

Uses and Management of Exotic Species: Poplars and Willows for Soil Conservation

In New Zealand, cultivars of both willows and poplars have been specifically bred and selected for erosion control purposes. They can be grown very easily from small cuttings and stakes or from larger pole material, and are able to be used for soil conservation purposes in a range of different situations, with relatively fast growth rates, and with a choice of cultivars suited to the site conditions.

Cultivars with desirable characteristics like resistance to disease, insects or possum browsing are targeted in the selection process, while those with less desirable characteristics such as brittleness or risk of spread are avoided.

While poplars and willows are usually planted for soil conservation purposes, they may be planted for other uses as well; including shelterbelts, stock fodder, bee forage, agroforestry, firewood and amenity purposes. Both poplars and willows are deciduous.

Characteristics

Willows have a high root mass, fast growth rate and good tolerance on wet soils. They are ideal for controlling erosion on river and stream banks, as well as for gully planting or slope stabilisation where the soils are not too dry or exposed.

Poplars have an ideal form and extensive root system suited for hill country stabilisation. Poplars grow best on deep friable soils with good summer moisture. On shallow or droughty soils growth rates are slow and establishment of unrooted (pole) material is poor.

Poplar selection

The main cultivars available in New Zealand are listed in Table 1 overleaf.

When selecting the most suitable poplar clone for your site, consider whether the site is drier or likely to be moist, whether it is exposed to the wind, and whether they are likely to be browsed by possums. It is also worth planting more than one type of clone for insurance against any problems that may affect one particular cultivar. Also, consider other benefits that different clones may provide, such as bee fodder or shelter.

An additional benefit of some poplar varieties is that those with high basic wood density can produce acceptable sawn timber, providing trees are correctly tended. However if the trees are planted in remote locations with difficult access then harvesting for timber may be uneconomic, making timber quality a lesser consideration.

Willow selection

Shrub willows and tree willows are the two most common types – the cultivars available in New Zealand are listed in Table 2 overleaf.

Tree willows grow up to 20m high (sometimes as short as 2m) and have single trunks between 60cm and 90cm in diameter. Leaves are lance shaped with long tapered tips

and catkins (flowers) appear at the same time as new leaves in spring.

There are two sub-groups of shrub willows; the osiers and the sallows.

Osiers form medium size shrubs up to 8m high with multiple stems arising from the base of the plant. Stem diameters can vary from 12-15mm up to 20cm depending on species and age of plants. Leaves are 5-10 times longer than they are wide and catkins appear 2-3 weeks before leaves.

Sallows are also multiple stemmed and carry stout branches. Form varies from low shrubs to small trees depending on the particular species. Leaf length is 2-3 times that of length width, and leaves are oval to round shaped. Catkins appear several weeks before leaves.

For soil conservation tree willows are used where a deep, extensive root mass is required for soil stabilisation – tree willows can be used to control gully erosion, slip erosion or streambank erosion as long as the site is not too dry. Shrub willows are used to control erosion by running water because their dense root mat resists scouring. Shrub willows also have a smaller aerial mass (compared with tree willows) which



Pair pole planting of tree willows for streambank erosion control

is a management advantage in some situations. Although the root mass of the shrub willows is dense, it is limited in extent.

Willow planting is widely used for river control. Tree willows are used in two different ways. Firstly, as part of a live engineering structure (such as groynes) to control severe streambank erosion; secondly, they can be planted on riverbanks and layered or mulched onsite as they grow to provide heavy vegetative riverbank protection. Shrub willows are planted on berms and banks of rivers where erosion is less severe, but the streambank needs to be stabilised.

Tree willows generally have good strong primary and secondary root systems, while shrub willows have a dense root mat, but with finer roots. When used together, the two types of willow are able to complement each other, and provide excellent bank protection in high energy river environments, such as the fans and/or semi-braided river systems of the eastern Bay of Plenty and Kaimai range. Historical willow planting of more invasive and brittle willow species (including crack willow, grey willow and pussy willow) has resulted in all willows being viewed as undesirable. However the willow species bred specifically for soil conservation and river control purposes have a valuable role that other plant species are not able to provide. Willows are the best option for bioengineering in river control and gully control as part of live engineering structures, and as a primary riparian protection in high energy environments of fans and semi-braided river systems.

Riparian planting of willows is increasingly viewed as being important for providing bee fodder during the critical spring period, when there is often a shortfall. In particular, corridors of selected willow plantings along river and stream systems can provide a valuable source of bee fodder as part of increasing biodiversity within a catchment.



Bioengineering using willows as part of gully control works. The extensive root system provides ongoing soil stabilisation to control headward gully erosion in conjunction with check dams.

