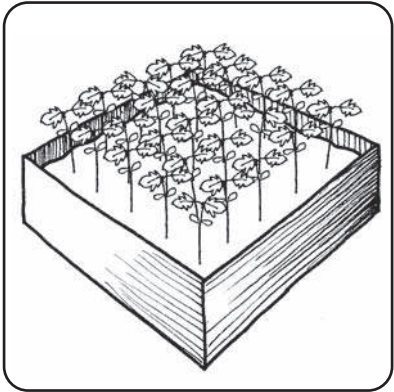
Seeding indoors and transplanting: Seed boxes

1



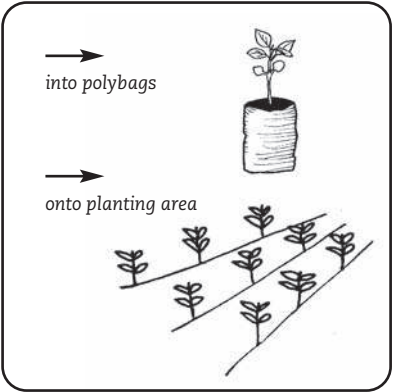
In January / early February seeds can be sowed indoors into seed boxes. Sow in rows 10 cm apart.

2



The seedlings grow up to three months...

3



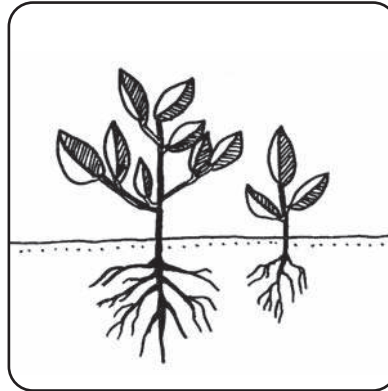
...before transplanting them into poly bags or directly onto the planting area in May / June.



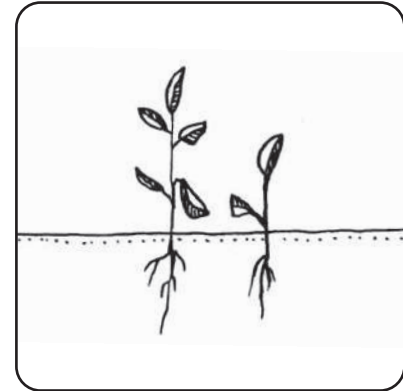
Seedling quality

Plant healthy and good looking seedlings only! Assure that the roots of seedlings are never directly exposed to sun and wind during storage or transport! Prevent drying out! Cover the roots with appropriate material at all times.

Plant seedlings the same depth as they have stood before in the seed boxes or poly bags. Do not compress roots!



Good seedlings



Bad seedlings



Planting of seedlings

With naked roots using a spade

1



Take a spade and cut out a block of soil.

2



Dig up the block of soil.

3



Put a seedling into the hole.





Planting of seedlings

With naked roots using a spade

4



Put the block back into the hole.

5



Compact soil by stepping.

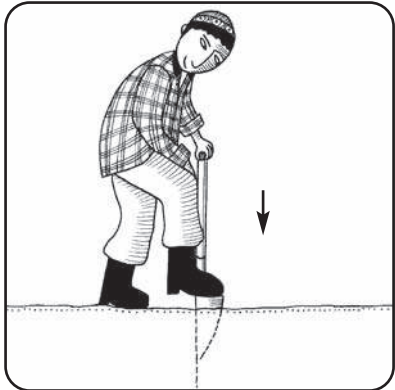




Planting of seedlings

With naked roots using a tree planting spade

1



Put the tree planting spade vertically into the soil. Do not remove any soil.

2

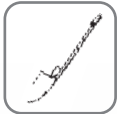


Make an angular counter cut.

3



Remove the soil but leave it on the spade.





Planting of seedlings

With naked roots using a tree planting spade

4



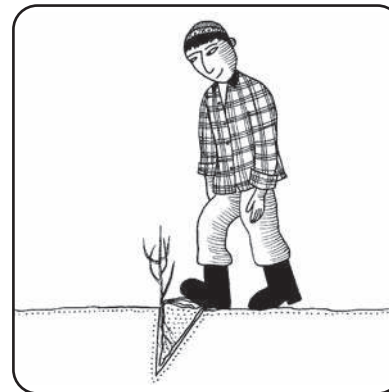
Put a seedling into the hole.

5



Put the soil back into the hole.

6



Compact soil by light stepping.

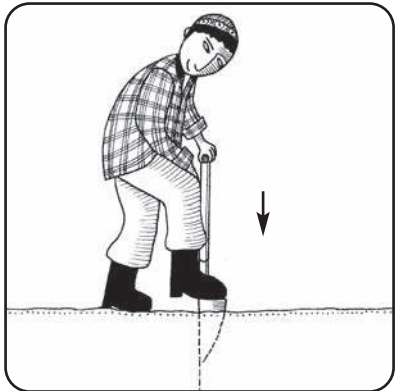




Planting of seedlings

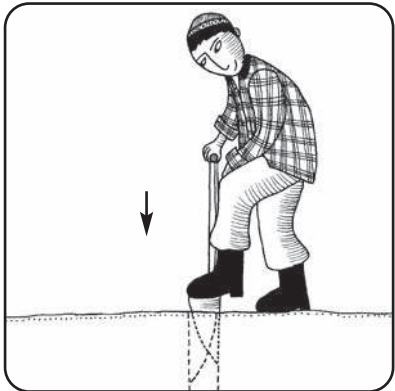
Container seedlings using a tree planting spade

1



Put the tree planting spade vertically into the soil. Do not remove any soil.

2



Make a second vertical stich, just opposite.

3



Remove the soil.

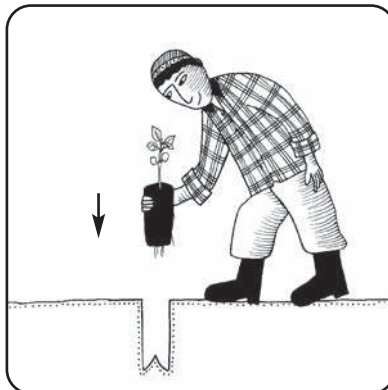




Planting of seedlings

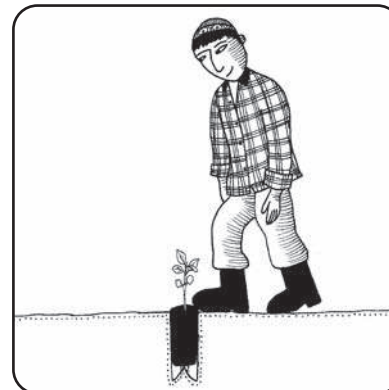
Container seedlings using a tree planting spade

4



Put the seedling with earth into the hole.

