SHELTERBELTS FOR THE PEACE RIVER REGION

PUBLICATION 1384
REVISED 1975

Agriculture Canada

Copies of this publication may be obtained from
INFORMATION DIVISION
CANADA DEPARTMENT OF AGRICULTURE
OTTAWA
K1A 0C7

Printed 1969
Revised 1975

8M—11:75

WHY PLANT SHELTERBELTS?

Properly spaced shelterbelts pay dividends. Here are some economic advantages:

- Increase the yield per quarter section (64.7 ha) of:
  - barley by 121 bu (3293 kg).
  - sunflowers by 216,000 lb (98 000 kg).
  - alsike seed by 3000 lb (1361 kg).
  - alsike hay by 5.6 tons (5.1 tonnes).
- Increase cattle gains by as much as 35 lb (15.9 kg) per animal during mild winters.
- Reduce weight loss of cattle by as much as 10.5 lb (4.8 kg) per animal in severe winters.
- Reduce cost of heating farm buildings.

Shelterbelts slow down the wind and divert some of the force upward. The reduced wind speed conserves moisture and results in less bruising, abrasion, and lodging of crop plants, less erosion of the soil, and higher air temperatures.

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SHELTERBELTS FOR THE PEACE RIVER REGION

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BENEFITS

Shelterbelts protect soils, crops, livestock, and buildings by slowing down the wind and diverting it upward.

The diversion of the wind creates fairly calm areas where soil drifting is lessened, evaporation is reduced, and air temperature is increased. These results help to conserve moisture for better plant growth, and provide better conditions for the pollination of legumes by bees. In winter, snow does not blow so much, animals make greater gains, and buildings are easier to heat. For every foot (0.3 m) of shelterbelt height, a distance of 50 ft (15 m) on the leeward side of the windbreak is affected.

Shelterbelts also reduce bruising, abrasion, and lodging of plants, snowmelt runoff, and wind erosion of soil They prevent snowdrifts from blocking roads, provide shelter and a source of food for birds, increase the living comfort of man and livestock, reduce heating costs of the home by as much as one-third, and make the farmstead more attractive and add to its value.

Experiments at Beaverlodge have shown that shelterbelts will reduce wind by an average of 49% and evaporation by 27%, and increase the yield of barley by 25%, alsike hay by 18%, alsike seed by 30% and sunflowers by 315%. The yield of barley from a quarter section (64.7 ha) that is protected by shelterbelts is 121 bu (2293 kg) more than from a quarter section (64.7 ha) that is unprotected. In addition there is a saving of seed and fertilizer for about 12 acres (5 ha) of land.

Tests at the Forest Nursery Station, Indian Head, Sask., showed that a single row of white spruce 25 ft (8 m) high reduced wind velocity 50 ft (15 m) away by 80%, and 250 ft (76 m) away by 25%. At 50 ft (15 m) away, evaporation was reduced by 40%, and at 250 ft (76 m) away, by 10%. The United States Department of Agriculture found that

in the Great Plains the air temperatures on the leeward side of a shelterbelt, at a distance two to three times its height, were about 2° F (1.1° C) higher on a clear day. In Montana a herd of beef cattle protected by windbreaks gained 35 lb (15.9 kg) more per animal during a mild winter and lost 10.5 lb (4.8 kg) less during a severe winter than an unprotected herd.

One of the main criticisms of shelterbelts is that deep snowdrifts are formed and prevent uniform drying and early working of the fields in the spring. Snowdrifts are formed by snow blown from adjacent fields,

Fig. 1. Upper: Snow drifting in the shelterbelt on the windward side.
1. Lower: No snow drifting in the shelterbelts on the leeward side of the windward shelterbelt.

but little or no drifting occurs when shelterbelts are properly spaced to provide uniform wind protection over a wide area. Measurements taken at Beaverlodge in a year of above-average drifting showed that about 3 in. (8 cm) of snow was blown off unprotected fields and deposited to a depth of 52 in. (132 cm) in the first shelterbelt on the windward side. On the protected side of the shelterbelt, little blowing occurred so that the snow cover was evenly distributed over the field. Snowdrifts in all shelterbelts on the protected side did not exceed 3 in. (8 cm) of snow, or 0.3 in. (0.8 cm) of water.

COST OF ESTABLISHING AND MAINTAINING

A survey of Alberta Agriculture field offices found the cost of establishing 1 mile (1.6 km) of a single-row shelterbelt in 1973 to be:

Year 0 – Summerfallow before planting		
Cultivation 4 times	$ 8.00	
Labor	3.00	
		$ 11.00
Year 1 – Planting and cultivating		
Shipping charges for trees	$ 5.00	
Planting with county planter	17.00	
Cultivation – machine, 4 times	11.00	
– hand, 2 times	48.00	
		$ 81.00
Year 2 – Replanting and cultivation		
Shipping charges	$ 1.00	
Planting by hand	12.00	
Cultivation – machine, 4 times	11.00	
– hand, 2 times	48.00	
		$ 72.00
Year 3 – Cultivating – machine, 4 times	$11.00	
		$ 11.00
Total		$175.00

These figures were determined by H. T. Oosterhuis, Supervisor, Shelterbelt Program, Plant Industry Division, Alberta Agriculture.

