MAF Sustainable Farming Fund

PWNews

Managing poplars and willows on farms

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Welcome to this issue

Peter Gawith

I welcome you as a reader of this newsletter and as a participant in our SFF Project concerned with managing trees on farms and using poplars and willows on farms in various ways. Since the first issue a few months ago the team has been accelerating its effort to carry out the work that achieves the milestones we set ourselves at the start of the project. This newsletter describes in some detail how we are progressing in the different facets of poplar and willow use on-farm. I am also pleased to report that there was a great turnout at the field day we organised on Fraser and Shona Gordon's hill property near Taihape. It was a perfect day and those attending – some from as far away as Wairoa – saw how Fraser is developing browse blocks for his stock and still retaining these trees for preventing soil erosion.

Progress continues down south with the Otago group looking at using these trees more effectively for that particular challenging environment. In mid-March tree foliage was harvested on Dick Sharpin's farm at Tuapeka and on John Prebble's property at Dunback for dry matter yield and other data. You can read more about this and other project progress in this issue of *PWNews*.

Peter Gawith, Project Leader, Gladstone, Wairarapa

Progress to date

From Project Manager Grant Douglas, AgResearch, Palmerston North

Grant Douglas

At the end of the first year of this three-year project, it is timely to reflect on our achievements, particularly over the last six months. Many members of the project team in Otago and the lower North Island have been busy conducting field work and several other tasks. Achievements (in no particular order) include:

- Draft economic models have been prepared for the three main tree pasture systems – browse (using Wairarapa experiences), pollard (Otago) and coppice (Otago), and are being fine-tuned before wider distribution.
- A trial determining the potential of willow browse blocks to control parasites in lambs has been completed at Massey University's Riverside Farm and data are being analysed.
- Growth/regrowth of coppiced willows (dairy farm) and pollarded poplars (sheep/beef farm) in Otago and pollarded willows in central Hawke's Bay (sheep/beef farm), have been determined.
- A framework has been developed for the Planting and Management Plan and several farmer and research experiences with recent storms e.g. in Manawatu, have been collated.
- A dedicated website (address at the top of this page) for the project is operational and has links to former projects on tree fodder and managing dairy effluent using coppiced hardwoods.
- Work has commenced to determine the environmental effects of willow browse blocks e.g. on soil water/nutrient patterns.
- A field day on poplars and willows for fodder, soil stabilisation, and potential parasite control was held in April at Fraser and Shona Gordon's farm near Taihape, and was attended by about 40 people.
- A popular article on the poplar fodder trial at John and Heather Prebble's farm at Dunback, Otago, was published in the February issue of *New Zealand Tree Grower*.

I wish to acknowledge the contribution of John Labes, Clutha Agricultural Development Board (CADB), who was responsible for overseeing the Otago activities in the project until early this year, when he decided to "semi-retire". His role has been taken over by Malcolm Deverson at CADB, who has come on board very quickly, and follows John in making my job much easier.

Taihape field day well attended

From Deric Charlton, Greenfields Communications, Palmerston North

There was an excellent attendance at a field day organised by the SFF Project team, giving the latest information on the many benefits of growing poplar and willow trees on farms. This event was held in perfect weather on Friday 22 April at Fraser and Shona Gordon's Wairere property, at Taoroa Junction south of Taihape. A broad range of speakers covered different aspects, and those attending saw browse blocks of willows grown by Fraser on the 500 effective ha hill country farm. The Gordons have run deer, sheep and beef on this family farm during the past 30 years and find the stock benefit from browsing the many poplar and willow trees grown on the property. Accordingly they have planted special-purpose blocks of closely-planted poles on some erosion-prone areas, and Fraser says that these not only help to prevent soil erosion but offer valuable summer feed and prevent any ryegrass staggers and facial eczema effects in dry summers.