5



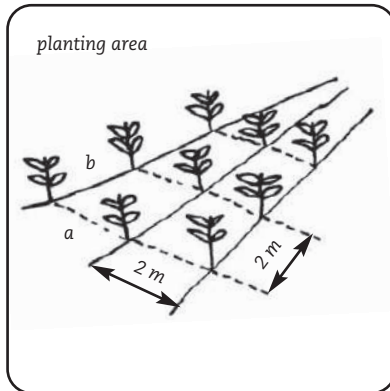
Compact soil by light stepping.





Planting

Plant quantity requirements and spacing



Example: Spacing of willow and poplar 2 x 2 m, 2500 cuttings per ha

Willow:	2 x 2 m
Poplar:	2 x 2 m
Sea Buckthorn:	2 x 4 m
Dog Rose:	2 x 4 m
Black Currant:	2 x 4 m

Spacing of different species

Number of plants per planting area

a = space between rows
 b = space between plants
 p = planting area
 s = space per plant
 n = total number of plants

$s = a \times b$
 $n = p \div s$

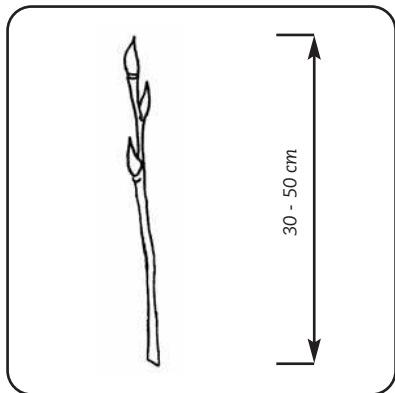
Example: $a = 2 \text{ m}$
 $b = 2 \text{ m}$
 $p = 5 \text{ ha} = 50\,000 \text{ m}^2$
 $s = a \times b = 4 \text{ m}^2$
 $n = p \div s = 50\,000 \text{ m}^2 \div 4 \text{ m}^2$
 $n = 12\,500 \text{ plants}$

Calculation of space requirements and number of plants per planting area



Planting preparation

Selection of cuttings



1 year old branch with a diameter of about 2 cm, minimum of 3 buds

Cut 30 to 50 cm long sticks with at least three buds each. Preferably use top ends. Cut them from one year old branches of trees no older than six years! **Before Planting:** Soak cuttings for 8 to 12 days, preferably using fresh-flowing water.

Requirements for quality cuttings: Buds should not be open yet! No bark injuries! Straight, healthy shape! Only one terminal bud for pyramidal poplars!





Planting

Planting technique: Cuttings

1



Punch small holes into the ground with a planting stick or an iron bar!

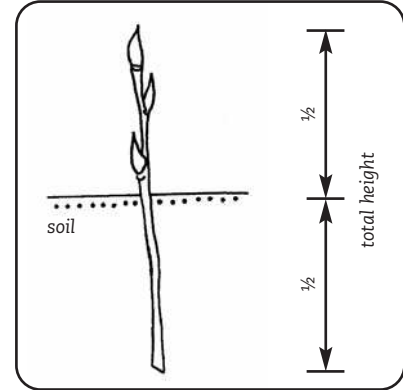


2



Stick cuttings into the ground!

3



Assure that about 1/2 of the cutting is in the soil!

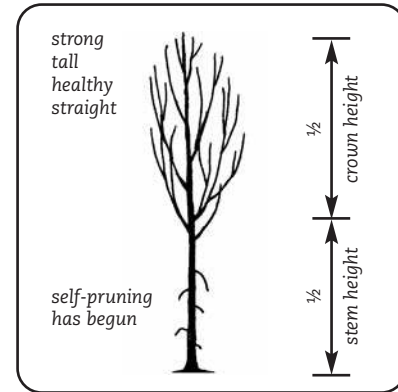
Tending Operations

Selection of Potential Crop Trees (PCT)

Mark a PCT (Potential Crop Tree) approximately every 4 to 6 m at the time when self-pruning has started! A number of 400 to 500 PCTs per ha is recommended (spacing 4 x 4 m or 5 x 5 m).

A PCT is a tall and strong tree with a straight bole. Your focus is on these PCTs for construction wood production only!

Assure a crown length of $\frac{1}{2}$ of the total stem length of these PCTs. A crown length of $\frac{1}{3}$ of the total stem length is sufficient when the second half of the rotation period has started (after about 10 years).



Characteristics of a PCT
(Potential Crop Tree)

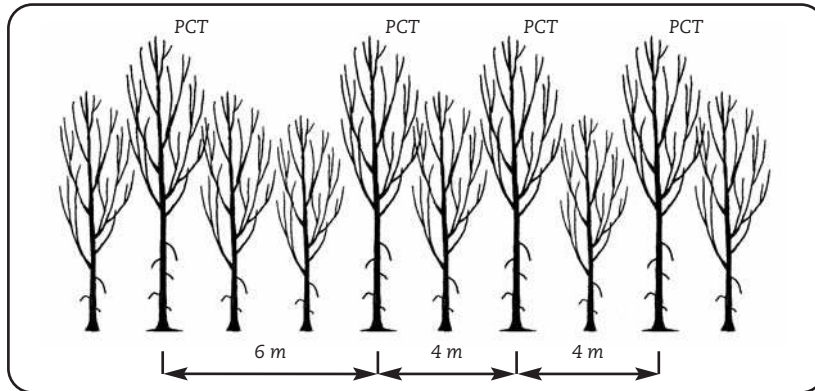


poplar

Tending Operations

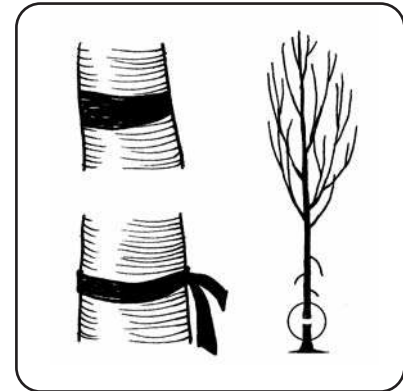
Selection of Potential Crop Trees (PCT)

1



Identify PCTs (Potential Crop Trees) approximately every 4 to 6 m at the time when self-pruning has started!

2



Mark PCTs with paint or ribbon!