Costs of machine cultivation were based on a 30 horsepower (22 380 W) tractor with an 8-ft (2.4-m) cultivator traveling at 4 mph (6.4 km/hr) and cultivating an 8-ft (2.4-m) strip on either side of the shelterbelt. Cost of establishing a three-row shelterbelt would be about three times that of establishing a one-row shelterbelt.

Maintenance costs in subsequent years should not exceed the cost of year 3 and will gradually decrease as the shelterbelt grows.

PLANNING THE SHELTERBELT

Some present stands of trees may provide good windbreaks. These natural shelterbelts are simply native trees left when the land is cleared. Because they are already established, they have only to be maintained. Some of the trees may be short-lived, but seedlings will spring up, and if protected, they will grow and replace trees that die. The mulch created by leaves, the shade cast by trees, and the native forbs and grasses eliminate the need for continuous cultivation to control weeds.

Natural shelterbelts need to be wider than planted ones, particularly if the land being cleared is not heavily treed. Native trees thrive better if given the opportunity to shelter each other. Moreover, since they are not orientated in rows, they have less chance of presenting closed fronts to the wind.

Planted shelterbelts, depending on whether they are for field, road, garden, or building protection, are composed of one or more rows of trees and shrubs. They require frequent cultivating and hoeing and occasional spraying, but live longer than most native trees. They are generally not as well adapted to the soil and climate as are natural shelterbelts, but good long-lived shelterbelts can be created if trees and shrubs suitable for the local area are used.

Water erosion is often associated with field shelterbelts. This problem arises when the slope of the land and the shelterbelts are orientated in the same direction. Therefore, establish the shelterbelts across the slope. If it is not possible to do this and yet have the shelterbelts against the prevailing wind direction, compromise between the two factions. In difficult cases consult your district agriculturist.

Location

Plant shelterbelts on the windward side of the area they are to protect. In the Peace River region, this is usually to the west but is sometimes to the north.

To make it easy to use farm machinery, plant field shelterbelts in one direction only. However, gardens, buildings, and feedlots may need protection on all four sides, but usually the west, north, and east sides are sufficient if the west windbreak is extended 100 ft (30 m) or more south of the area it is to protect.

In Alberta, the Department of Highways requires shelterbelts along numbered highways to be a minimum of 200 ft (61 m) from the center, or 100 ft (30 m) from the highway property line, whichever is greater. To prevent snow piling up in farm roadways and against buildings, plant the shelterbelts 50 to 100 ft (15 to 30 m) away. Plant roadway shelterbelts along the north side of east-west roads and along the west side of north-south roads.

Fig. 2. Typical natural shelterbelts in the lower Peace River region.

Fig. 3. Typical three-row planted shelterbelts at the Canada Department of Agriculture Research Station, Beaverlodge, Alberta.

To reduce the danger of frost, provide air drainage from the lowest area in the garden. If a low part of the garden is adjacent to a windbreak, remove the lower branches of the trees in the lowest corner. The heavy, cold air will then move down and out from this area and it will be replaced by warmer air from the upper region.

Avoid leaving gaps in the shelterbelts because they allow the wind to funnel through at greatly increased speeds. If gaps for roadways are unavoidable, put the road through at an angle.

Number of rows

Native trees grow best when they shelter one another, so leave strips 80 to 100 ft (24 to 30 m) wide when you clear the land. When strong new growth has formed along the edge of the shelterbelt, the width of the shelterbelts can be reduced to 40 ft (12 m).

The number of rows in cultivated shelterbelts ranges from one to twelve or more. In many areas, a single row of trees is recommended and these are satisfactory if there is good branching along the ground. If the branching is not sufficient, the amount of wind and evaporation close to the ground is increased. Protection increases with an increase in number of rows, but so does the cost of establishment and maintenance and the amount of land taken out of production to accommodate the shelterbelt.

Three rows are optimum for most field shelterbelts in the Peace River region. Seven three-row shelterbelts spaced across a section (259 ha) will take less than 40 acres (16 ha) out of production. Six-row shelterbelts are usually sufficient for protecting buildings and gardens, and one to three rows are used for protecting roadways. Keep about 14 ft (4 m) cultivated on both sides of the shelterbelt.

For the windward row of field shelterbelts plant fast-growing shrubs. For the middle row, use fast-growing trees, and on the leeward side, plant a row of long-lived conifers. For garden and building shelterbelts, plant a row of small ornamental trees and a row of long-lived deciduous trees between the row of shrubs and the row of fast-growing trees and, as well, plant a second row of conifers.