Following introductory comments from Fraser Gordon and project leader Peter Gawith, Kevin Rooke, the Horizons Regional Council soil conservator covering this region, described the Council's poplar and willow planting programme for soil erosion control. At least a million of these trees have been planted in the lower North Island during the past ten years and in last year's storms, many farmers with established trees suffered significantly less damage to their land than those under pasture only. Professor Tom Barry described his research programme, largely undertaken on Massey University's Riverside Farm near Masterton, to study effects of feeding sheep on willow browse blocks with a pasture understorey for controlling internal parasites in sheep. While results are still being processed, he indicated that undrenched lambs grazing the browse blocks performed similarly to drenched lambs grazing pasture yet had lower faecal egg counts and were much less daggy than undrenched lambs grazing pasture, whose faecal egg counts rose to high levels.

Fraser Gordon's three-year-old Kinuyanagi willow browse block

Associate Professor Peter Kemp gave an update on how much feed these trees can supply through summer pruning and that this tree feed can boost energy levels in pinch feed periods. Supplementing sheep diet with poplar and willow prunings can benefit subsequent lambing and weaning percentages, he said.

Taihape veterinarian Andrew Dowling was staggered at the high drench resistance levels on local farms following a survey of 65 properties, so was looking for alternative options. Working with Fraser Gordon two years ago he had tried feeding some bulls with willow fodder, comparing them with bulls on a normal pasture diet. While the farm trial failed to show anything conclusively, Fraser Gordon said that the trial had produced several bull carcases that graded "T" for the first time in his experience, and he attributed this to the willow feed, although Andrew Dowling felt that the comparison needed to be repeated in a properly conducted trial. He did say however, that when farm stock on Taihape farms suffer from ryegrass staggers and facial eczema during summer and early autumn, willow and poplar fodder will alleviate the problem. HortResearch scientist Ian McIvor concluded the field day with a discussion on dealing with large trees, telling those present that poplars and willows will still act as soil conservation trees while being pruned for fodder. Although their root systems will not spread as far as those of unpruned trees, there will be more trees planted per hectare anyway, when grown in browse blocks.

Grazing willow browse blocks for parasite control

From Carolina Diaz Lira, Tom Barry and Bill Pomroy, Massey University

In early December 2004, groups of 30 weaned male lambs were allocated to each of six treatments on Massey University's Riverside Farm, near Masterton. These comprised drenched and undrenched lambs, grazing either a pasture control, pasture (grazed for three weeks) with access to a browse block (for one week) in rotation, and some given full access to the established browse blocks. The browse blocks were planted in 2000 and 2001 at 6,000 stems/ha and contained a mixture of trees and herbage. They were planted on rush-infested areas that had no productive potential in their unimproved state. The experiment lasted for 16 weeks, during which each group grazed separate areas. Rotational grazing was applied, with each group grazing the same area three times. As the experiment has only just finished, statistical analyses have not yet been conducted. However, the following trends seem evident:

Tom Barry in a browse block

Mean faecal egg counts (FEC) as eggs/g of faeces for undrenched lambs on the three forage treatments.

Date	Pasture	Pasture/browse block	Browse block
5 January	411	140	214
2 February	446	455	965
2 March	616	453	207
15 March	1270	891	534
Drenched lambs:			
Upper	437	267	305
Lower	143	154	59

- FEC remained very low in all the drenched groups.
- FEC progressively increased in undrenched lambs on pasture, especially later in the experiment.
- For undrenched lambs with full access to browse blocks, the FEC increased early February and then declined.
- At the experiment end, FEC of undrenched browse block lambs was similar to that in drenched lambs on pasture.
- FEC for undrenched lambs in the pasture/browse block treatment was often between that of undrenched lambs on control pasture and those with full access to browse blocks.

Liveweight gain (LWG; g/day) and final dag score (units).

Attribute		Pasture	Pasture/browse block	Browse block
LWG				
7 Dec – 2 Feb	Drenched	220	200	200
	Undrenched	200	200	190
7 Dec – 15 March	Drenched	160	130	190
	Undrenched	110	110	160
Final liveweight	Drenched	43.9	40.6	46.4
15 March	Undrenched	39.2	39.0	43.5
Dag Score	Drenched	1.33	1.20	1.13
	Undrenched	1.80	1.40	1.40

- LWG was approximately 200 g/day early in the experiment and similar for all six groups.
- Total LWG tended to be increased by drenching and by full access to browse blocks.
- Total LWG and final liveweight were similar for full access/undrenched lambs and control pasture/drenched lambs.
- Initial dag score was 1.2 and increased markedly in undrenched pasture-fed lambs. Drenching and full access to browse blocks reduced dag score.
- Considering all the results, the undrenched lambs grazing browse blocks performed similarly to drenched lambs grazing control pasture.