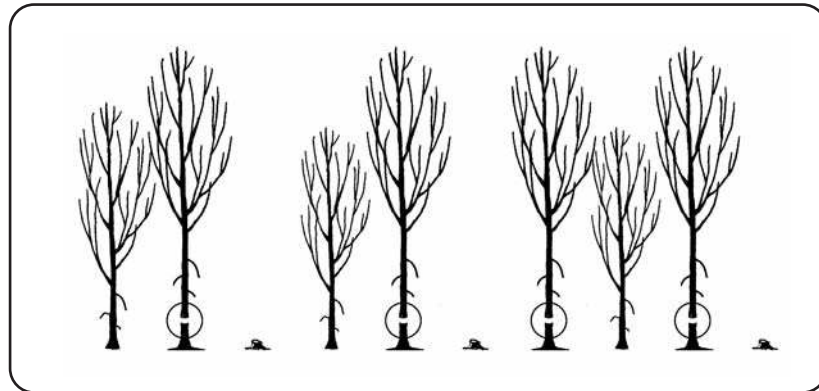


Tending Operations

Stands originated from cuttings

1st thinning

Carry out the first thinning by cutting of one competitor per PCT! Do not cut more than two competitors per PCT at the same time! Pay attention to the thickness of branches to guarantee construction wood production.



Cut 1 competitor per PCT!

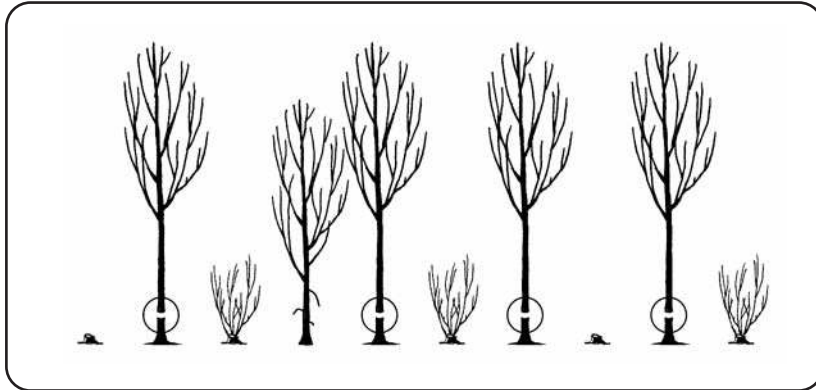




Tending Operations

Stands originated from cuttings

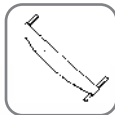
Subsequent thinnings



Continue the thinning operations every 3 to 5 years for this purpose only! Between these PCTs cutting of firewood from coppice regrowth is possible as long as it does not interfere with the construction wood production.

Every 3 to 5 years.

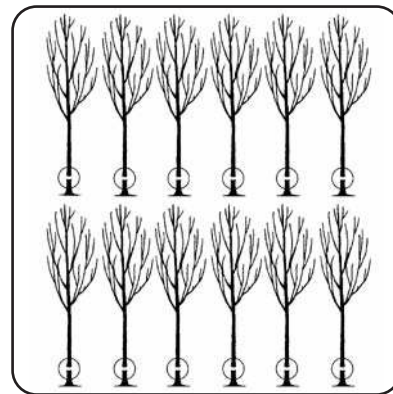
No gaps bigger than a crown diameter!



Tending Operations

Stands originated from cuttings

When the first PCTs have reached construction wood size after about 15 years, start a 3-step harvest cutting procedure. In each step cut $\frac{1}{3}$ of the total volume. Repeat each step after 3 to 5 years. Let appearing coppices grow until self-pruning starts, then follow the tending system!



PCTs prior to clearing





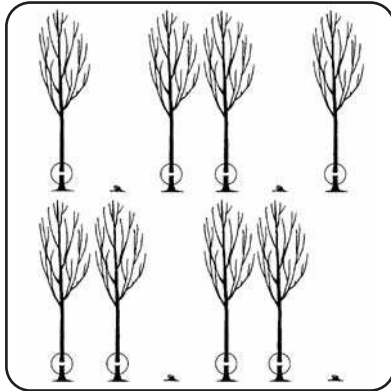
poplar

JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
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Tending Operations

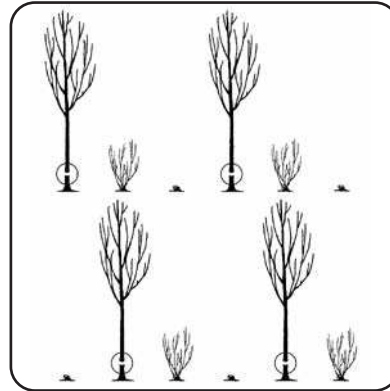
Stands originated from cuttings

1st harvest cut

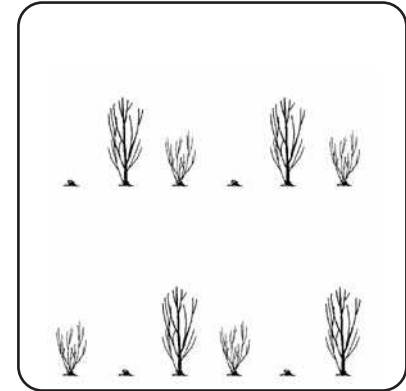


Cut $\frac{1}{3}$ of the total volume.

2nd harvest cut



3rd harvest cut



After another 3 to 5 years cut the last third.

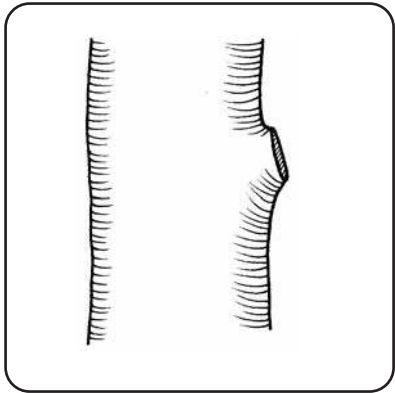


Pruning Operations

Pruning for construction wood production

Pruning promotes tree stem growth and thus improves timber production. It is carried out on PCTs (Potential Crop Trees) only!

When: Pruning starts after the marking of PCTs and the first thinning have been carried out. Pruning of poplars is best carried out towards the end of the growing season (October), when the foliage can be used for fodder. This also minimizes the regrowing of small shoots on the main stem. It should be repeated every two or three years.