Field shelterbelts

Row 1-windward: fast-growing shrub
Row 2-windward: fast-growing tree
Row 3-leeward: long-lived conifer

Building and garden shelterbelts

Row 1-windward: fast-growing shrub
Row 2-windward: ornamental tree
Row 3-windward: long-lived deciduous tree

Row 4-windward: fast-growing tree
Row 5-windward: long-lived conifer
Row 6-leeward: long-lived conifer

A popular field shelterbelt in the Peace River region consists of caragana, northwest poplar, and either white spruce or lodgepole pine. These trees and shrubs are also satisfactory for building and garden shelterbelts, but a row of green ash, which is a long-lived deciduous tree, and a mixed row of ornamental trees and a second row of conifers should be added.

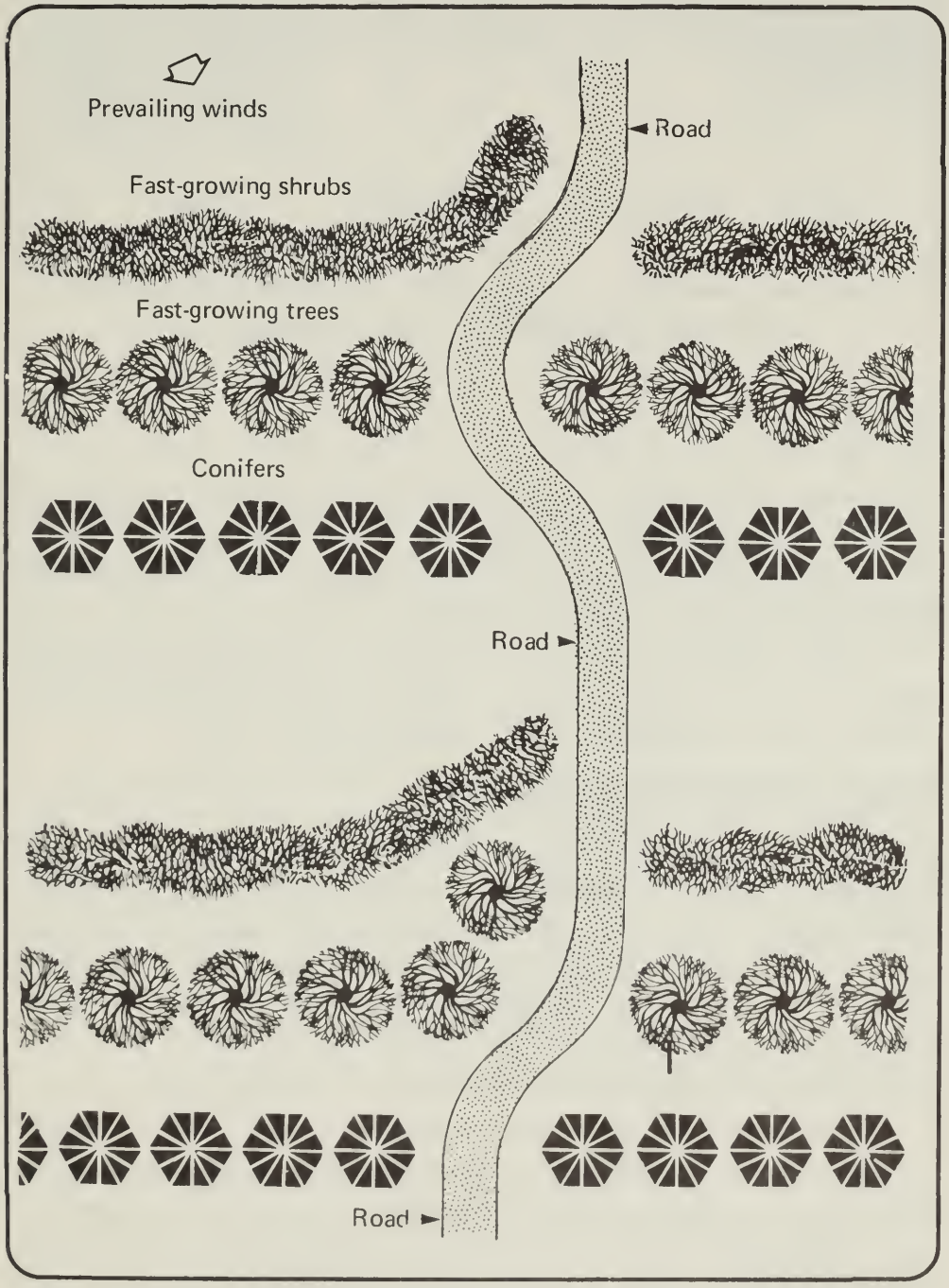

Fig. 4. The arrangement of shelterbelts around a gap in the main shelterbelt.