Establishment and management

Poplars and willows both grow readily from woody cuttings - the most common plantings are either 60-100cm long stakes or 2.5m to 3m long poles. Rooted cuttings may be used in some situations, such as drier sites. All planting should be done during the winter dormant period, and the stakes or poles should be well soaked (2-3 days) in fresh water before planting.

For stake/pole planting, stock should be kept out of the planted area, and weed control will also be required for the first season. It can be carried out in grazed areas, but Dynex protective sleeves should be used, and heavy cattle kept away for the first two to three years until the trees are well established (*see reference video - Successful planting*).

This type of planting of poplars and willows in the volcanic soils of the Bay of Plenty is generally targeted to gully control, rather than space planting to control slip erosion. This is because space planting of poplars and willows can result in stock seeking shade under the established trees, which may cause sheet erosion of the ash soils. To prevent this, sufficient poles should be planted, and closely spaced so that there is enough shade for stock over a wider area. When planting poles in ash soils, an auger should be used for the pilot hole (*see reference video - Successful planting*).

Poplars and willows planted for erosion control will have a useful life of 40 years or so. Before planting you should think about how they are managed and replaced in the long term.

Both poplars and willows are susceptible to disease and pests. The New Zealand Poplar and Willow Research Trust (<http://www.poplarandwillow.org.nz/>) carries out research to select for disease and pest resistance well as to promote good management of poplars and willows planted for soil conservation purposes.

Recommended References

1. Videos – Planting poplar and willow series: Assessing the Site; Choosing the best poles; Successful planting. <http://www.poplarandwillow.org.nz/library/filter/videos>
2. Growing Poplar and Willow Trees on Farms (May 2007), ISBN: 978-0-473-12270-6.
3. Trees for the farm – A decision support tool for farmers (2016), Ian McIvor, Plant and Food Research.
4. Plant materials Handbook for Soil Conservation, Vols I-III. CWS Van Kraayenoord and RL Hathaway (eds 1986) Water and Soil Miscellaneous Publications No.93, No.94 and No.95, NWASCO.

Tables showing characteristics of poplar and willow cultivars:

Table 1: Poplar cultivars

Species	Cultivar (Clone No.)	Characteristics	Basic density	Uses
<i>Populus alba</i> x <i>glandulosa</i>	Yeogi 1 (PN895)	Resistant to rusts, leaf spot and possums. Good tolerance of drier and/or saline soils. Limited tolerance to wet soils. Suckering habit. Male clone.	390 kg/m ³	Soil conservation, forestry, agroforestry
<i>Populus deltoides</i> x <i>maximowiczii</i>	Eridano (PN850)	Fast growth. Resistant to rusts and leaf spot. Highly unpalatable to possums but large leaves and brittle branches susceptible to wind damage. Male clone.	300 kg/m ³	Soil conservation, forestry
<i>Populus deltoides</i> x <i>tricarpa</i>	Pakai (NZ5009)	Good possum resistance but slight susceptibility to frost in juvenile stage. Limited budwood can cause some variation in strike. Male clone.	350 kg/m ³	Soil conservation, agroforestry
<i>Populus deltoides</i> x <i>yunannensis</i>	Kawa (NZ5006)	Faster growth and better form than parent <i>P. yunannensis</i> . Moderately susceptible to wind and possums, disease resistant. Male clone.	370 kg/m ³	Soil conservation, agroforestry, amenity
<i>Populus</i> x <i>euramericana</i> (import)	Tasman (PN559) Veronese (PN870)	Both clones are moderately susceptible to leaf spot and are possum palatable. Tasman is resistant to rust, while Veronese is moderately susceptible. Tasman is a narrow crown, male clone, that requires moist sites. Veronese is a female clone, with a degree of drought tolerance.	330 kg/m ³	Soil conservation, shelterbelts, agroforestry, amenity
<i>Populus</i> x <i>euramericana</i> (NZ bred)	Argyle (NZ5095) Eastwood NZ5021 Kaianga (NZ5024) Margarita (NZ5014) Pakaraka (NZ5013) Weraiti (NZ5018)	Argyle and Eastwood form broad crowns and Argyle has early formation of heavy bark. All are possum palatable and have good disease resistance, except Margarita, which has slight rust susceptibility in late summer. Kaianga is a male clone, all others are female.	330-340 kg/m ³	Soil conservation, shelterbelts, agroforestry
<i>Populus euramericana</i> x <i>yunannensis</i>	Toa (NZ5007)	Resistant to rusts and leaf spot, low palatability to possums, fast growth rate. Female clone.	320 kg/m ³	Soil conservation, shelterbelts