Laboratory work from this experiment is ongoing. Digestive tracts from 12 lambs in each of the undrenched groups were collected at slaughter, and full worm burdens in the abomasum, small intestine and large intestine are being determined for each species of internal nematode parasite and will be presented in a future issue of *PWNews*.

On-farm grazing

From Jeff Ravenwood, Fernglen, Wairarapa and Tom Barry, Massey University

Groups of 100 ewes were allocated to normal control pasture or the established willow browse block in late February 2005 at Fernglen, near Riversdale Beach in Wairarapa. Rams were run with the ewes for two cycles, with most of the mating in the browse block group being done while the ewes were grazing these blocks. The two groups were then joined and grazed on pasture.

Fernglen ewe grazing 2005 - pasture measurements.

	Primary Growth		Regrowth	
	Control Pasture	Browse block	Control Pasture	Browse block
Pasture mass (kg DM/ha)				
Pre-grazing	**2611**	**5164**	**1636**	**2664**
Post-grazing	**1512**	**2241**	**718**	**784**
Dead matter content (%)				
Pre-grazing	**46.2**	**15.7**	**71.6**	**56.6**

Pasture masses were close to recommended practice for ewes mated on control pasture, with liveweight gain being good at 115 g/day, despite considerable dead matter in the pastures following a dry January and February.

Pasture masses were higher in the browse blocks and nutritive value lower; consequently, liveweight gain was lower for these ewes than for ewes grazing pasture. Initial liveweight and body condition score were high, indicating good quality stock. Scanning results on these ewes are awaited with interest and will be reported in a future *PWNews*.

Fernglen ewe grazing 2005 – ewe measurements.

	Control Pasture	Browse block
Initial liveweight (kg)	**69.7**	**71.6**
Liveweight change (g/day) †	**115**	**21**
Initial condition score (CS units)	**3.23**	**3.26**
CS change (units) †	**+0.44**	**+0.28**

† At 30 days

Studies at both Fernglen and Riverside Farm show that one of the main problems in using browse blocks for livestock production is control of herbage growing under the trees.

The most satisfactory system of control tried to date involves three light grazings during the growing season (early October to late April). Future work is planned to further develop this system.

Willow coppice blocks for dairy effluent disposal

From Malcolm Deverson, Barrie Wills and Murray Harris, Otago

The trial established last September at Sharpin's Wharetoa share-milking property was assessed in March 2005. Plant material was harvested to determine dry matter yield (DMY) and plant survival was assessed, given the relatively cool, wet season and extensive pasture growth/competition. The past season has been relatively cool and wet, with intervening short but warmer periods.

Although spray releasing was conducted on the shrub willows during late spring, subsequent regrowth overwhelmed some weaker kinuyanagi cuttings, particularly those from Environment Canterbury. These were planted at about 10,500 plants/ha, and about 88% survived. Their mean DMY was 355 kg/ha, with a third being leaf, a third edible stem and a third stem.

Kinuyanagi willow at Sharpin's

The rooted cuttings (Wensley, Winton) and unrooted cuttings from IHC (Barnego, Balclutha) planted at about 12,000 plants/ha, all survived and grew reasonably well. Mean DMY per plant was 1661 kg/ha, with 37% leaf, 38% edible stem and the rest stem. Only about a third of this yield was attributable to the past season's growth, because these were already sizeable plants when the trial was established. Plant survival of cuttings from IHC (planted at 10,500 plants/ha) also averaged 88%, mortality being principally because of pasture competition.

Their DMY averaged 643 kg/ha, also with a third comprising leaf, a third edible stem and a third inedible stem. The IHC plants showed stronger growth, and many were over 1.5 m high. While the pasture was not measured at establishment, levels were minimal because of pre-plant grazing. About 3200 kg DM/ha pasture had accumulated over the intervening four months or so, and was mostly weeds like mallow, Kentucky bluegrass, brome grass and browntop. In many areas heavy pasture growth had overwhelmed the weaker willow cuttings.