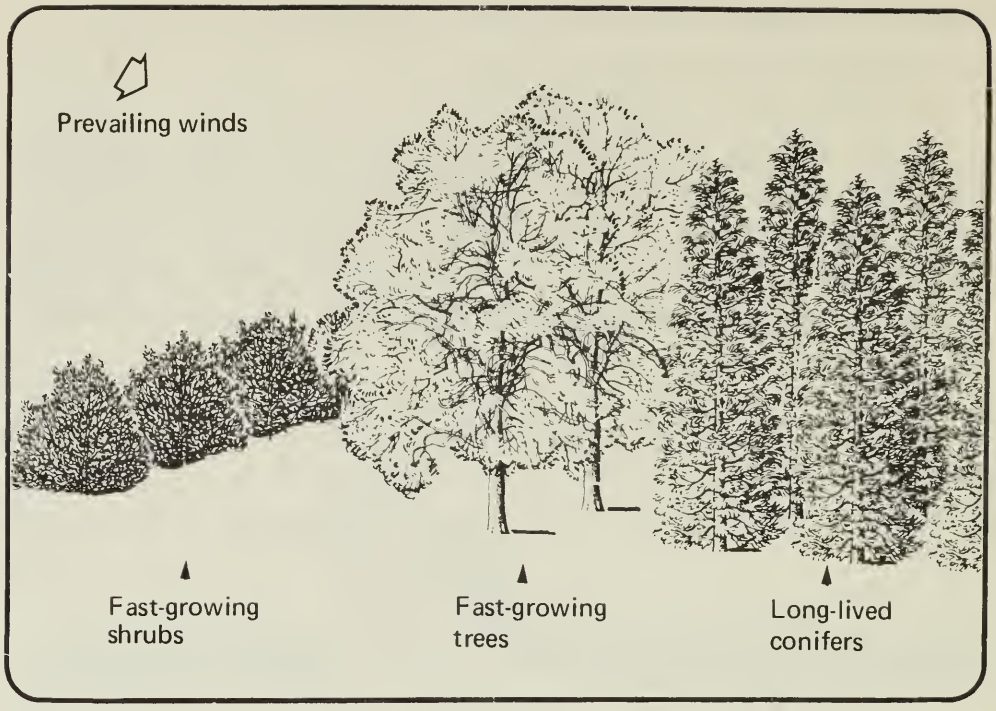

Fig. 5. Arrangement of rows in a field shelterbelt.

Spacing

Between rows, allow at least 4 ft (1.2 m) more than the width of the cultivating equipment to be used, but do not leave less than 12 ft (4 m) between rows of shrubs and trees and 16 ft (5 m) between fast-growing trees and long-lived conifers.

Perhaps the best shrub for the windward row is caragana. Set these plants 1 ft (0.3 m) apart in the row. Plant all other fast-growing shrubs 3 ft (0.9 m) apart, and all trees 6 to 8 ft (1.8 to 2.4 m) apart.

Distance between field shelterbelts

Over a large tract, there is a point up to which land can be cleared to increase total crop production; if too much land is cleared, the overall yield will drop. This point is reached when about 90% of the land is cleared. On the average section in the Peace River region, 20 to 35 acres (8 to 14 ha) are occupied by slough margins, waterways, and steep slopes that should not be cleared under any circumstances, and 30 to 45 acres (12 to 18 ha) should be occupied by shelterbelts.

Experiments have shown that maximum yields of small grains are obtained on the leeward side of the shelterbelts, in the area from the shelterbelt to a distance of 30 to 50 times the height of the shelterbelt trees. Because 30 to 40 ft (9 to 12 m) is a good average height for a mature windbreak, plant the belts 750 to 1000 ft (229 to 305 m) apart to provide five to seven belts across each section (259 ha). With each

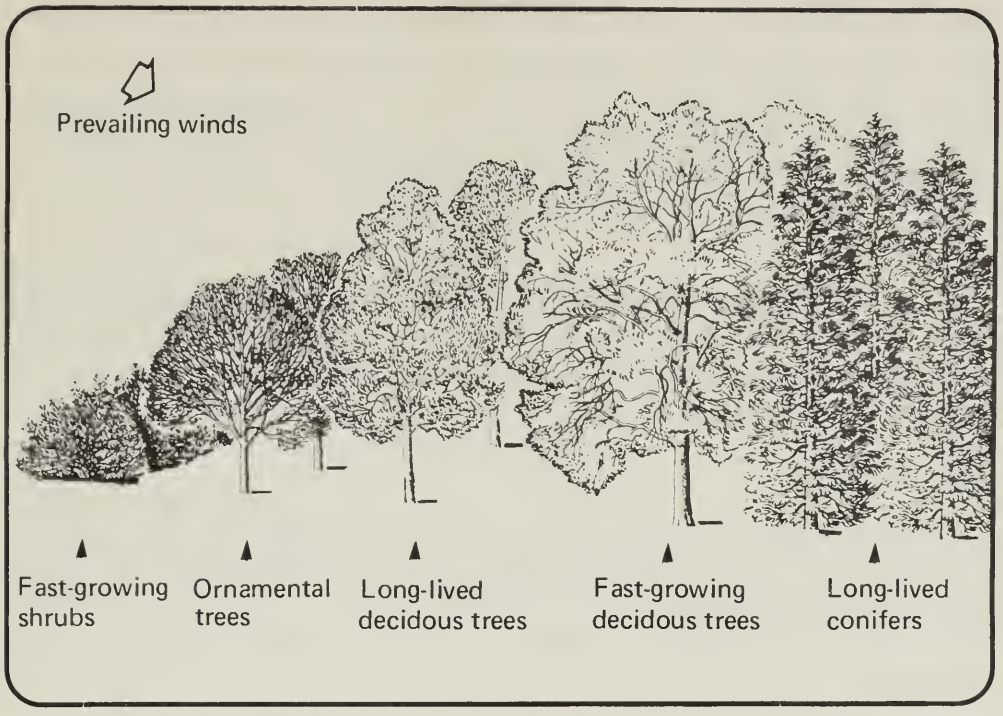

Fig. 6. Arrangement of rows in a building or garden shelterbelt.