Table 2. Tree Willow Cultivars

Species	Cultivar (Clone No.)	Characteristics	Uses
<i>Salix matsudana</i>	PN227	Tolerates drier soils than most other willows; develops early rough bark. Large spreading tree becomes prone to wind damage with age. Moderate susceptibility to leaf rust. Female.	Soil conservation, shelterbelts (requires side trimming)
<i>S. matsudana</i>	Shanghai (PN695)	Faster growing than PN227 but similar drought tolerance and early rough bark formation. Broad crown, best planted in gullies and form pruned to reduce wind breakage. Moderate susceptibility to leaf rust. Female.	Soil conservation
<i>S. matsudana</i>	Tsinan (PN694)	Similar to PN695 but faster growing and more susceptible to wind damage. Has less palatability to possums in the second year after planting. Moderate susceptibility to leaf rust. Female.	Soil conservation
<i>S. matsudana</i> x <i>alba</i>	Adair (NZ1143)	Reasonably narrow crown. Leafs out early in August. Male.	Soil conservation, shelter belts, river control
<i>S. matsudana</i> x <i>alba</i>	Aokautere (NZ1002)	Susceptible to marsonnins leaf spot disease and not recommended for humid areas. Fairly narrow crown, less susceptible to wind damage than PN227 parent. Male.	Soil conservation
<i>S. matsudana</i> x <i>alba</i>	Hathaway (NZ 1317)	Growth rate and form intermediate between NZ1130 and NZ1149. Has a degree of possum resistance. Male.	Soil conservation, river control, amenity

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<i>S. matsudana x alba</i>	Hiwinui (NZ1130)	Rather spreading crown and pendulous lower branches. Male.	Soil conservation, river control, bee forage, amenity
<i>S. matsudana x alba</i>	Moutere (NZ1184)	Fast growing, reasonably narrow crown. Good for erosion control on streambanks, in gullies and on foot slopes. Male.	Soil conservation, shelter belts, river control
<i>S. matsudana x alba</i>	Tangoio (NZ1040)	Better for shelter and not as vigorous as other hybrids. More drought tolerant than Motere and more suitable for planting on hillsides. Female.	Soil conservation, shelterbelts
<i>S. matsudana x alba</i>	Wairakei (NZ1149)	Fast growing, moderately spreading crown. Male.	Soil conservation

Table 3. Shrub willow species

Species	Cultivar (Clone No.)	Characteristics	Uses
<i>Salix purpurea</i>	Booth (PN249)	Shrub or small tree (7-8m), flexible branches, resistant to breakage. Best in gullies or along streambanks, can be used as an initial stabiliser on sites being revegetated with native plants. Triploid female, sterile.	Soil conservation, revegetation, river control
<i>S. purpurea</i>	Holland (PN605)	Shrub (to 7m), with spreading habit and flexible branches, similar to Booth. Best in gullies and along streambanks. Male.	Soil conservation, river control
<i>S. purpurea</i>	Irette (PN608)	Shrub to small tree (7-8m), upright habit. Performs well at higher altitudes but not drought tolerant. Good dense root system for streambank stabilisation. Male.	Soil conservation, river control, lower stratum in wind breaks
<i>S. purpurea</i>	Pohangina (NZ1087)	Shrub (7-8) moderately spreading. Vigorous slender flexible stems. Male.	Soil conservation, river control
<i>S. elaeagnos x daphnoides</i>	Tiritea (NZ1012)	Shrub (to 8 m) very vigorous Multi-stemmed with an open upright habit and flexible branches, slightly susceptible to leaf rust, not tolerant of dry conditions. Male.	Soil conservation, river control
<i>S. glaucophylloides</i>	Glenmark (CM4)	Clonal mix shrub (6-8m), multi-stemmed and spreading. Vigorous on most sites and grows well on high country sites. Tolerates acid soils. Foliage moderately palatable to possums. Male.	Soil conservation, river control
<i>S. repens x purpurea</i>	Kumeti (NZ1057)	Semi-prostrate shrub (2-3m), with many almost horizontal branches. Medium growth rate, suitable for low groundcover. Male.	Soil conservation, river control
<i>S. xreichardtii</i> (= <i>S. 'discolor'</i>)	PN215	Shrubby tree (to 10m), erect, multi-stemmed habit. Tolerates drier conditions than most willows, moderately tolerant of salt winds, and tolerates acid soils. Slightly susceptible to leaf rust. Male.	Soil conservation, windbreaks
<i>S. viminalis</i>	Kinuyanagi (PN386)	Large shrub to small spreading tree (6x6m) very vigorous on moist fertile sites once established. Leaves are silvery underneath. Performs well as a coppice fuel wood and forage species. High tannin levels in foliage reduce palatability to livestock after mid summer. Male.	Forage, fuel wood, amenity



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