Clean pruning cut



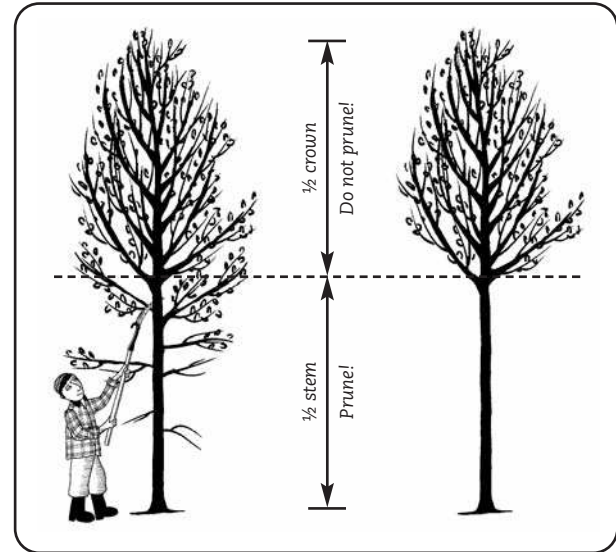


Pruning Operations

Pruning for construction wood production

How: Remove all side branches (living or dead) and any extra leaders. Assure that the remaining living crown height is at least $\frac{1}{2}$ of the total stem height during the first 10 years of the tree. A crown height of $\frac{1}{3}$ of the total stem height is sufficient when the second half of the rotation period has started (after about 10 years). Prune until at least 6 m of clear stem have developed to produce construction timber.

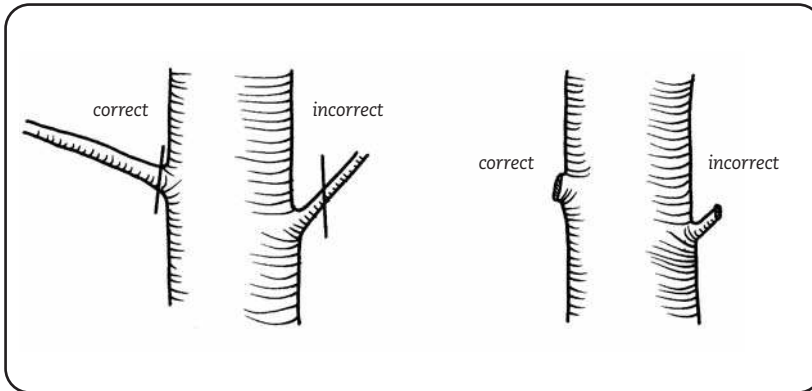
Before and after pruning



Pruning Operations

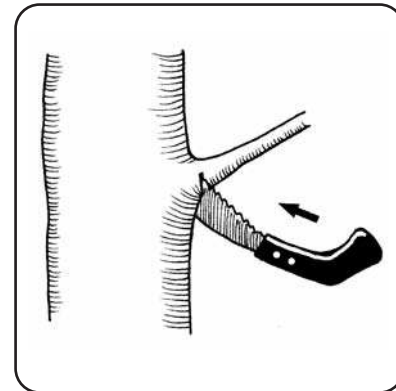
Pruning for construction wood production

Small branches / twigs



Make a sharp and straight (under)cut along the tree's bark without damaging it! Maximum length of stub is 1 cm.

Small living branches



To prevent damage undercut from below by pressing saw forward.

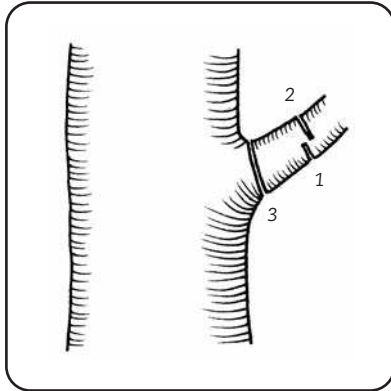




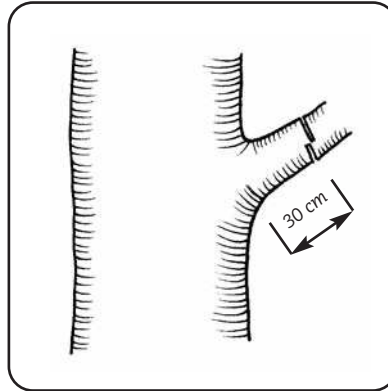
Pruning Operations

Pruning for construction wood production

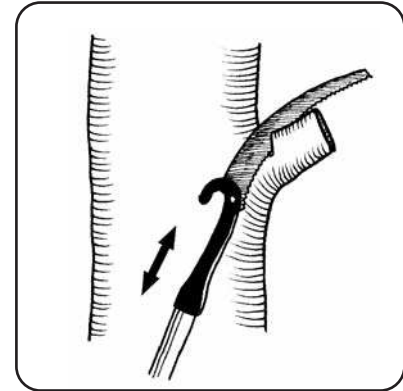
Large branches with a diameter over 5 cm



To prevent damage or breakoff cut in 3 steps!



Shorten the branch to about 30 cm. Start with an under-cut (1), then cut down from top (2).

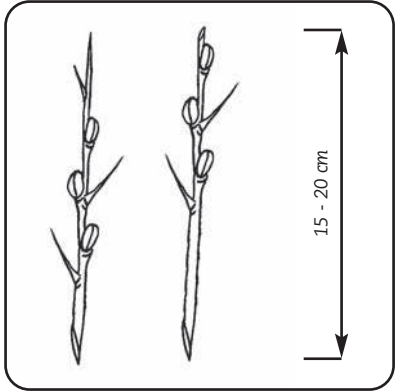


Finally trim off the stump close to the stem (3) to get a clean cut without injuries.



Planting preparation

Selection of cuttings



diameter: max 1 to 2 cm,
minimum of 3 buds

Cuttings should be taken from healthy, well developed plants in fruiting stage, so their sex can be determined. Cuttings have the same type / sex as the parent plant. For easy selection mark the most promising female plants already during fruiting season.

Take cuttings from the previous year's growth, especially from young branches that grow close to the root. Prepare cuttings in February or early spring, when the buds are still closed.



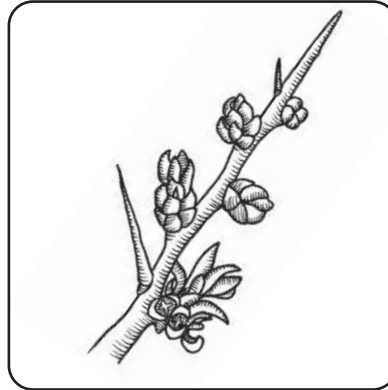


Planting

Male and female plants: Ratio and differentiation

If you want to harvest sea buckthorn fruits the **ratio of male to female** plants is very important, as the number of female trees in each planting directly affects the total yield. Keep a ratio of about **1:8 to 1:10**. At least every 10th plant should be male to serve as a pollinator. If you make additional plantings to existing stands with a lot of male plants, plant female cuttings or saplings only.

male



Several flowers close together on a very short stalk. Buds are thick and roundish, also darker and bigger than female buds.

female



Only a single flower on a slightly longer stalk. Flowers are twice as big as male flowers.