three-row shelterbelt 60 ft (18 m) wide, the area in shelterbelts will be 30 to 45 acres (12 to 18 ha). Because natural shelterbelts are wider, they give more protection, and four rows are enough to assure optimum yields in a section. If natural shelterbelts have few coniferous trees, plant some down the center. Plant the trees with a shovel without clearing any brush; they will soon grow up, produce seeds, and perpetuate themselves.

PREPARING THE LAND

If the soil is low in organic matter, add humus by plowing in a cover crop, or apply 4 to 6 in. (10 to 15 cm) of peat or well-rotted manure and work it into the soil. Prepare the land as far in advance of planting as possible and keep it free from weeds for at least a year before planting. To avoid destroying the soil structure use a cultivator with wide shovels rather than a disc implement or rotary cultivator.

SUITABLE TREES AND SHRUBS*

Fast-growing shrubs, up to 10 ft (3 m) high, for windward rows

Siberian caragana

This shrub exceeds all others in adaptability for windbreaks, but it does not thrive on poorly drained soil. It is easily established, fairly

*For scientific names see pages 21-23.

long-lived, and hardy. It is of special value for the outermost windward row, and its dense growth provides excellent protection for the lower portion of other rows of the windbreak. It is also used as a snow trap. After dandelions have flowered and before clover starts to flower, caragana flowers provide food for bumblebees.

Late lilac

Of about the same form and height as caragana, the late lilac is used for the same purposes. It is hardy and long-lived and does not require as much pruning as caragana. The pinkish flowers are borne in small, dense panicles.

Hungarian lilac

Though similar to the late lilac, the Hungarian lilac is more upright. Its flowers are mauve purple, pleasingly fragrant, and in panicles larger than those of the late lilac.

Saskatoon

The saskatoon may be transplanted from the wild by plowing up a patch and selecting and planting foot-long abundantly fibrous rooted cuttings with a 3-in. (8-cm) upright stub. This shrubby tree is beautiful when in flower. The fruit is edible.

Pin cherry

A native tall shrub, the pin cherry is easily cultivated. Seedlings and root sprouts from different patches should be planted to ensure cross-pollination. Suckering can become a problem. Its blossoms are white. The red fruit makes excellent jelly.

Roses

Altai Scotch, Tetonkaha, Yatkan, and Lac La Nonne are vigorous, tall-growing rose varieties. They are also useful for the ornamental value of their showy flowers and hips.

Silver buffaloberry

The silver buffaloberry is a hardy, silver-leaved shrub from southern Alberta. Female trees bear heavy crops of red or yellow berries, which stay on all winter. Some male plants should be planted to provide pollen.

Hawthorn

There are many varieties of hawthorn suitable for windbreaks. Fireberry, red haw, blackfruit, cerro (or chocolate), and fleshy hawthorns are all hardy and heavily armed with long thorns. The native hardy fireberry grows 6 to 8 ft (1.8 to 2.4 m) high and the fleshy hawthorn to 20 ft (6 m). The others are intermediate in height. All

these hawthorns have white blossoms in June and colored fruit in autumn. The fruit is very attractive to birds.

Tatarian honeysuckle

A hedge plant producing attractive blossoms in the spring and colorful berries in the autumn, the Tatarian honeysuckle is a vigorous and extremely hardy shrub.

Small trees and tall shrubs for intermediate rows

Because the following plants usually require protection from direct winter sun, they should be set out between rows of other shrubs and trees.

Amur choke cherry

The Amur choke cherry is a small, narrow, very hardy tree that grows to 12 ft (4 m). In the spring it has white blossoms, and in the fall it bears black, bitter cherries. Its papery orange brown bark is very ornamental in winter.

Common choke cherry

A native shrub, the common choke cherry grows to 12 ft (4 m), and it is well adapted to cultivation. It has fragrant white blossoms in the spring and a heavy crop of astringent, red or black berries in the late summer and fall.

European bird cherry

European bird cherry, a hardy, small tree with a broad head, may grow as high as 20 ft (6 m). It has fragrant blossoms in May, and black inedible fruit in the fall.

Mountain-ash

The American, Greene's, and showy mountain-ash trees are all hardy. The native Greene's mountain-ash grows 8 ft (2.4 m) high, the American mountain-ash to 12 ft (4 m), and the showy mountain-ash to 25 ft (8 m). The fruit of all varieties is readily eaten by birds.

American, or high, bush-cranberry

A native shrub along some rivers and lakes, the high bush-cranberry grows to about 10 ft (3 m). Its fragrant flowers are in flat clusters. The bright red fruit is excellent for jelly. The shrub has delightful fall colors.