Pollarded poplar for forage

From Barrie Wills, John Prebble and Murray Harris, Otago

The poplar forage trial at Prebble's Dunback farm was also re-assessed by harvesting in March 2005 and the pollarding treatments carried out in Nov 2004 were repeated.

The Flevo poplars either had:

- Pollard regrowth trimmed leaving only stems ≥ 20mm diameter
- Pollard regrowth trimmed leaving only stems < 20mm diameter
- No trimming of pollarded trees (control)
- Adjacent semi-mature trees from the 1998 pollarding were cut back to a bare coppice.

Flevo poplars pre-pollarding at Prebble farm

After one growing season the trees now have only about half the branch number they had in November 2004. The lighter branches seem to have gone, presumably because of competition for light. Conversely branch length has increased by about 50% and the biomass has approximately tripled during the same period.

The proportion of edible leaf on the trees increased slightly from 48% in Nov 04 to 51% in March 05, comprising about 25% dry matter, and about 50% dry matter for the heavily lignified inedible stems.

Roots – what's Going On Down There?

From Ian McIvor, HortResearch and Grant Douglas, AgResearch Palmerston North

Poplars are commonly planted on moist, unstable New Zealand hill country to prevent or reduce soil erosion. The distribution and structure of the poplar root system has a major influence on a soil's physical properties, such as soil binding and water content, which in turn influence both soil stability and pasture growth. We know of no other studies investigating root distribution, direction and size of poplar roots in hill country plantings.

The root systems of single Veronese hybrid trees were excavated at AgResearch's Ballantrae research station near Woodville. They were growing among a stand established from 3 m poles in 1995 and planted at 8 m x 8 m spacing (156 stems/ha) on an erosion-prone hillslope. The structural roots (diameter >2 mm) were excavated at 5, 7 and 9½ years. Radial roots were excavated manually, and then a mechanical digger was used to excavate the stump and deep sinker roots.

Extensive research work on hill slopes shows that when compared with soils not root-permeated, even low tree root densities can boost shear strength. Tree roots reinforce soils and relieve local high stress by transferring any load to regions of lower stress. Additional strength is mobilised within the soil-root complex by forces developing between the root fibres and the surrounding soil. Shear stresses in the soil mobilise tensile resistance in the tree roots, which makes the soil stronger. Soil reinforced by roots is more able to resist continued deformation without loss of residual strength, than soil alone.

Table 1. Dimensional data for the excavated trees.

Tree age (years)	DBH (cm)	Height (m)	Root dry mass (kg)	Root length (m)	Root mass: trunk area	Root length: trunk area
0	6.5	2.0	0	0	N.A.	N.A.
5	8.4	7.3	0.57	79.4	0.0103	1.43
7	14.0	9.0	7.80	275.4	0.0507	1.79
9.5	21.3	13.3	17.90	643.7	0.0503	1.81

Radial roots were generally found within 40 cm of the soil surface, many only 10-15 cm below the surface. Only the radial roots growing uphill penetrated deeper, and then only for a relatively short distance (<2 m). Thin (2-5mm) sinker roots growing from the radial roots penetrated deeper than 70 cm.

The area around a tree resembles tree annular rings. Within each ring the root mass and root length can be analysed to give an idea of root anchoring at different distances from the tree over time. Roots of 'Veronese' poplars grown from poles make minimal contribution to soil stability in the first five years of establishment. The more root extension a tree produces then the greater is its capacity for stabilising a slope. Diameter at breast height (DBH) should be used as the guide to root development.

Gaining knowledge of the effects of poplars underground will help farmers to determine tree spacing and location for optimal effectiveness, and will help management decisions.

FEEDBACK

We are keen to hear from farmers and other people living or working on the land about their experiences with managing poplars and willows for soil conservation, shelter and shade and using them for supplementary fodder.

If you have had some experience with poplar and willow tree management and can offer some positive suggestions that we could include in the practical guidelines, then please contact one of the team listed on the back page and give us the details. We will check with you for accuracy and content suitability before any of your information is published.