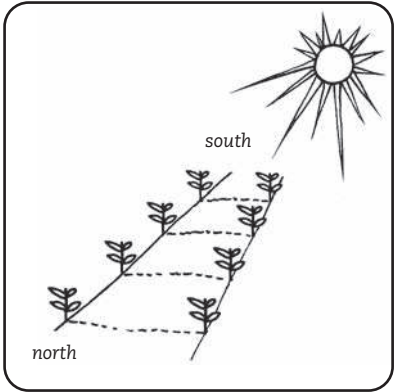


Planting

Planting technique: Cuttings

Cuttings can be planted directly onto the planting area at the beginning of the vegetation period. Optionally you can soak bundles of cuttings up to $\frac{2}{3}$ of their length in water until the beginning of root formation. Cuttings can be transplanted to the field when these roots are 1 to 2 cm long. However, take care that the roots are not damaged.

When establishing a plantation rows should be oriented in north-south direction to provide maximum sun exposure. Take care that water is supplied for establishment.



North-south orientation of plantation rows for maximum sun exposure



Planting

Planting technique: Cuttings

1



Punch small holes into the ground with a planting stick or an iron bar!

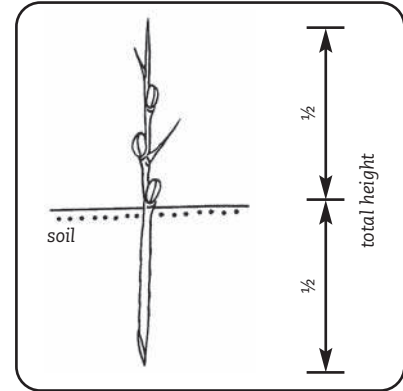


2



Stick cuttings into the ground!

3



Assure that about $\frac{1}{2}$ of the cutting is in the soil!



Planting

Planting techniques: Propagation by rooted saplings

1



2



3



Rooted saplings grow around maternal plants. As it is difficult to determine sex with young plants mark the most promising females already during fruiting season. Take saplings around them in spring and...

...transplant them onto the planting area, 10 cm deep.





sea buckthorn

JAN

FEB

MAR

APRIL

MAY

JUNE

JULY

AUG

SEP

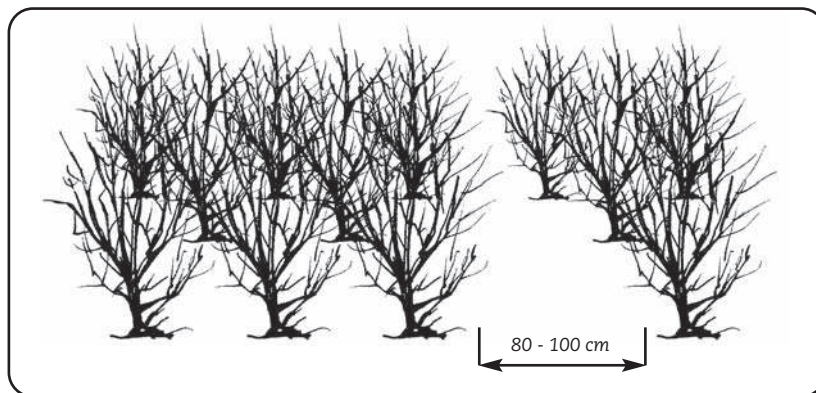
OCT

NOV

DEC

Establishment of corridors for tending and harvesting

For easy harvesting and tending corridors should be established in dense stands. Cut away male plants especially. They can be used for firewood or fencing purposes. For forest and soil protection measures make sure that the corridor ground is covered by vegetation like grasses.

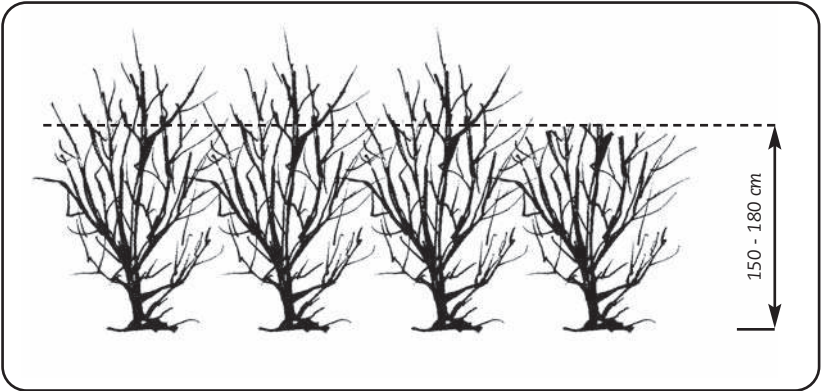


Width of corridor: 80 to 100 cm





Pruning



Large female plants should be pruned for easier harvesting. Cut at 150 to 180 cm. Prune in autumn or winter in combination with harvesting fruits.

Most promising female trees should be pruned annually to remove overlapping branches. 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.





Harvesting of sea buckthorn

Harvesting during frost

1



Cut *branches with berries.*

2



Let the cut branches freeze overnight.

3



Shake off the frozen berries.





Harvesting of sea buckthorn

Harvesting without frost

1



Cut branches with berries.

2



Cut branches into small segments of about 5 cm.

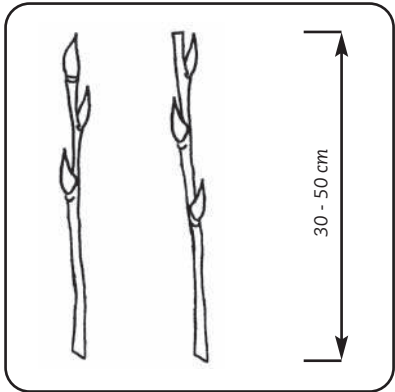
Berries on cut twigs can be stored up to 1 week without losing quality. Correct pruning of bushes can increase the yield.





Planting preparation

Selection of cuttings: For vertical planting



Cut 30 cm to 50 cm long sticks with at least three buds each. Cut them from one year old branches of trees no older than six years!

Requirements for quality cuttings: Buds should not be open yet! No bark injuries! Straight, healthy shape!

*For vertical planting,
1 year old branch,
minimum of 3 buds*



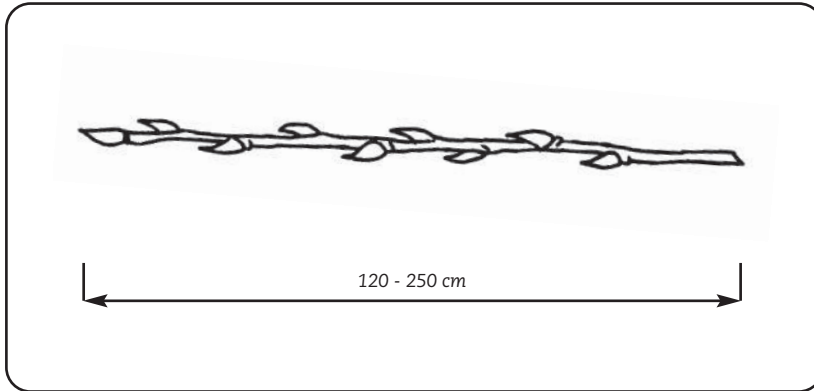


willow

JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
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Planting preparation

Selection of cuttings: For horizontal planting



Cut 120 cm to 250 cm long sticks with a diameter of about 3 cm. Sticks should be of good health, straight and with a lot of buds. Cut them from trees no older than six years!