Siberian crab apple

The Siberian crab apple is a small tree growing to 15 ft (5 m), of uniform size and hardiness. It has fragrant white blossoms, which are followed by small scarlet fruits. Rabbits and mice eat the bark, and crab apple trees should only be used if the trunks and lower branches are protected from these pests every winter.

Fast-growing trees for center rows

Poplar

The northwest poplar is the most satisfactory poplar for Peace River conditions. It is fast-growing and hardy, but has a small tendency to sucker. It does not shed cotton like many other poplars. It grows well in spots too wet for other trees, and may, at maturity, reach 50 ft (15 m). Griffin and Dunlop are more upright forms of the northwest poplar, but they are not as hardy. Balsam, black, and balm-of-Gilead poplars are vigorous and hardy but short-lived. They also sucker freely and the female trees shed masses of cotton-like hairs.

Siberian larch

The Siberian larch is preferable to the native species, the tamarack. The Siberian larch is fast-growing, drought resistant, and hardy. It has a broad base and a narrow crown. Like the tamarack, it loses its needles in the fall. Its mature height is 40 ft (12 m).

Willow

A number of willows are suitable for locations too wet for most other trees. Peachleaf, sharpleaf, and yellowstem willows have been the most satisfactory in the order listed. Some dying occurs from time to time. They reach 30 ft (9 m) in height.

Manitoba maple or box-elder

Although it does well under some conditions, the Manitoba maple is not recommended for general planting in the Peace River region because it is not sufficiently hardy.

Long-lived, slow-growing deciduous trees for intermediate rows

Green ash

Slow growing, but hardy and long-lived, the green ash does not leaf out until quite late and loses its leaves early. Its mature height is 30 ft (9 m).

Bur oak

The bur oak is slow-growing, hardy, long-lived, and attractive. The mature tree is about 30 ft (9 m) high.

Long-lived, slow-growing conifers for leeward rows

White spruce

The thick, ascending branches of the native white spruce make it the best tree for a permanent windbreak. When mature it is 40 to 100 ft (12 to 30 m) high.

Colorado spruce

Branches of the Colorado spruce are horizontal and whorled, and the needles vary in color from blue green to silvery light blue. The mature height of this tree is probably less than that of the white spruce.

Lodgepole pine

Lodgepole pine is a native tree that can be identified by its upright habit, its long, dark green needles, and barbed cones pointing toward the center of the tree. Its mature height is 40 ft (12 m).

Scots pine

A vigorous tree, the Scots pine is attractive when young, but more irregular in appearance than the lodgepole pine when older. When fully grown it is 40 ft (12 m) high.

Jack pine

A native tree, the jack pine is inferior to lodgepole and Scots pines because of its more ragged, open habit. Jack pine eventually becomes about 40 ft (12 m) high.

ORDERING

Farmers may obtain trees and shrubs for shelterbelts from the Tree Nursery, PFRA, Indian Head, Sask., S0G 2K0. In addition, Alberta farmers can obtain trees and shrubs from the Alberta Department of Agriculture by applying to their district agriculturist. Other residents should obtain their trees and shrubs from commercial nurseries.

CARING FOR THE NEW PLANTS

Untie the bundles as soon as the plants arrive, and soak the roots in water for a day. Then heel in the plants in a shady location.

To heel in, dig a trench to the depth of a shovel with one wall at a 45-degree angle. Separate the plants, place each one against the sloped wall, cover the roots with soil, tramp the earth to prevent drying out, and water well. The plants can be held for several weeks in this way.

Poplars and willows grow easily from cuttings, and the nurseries sometimes send cuttings instead of plants. If you use cuttings, soak them for several hours to a day after they arrive. Losses are usually heavy if cuttings are planted directly in the field; therefore, plant them in a nursery row and set them out in the field the following spring. After the cuttings have soaked, plant them 6 in. (15 cm) apart in a trench made at a 45-degree angle. Leave only the top bud of the cutting above the ground. Pack the soil with your heel to make sure that the entire cutting is surrounded by earth and no air spaces are left.

Fig. 7. Heeling in. From left to right: a trench at a 45-degree angle; trees laid in the trench; roots covered with soil; and soil firmed around the roots.

PLANTING

Planting should be done as early in the spring as possible. Follow these basic rules:

- Set stakes to establish the rows in a straight line.
- Keep roots moist at all times. Carry the small trees in a large container of water, and keep the plants, especially the roots, constantly covered with wet burlap.
- Make a hole or trench wide enough and deep enough to permit roots to spread naturally without crowding or curling.
- Set the trees a little deeper than they stood in the nursery.
- Pack the soil firmly around the roots.

Plant the windbreaks by one of the following methods:

- Use a planting machine rented from an appropriate agency. This is by far the quickest method. See your district agriculturist about obtaining a machine.
- Plow a furrow and lay the plants against the upright side. As the plants are placed, kick a little soil over the roots to prevent them from drying out and to hold them in place. After the plants are set, plow the earth back into the furrow and pack it by running the tractor wheel alongside the trees or shrubs.