*For horizontal planting,
8 to 9 buds*





Planting

Planting technique: Vertical cuttings

1



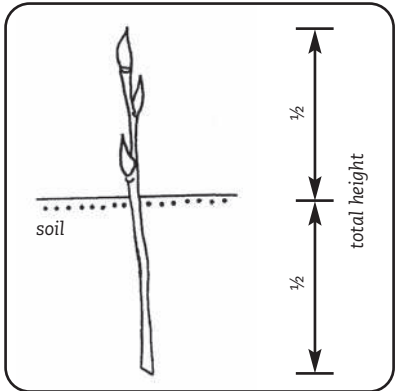
Punch small holes into the ground with a planting stick or an iron bar!

2



Stick cuttings into the ground!

3



Assure that about 1/2 of the cutting is in the soil!





Planting

Planting technique: Horizontal cuttings

1



Dig a small ditch, about 20 cm deep.

2



Lay the cutting into the ditch and...

3



...cover it with soil.

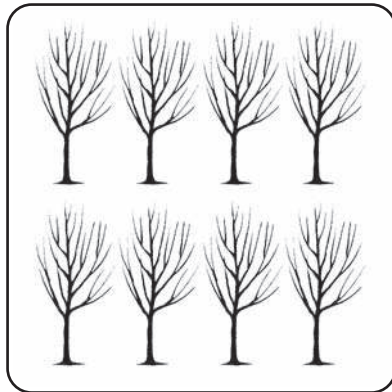




Management of willow stands

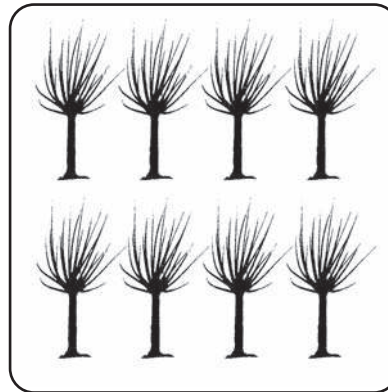
The three production targets

Energy wood plantation



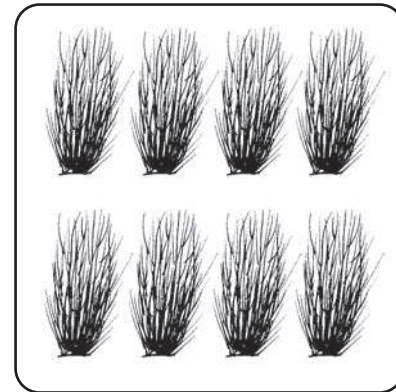
Willow stands originated from cuttings

Small construction wood



Pollarded willow stands

Fire wood



Willow coppice stands



willow

Management of willow stands

Energy wood plantation



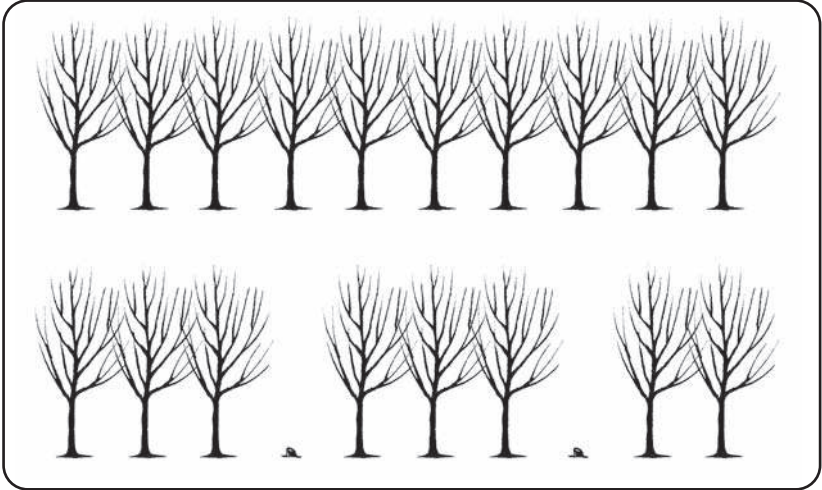
Willow growth from cutting



Management of willow stands

Energy wood plantation: Thinning

1st thinning



When the crowns touch each other...

...cut each 4th tree!





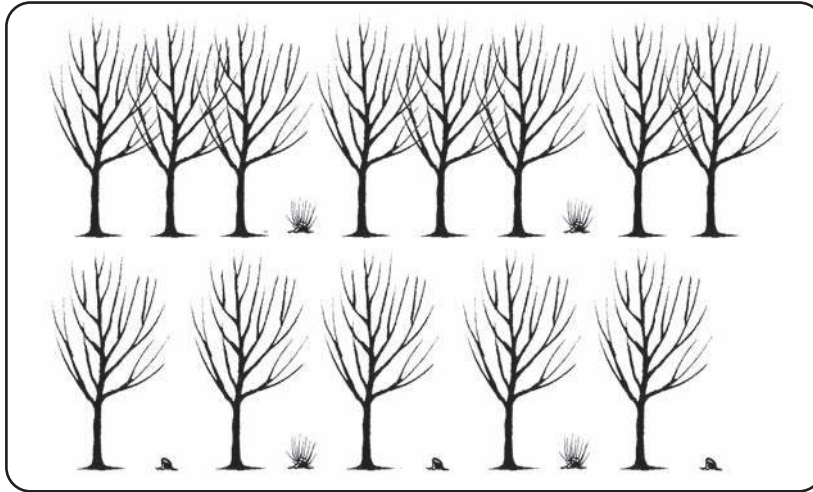
willow

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Management of willow stands

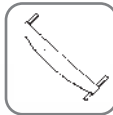
Energy wood plantation: Thinning

2nd thinning



Let the trees grow until the crown gabs have been filled.

Then cut again each 4th tree. Include the stumps while counting!

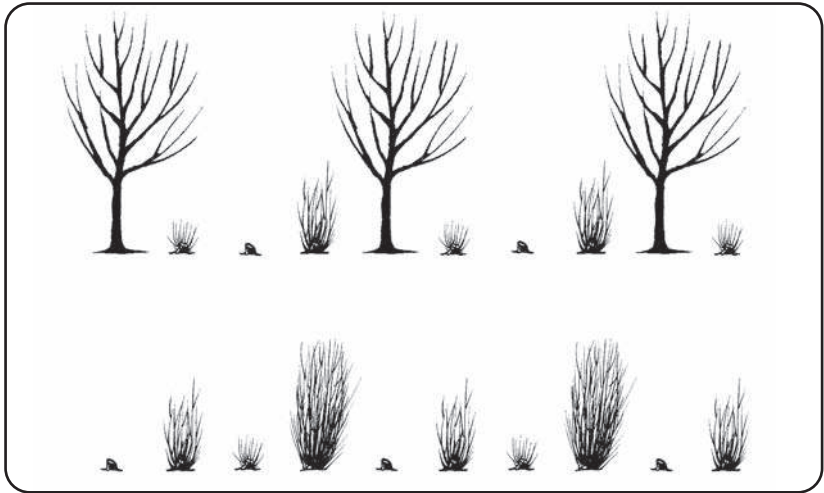




Management of willow stands

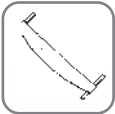
Energy wood plantation: Thinning

Subsequent cuts



Continue cutting each 4th tree until coppices appear on the stumps.

Then follow the coppice forest system!





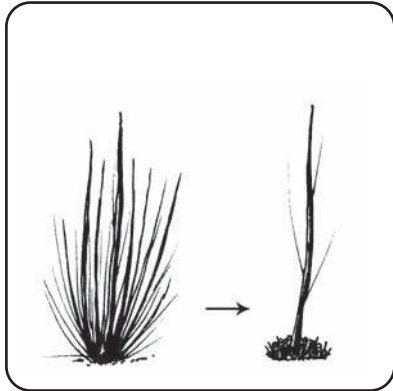
willow

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Management of willow stands

Pollarded Willows for small construction wood

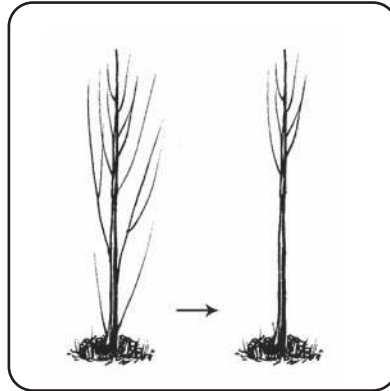
1



To grow a pollarded willow select the best shoot of a shrub and cut all others.

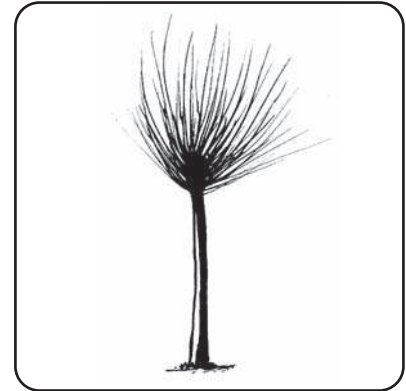


2



Then repeatedly cut all the lower branches...

3



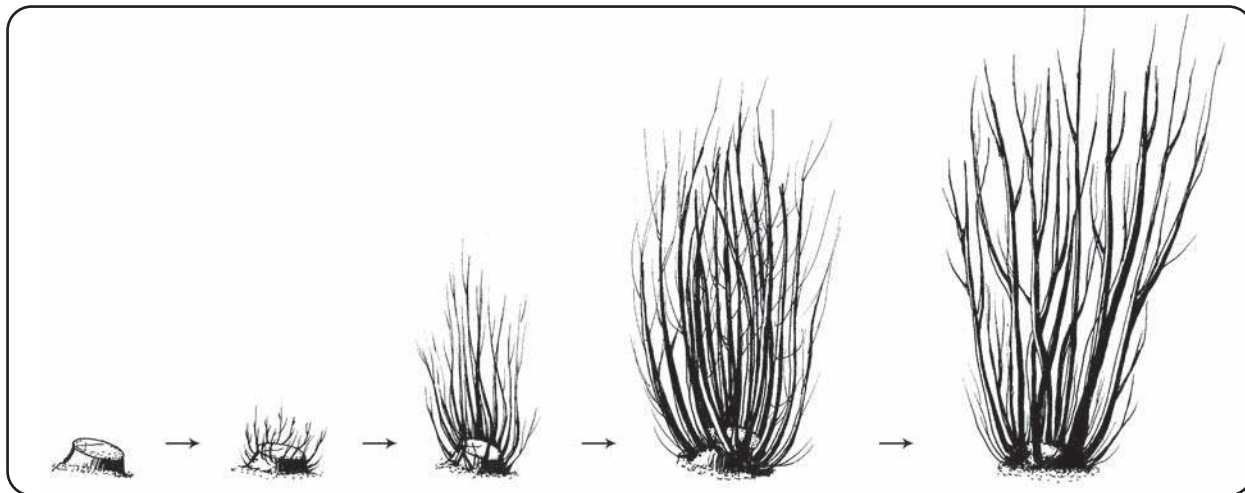
...and let the upper ones grow to the desired size.

willow



Management of willow stands

Willow coppice for fire wood



Coppice growth on a stump



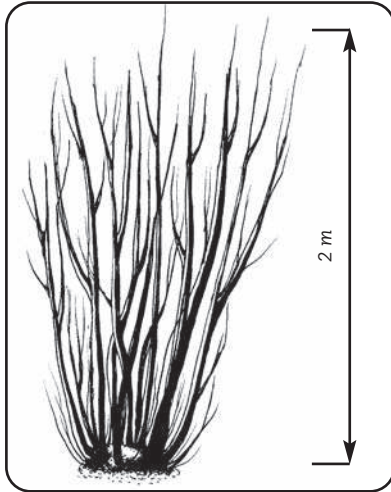
willow

JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
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Management of willow stands

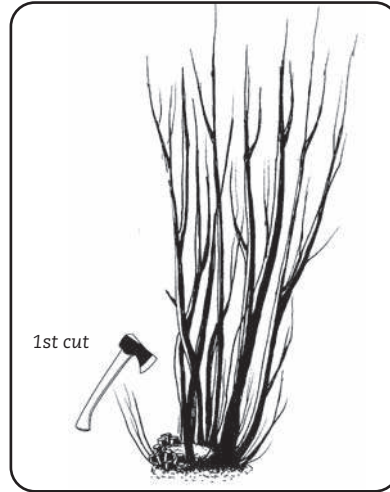
Willow coppice: Cutting sequence

1



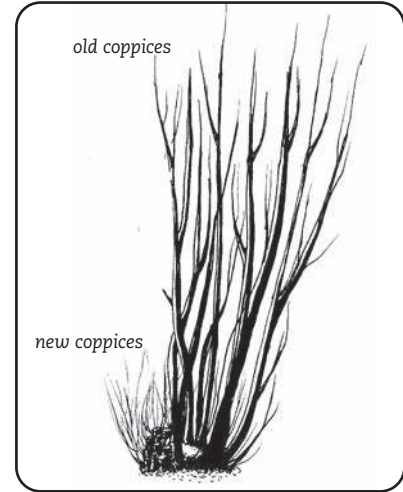
Let the coppices grow to a height of at least 2 m...