- Plant by hand. This method should be used when you have only a few trees. Insert the shovel to its full depth in the soil. Push the handle forward to make an opening. Insert the seedling into the hole with one hand and withdraw the shovel carefully with the other. After planting, firmly tramp the opening shut with your heel.

CARING FOR PLANTED TREES AND SHRUBS

Protect your shelterbelt from fire; do not pile trash near it. Make sure that cattle, horses, and other livestock do not eat, trample, or break the trees. Even when windbreaks are fully grown, hard-packed ground prevents proper aeration of the soil and penetration of water. Trees become weak and, in natural windbreaks, new trees do not grow to replace older ones.

Pruning

As soon as you have finished planting, cut off the top of the fast-growing outer hedge 1 to 2 in. (2.5 to 5 cm) from the ground. For the next few years cut off two-thirds of the annual growth. This induces branching and encourages growth from the base. Prune with a sickle-bar mower for the first 2 years. After the first 5 years, every second or third year thereafter cut off the top and sides. By so doing the hedge will become dense and compact.

The only pruning that trees require is the removal of multiple leaders by cutting out the weakest ones and the removal of broken limbs.

Pruning of deciduous trees and shrubs is best done in early spring before the leaves begin to appear. Cut close to the trunk so that no stub is left. Prune spruce and pine shortly after growth has begun in the spring. It is best to confine pruning to the current year's growth. For details on pruning, obtain a copy of Publication 1505, *The Pruning Manual,* from Information Division, Agriculture Canada, Ottawa, Ontario K1A 0C7.

If a branch more than 1 in. (2.5 cm) in diameter is cut off, treat the exposed wood with a water soluble latex paint or a wound dressing.

Cultivating

Cultivate in and around the windbreak until the trees are dense enough to shade the ground and to suppress weeds. Use a cultivator with wide shovels, because it does not pulverize the soil as much as discs do. Cultivate only the surface, never deeper than 3 in. (7.6 cm), so that the roots will not be damaged and the trees will not sucker.

Until the plants are large enough to smother weeds, hoe the rows,

or spray with a weed killer. Take great care to eradicate all brome and quack grass before they start to spread and go to seed. Weeds, and especially grasses, use up water and slow the growth of the shelterbelt.

Cultivate a strip 14 ft (4 m) wide on both sides of the windbreak. This prevents drying of the soil by the growing crop and provides a guard against fire.

Controlling weeds with chemicals

Chemical herbicides can be used to control weeds in shelterbelts. The effectiveness and safety of all herbicides depend on both the species and age of the weed, and the trees and shrubs in the shelterbelt. Because new herbicides are being tested and introduced regularly, consult your district agriculturist for the latest recommendations.

Mulching

Apply a mulch of partly decomposed straw, $1^1/_2$ ft (0.5 m) deep, around the trees. The mulch helps to smother weeds, conserves moisture, and supplies a small amount of plant nutrient.

Straw worked into the surface of the earth improves soil structure and reduces puddling and baking.

Fertilizing

Shelterbelts usually do not need fertilizing, and when fertilizers are used they must be applied with caution. Overfertilizing can result in winterkilling. An application of 11-48-0 at 25 lb per acre (28 kg/ha) every 2 years will stimulate growth without harmful effects. Light applications of barnyard manure also stimulate growth, but introduce weed seed and increase the need for cultivating.

Controlling pests

Like other plants, trees and shrubs used for shelterbelts may be injured by pests. Examine your shelterbelts regularly. Look for any signs of the branches wilting or dying. If you find such irregularities, send samples of the affected parts to your local agricultural office, or if you live in Alberta, send them to the Plant Industry Laboratory, Alberta Agriculture, O.S. Longman Building, 6909 – 116 St., Edmonton, Alberta T6H 4P2. If you live in British Columbia, send the samples to Pacific Canadian Forest Research Center, 506 W. Burnside Rd., Victoria, B.C. V8Z 1M5 – Attention: Dr. W. Ziller.

Removing rows

Usually all rows are left in for the life of the shelterbelt. However, field shelterbelts can be reduced to a single row of conifers without appreciably reducing their efficiency.

- Do not remove the row of fast-growing shrubs until the branches

of adjacent conifers touch each other 6 ft (2 m) above the ground.

- Do not remove the row of fast-growing trees until the branches of adjacent conifers touch each other 20 ft (6 m) above the ground.
- Do not remove any rows from the shelterbelt on the windward side of your property, or from building and garden shelterbelts.

OTHER HELPFUL PUBLICATIONS

The following publications were used in writing this work. Consult them for more detailed information.

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COMMON AND SCIENTIFIC NAMES OF SHELTERBELT TREES AND SHRUBS

ash, green	*Fraxinus pennsylvanica* Marsh.
box-elder	*Acer negundo* L.
buffaloberry, silver	*Shepherdia argentea* (Pursh) Nutt.
bush-cranberry, American or high	*Viburnum trilobum* Marsh.

caragana, Siberian	*Caragana arborescens* Lam.
cherry, Amur choke	*Prunus maackii Rupr.*
common choke	*Prunus virginiana* L.
European bird	*Prunus padus* L.
pin	*Prunus pensylvanica* L.
crab apple, Siberian	*Malus baccata* Borkh.
elm, American	*Ulmus americana* L.
Siberian	*Ulmus pumila* L.
hawthorn, blackfruit	*Crataegus chlorosarca* Maxim.
Cerro, or chocolate	*Crataegus erythropoda* Ashe
fireberry	*Crataegus chrysocarpa* Ashe
fleshy	*Crataegus succulenta* Schrad.
red haw	*Crataegus sanguinea* Pall.
honeysuckle	*Lonicera tatarica* L.
larch, Siberian	*Larix sibirica* Ledeb.
lilac, Hungarian	*Syringa josikaea* Jacq.
late	*Syringa villosa* Vahl.
maple, Manitoba	*Acer negundo* L.
mountain-ash, American	*Sorbus americana* Marsh.
Greene's	*Sorbus americana* Marsh.
showy	*Sorbus decora* (Sarg.) Schneid.
oak, bur	*Quercus macrocarpa* Michx.
pine, Jack	*Pinus banksiana* Lamb.
lodgepole	*Pinus contorta* Dougl.
Scots	*Pinus sylvestris* L.
poplar, balm-of-Gilead	*Populus balsamifera* L. var. *subcordata* Hylander
balsam	*Populus balsamifera* L. var. *balsamifera*
black	*Populus X parryi* Sarg.
Dunlop	*Populus* hybrid
Griffin	*Populus* hybrid
northwest	*Populus X bernardii*
rose, Altai Scotch	*Rosa spinosissima* L. var. *altaica* Rehd.
Lac la Nonne	*Rosa rugosa* Thunb. "Lac la Nonne"
Tetonkaha	*Rosa rugosa* Thunb. "Tetonkaha"
Yatkan	*Rosa rugosa* Thunb. "Yatkan"
saskatoon	*Amelanchier alnifolia* Nutt.
spruce, Colorado	*Picea pungens* Engelm.
white	*Picea glauca* (Moench) Voss
tamarack	*Larix laricina* (Du Roi)

willow, peachleaf	*Salix amygdaloides* Anderss.
sharpleaf	*Salix acutifolia* Willd.
yellowstem	*Salix alba* L. "Vitellina"

CONVERSION FACTORS FOR METRIC SYSTEM

Imperial units	Approximate conversion factor	Results in:	
LINEAR			
inch	x 25	**millimetre**	**(mm)**
foot	x 30	**centimetre**	**(cm)**
yard	x 0.9	**metre**	**(m)**
mile	x 1.6	**kilometre**	**(km)**
AREA			
square inch	x 6.5	**square centimetre**	**(cm^2)**
square foot	x 0.09	**square metre**	**(m^2)**
acre	x 0.40	**hectare**	**(ha)**
VOLUME			
cubic inch	x 16	**cubic centimetre**	**(cm^3)**
cubic foot	x 28	**cubic decimetre**	**(dm^3)**
cubic yard	x 0.8	**cubic metre**	**(m^3)**
fluid ounce	x 28	**millilitre**	**(mℓ)**
pint	x 0.57	**litre**	**(ℓ)**
quart	x 1.1	**litre**	**(ℓ)**
gallon	x 4.5	**litre**	**(ℓ)**
bushel	x 0.36	**hectolitre**	**(hℓ)**
WEIGHT			
ounce	x 28	**gram**	**(g)**
pound	x 0.45	**kilogram**	**(kg)**
short ton (2000 lb)	x 0.9	**tonne**	**(t)**
TEMPERATURE			
degree fahrenheit	°F-32 x 0.56 (or °F-32 x 5/9)	**degree Celsius**	**(°C)**
PRESSURE			
pounds per square inch	x 6.9	**kilopascal**	**(kPa)**
POWER			
horsepower	x 746	**watt**	**(W)**
	x 0.75	**kilowatt**	**(kW)**
SPEED			
feet per second	x 0.30	**metres per second**	**(m/s)**
miles per hour	x 1.6	**kilometres per hour**	**(km/h)**
AGRICULTURE			
bushels per acre	x 0.90	**hectolitres per hectare**	**(hℓ/ha)**
gallons per acre	x 11.23	**litres per hectare**	**(ℓ/ha)**
quarts per acre	x 2.8	**litres per hectare**	**(ℓ/ha)**
pints per acre	x 1.4	**litres per hectare**	**(ℓ/ha)**
fluid ounces per acre	x 70	**millilitres per hectare**	**(mℓ/ha)**
tons per acre	x 2.24	**tonnes per hectare**	**(t/ha)**
pounds per acre	x 1.12	**kilograms per hectare**	**(kg/ha)**
ounces per acre	x 70	**grams per hectare**	**(g/ha)**
plants per acre	x 2.47	**plants per hectare**	**(plants/ha)**

Examples 2 miles x 1.6 = 3.2 km, 15 bu/ac x 0.90 = 13.5 hℓ/ha

INFORMATION
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