2



...then cut $\frac{1}{3}$ of all coppices of each stump.

3



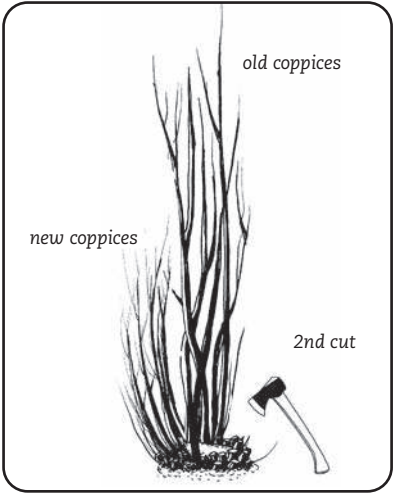
Wait for 2 years until new coppices have been grown...



Management of willow stands

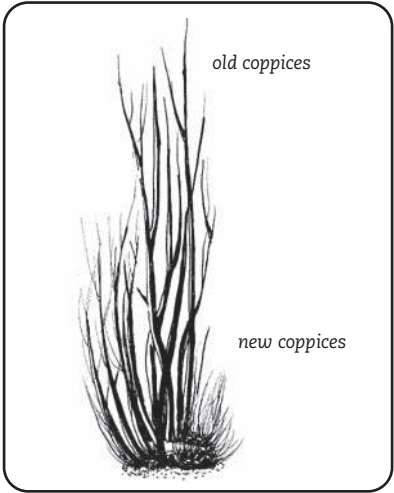
Willow coppice: Cutting sequence

4



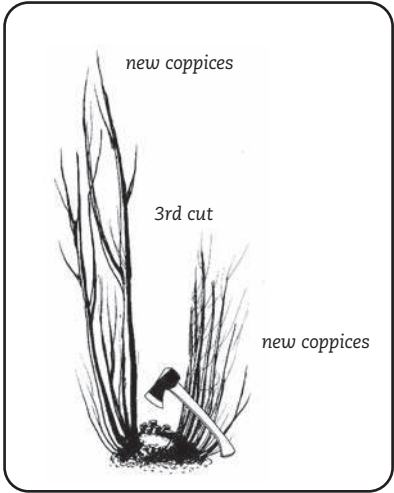
...then cut another $\frac{1}{3}$ of the older ones.

5



After another two years of growth...

6



...cut the last $\frac{1}{3}$ of the old coppices, which might be 3 to 4 m tall by now.



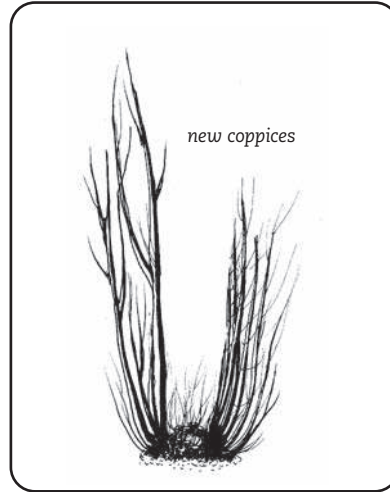
willow

JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
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Management of willow stands

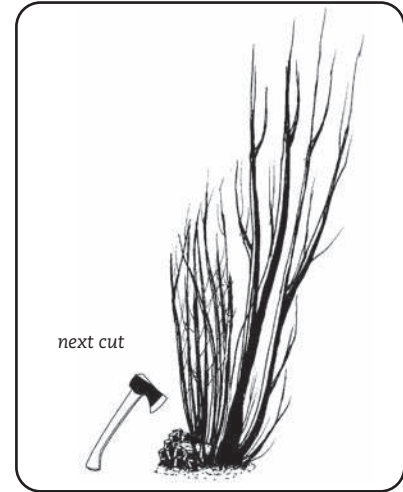
Willow coppice: Cutting sequence

7



After another two years of growth...

8



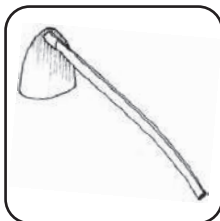
...start over.



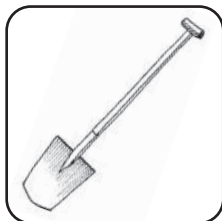


Planting & cutting tools

Hoe: To prepare the ground for sowing / to clean canals



Spade: To dig holes and canals / to plant seedlings



Shovel: To move loose soil



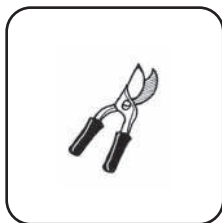
Tree planting spade: To plant seedlings



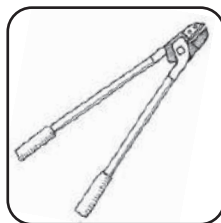
Dibber & iron bar: To punch holes into the ground for cuttings



Pruning Shears: To cut branches with a diameter of less than 3 cm



Small pruning shears: To cut twigs and small branches



Anvil pruning shears: To cut branches with a diameter of 3 cm and more



Pruning saw – hand: To cut branches



Telescope pruning saw: To cut branches that are high up



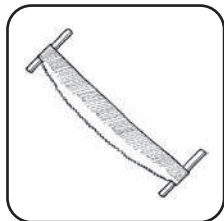
tools

Cutting & additional tools

Telescope pruning clipper: To cut small branches, high up



Whipsaw: Two-men-saw to cut trees



Axe: To cut small trees or thick branches



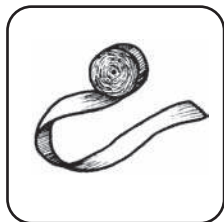
Pick axe: To work soil for fence or canal construction



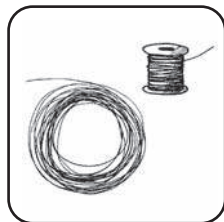
Pliers: To handle wire



Folding rule: To take measurements



Ribbon / strips of fabric: To mark trees



Wire: To connect fencing elements



Gloves: To protect hands