Fodder regrowth on harvested willow and poplar

From Peter Kemp, Steven McGill and Mark Osborne, Massey University

In the summer of 2003/04 the regrowth of poplars and willows harvested for the first time two years previously was measured. These were trees that had been cut through the trunk at approximately shoulder height (1.5-2.0 m above ground level).

Table 1 shows that regrowth was reasonable for all but the six-year-old Veronese poplars, which had suffered severe browsing damage, as the regrowth was within reach of cattle. Regrowth of Veronese poplar was related to diameter at breast height (DBH), and the regrowth of the 23.9 cm DBH trees was also greater than that of Tangoio willow of similar DBH (Table 1).

The fodder regrowth was faster than the original growth. For example, the 7.5 kg DM produced in two years on the 8–10 year-old trees would have taken five years to develop on a tree after it was planted as a pole.

Table 1. Regrowth of edible fodder dry matter (leaves and stems less than 5 mm diameter) on willow and poplar trees in Wairarapa.

Species	Regrowth	DBH	Age
Tangoio willow	4.8 ± 0.46 kg DM/tree/2 years	21.6 cm	7–10 yrs
Veronese poplar	7.5 ± 0.53 kg/DM/tree/2 years	23.9 cm	8–10 yrs
Veronese poplar	2.9 ± 0.31 kg DM/tree/2years	10.2 cm	8 yrs
Veronese poplar	0.7 ± 0.16 kg DM/tree/2 years	13.1 cm	6 yrs

The table below shows the regrowth of fodder on mature pollarded trees on Alec Olsen's property near Rissington in Hawke's Bay. These trees have been pruned so that the regrowth can be cut by a person standing in a "nest" of substantial branches growing above cattle browsing height. The regrowth of these mature trees is greater than for the younger trees in Table 1.

Table 2. Regrowth of edible fodder dry matter (leaves and stems less than 5 mm diameter) on mature, pollarded willows and poplars after eight months in Hawke's Bay.

Species	Regrowth	DBH	Age
Booth willow	6.4 ± 1.02 kg DM/tree/8 months	53.1 cm	19 yrs
Flevo poplar	2.9 ± 0.41 kg DM/tree/8 months	46.9 cm	19 yrs

Trees and the 2004 Storm

From Deric Charlton, Greenfields Communications, Palmerston North

In April I had a chance to see whether trees had saved the land on some lower North Island farms. The first farm I visited was Tyrone, the property of Hugh and Diana Stewart, which lies north of Marton in the Turakina Valley, right in the area that was heavily damaged during the storms of February 2004. Tyrone covers 770 ha of mostly steep hill country, on which Hugh runs 4,000 ewes and 2,000 hoggets; 160 Angus breeding cows and 40 rising two-year-old heifers.

Hugh Stewart and his poplars

He has mostly planted only poplars on his land – *Kawa* and *Veronese*, and also the Chinese poplar (*P. yunnanensis*), as he feels they perform best under his particular conditions. He removed any old Lombardy poplars as they suffered severe rust disease. He has also planted a few willows in particular "trouble spots".

Thanks to a recent Horizons Regional Council possum control programme in the area, there are none of these pests remaining. Hugh and Diana bought some adjacent farm blocks to increase the farm area, in 1982, 1986 and 1996, and he has or is in the process of planting these areas with trees to protect the steepest slopes.

Hugh Stewart told me that the storms that severely affected this region during February 2004 revealed the problems with growing trees on farms here. On the shady aspects the large poplars need topping, and a few big trees (0.1%) were blown over and came out completely. Topping and pruning these would obviously be beneficial. Young Kawa trees (4-5 years old) toppled sideways in the heavy winds, especially those growing on saturated soils. Crack willows planted many years ago blocked waterways. Those areas of the latest block that had not been planted were heavily damaged during the 2004 storm.

During the past year Horizons Regional Council has reported that the effectiveness of trees for stopping erosion depends on where they are planted. On most hill slopes they reduce erosion tremendously but large, woody trees may contribute to stream bank erosion by restricting water flow and log jams building up against bridges. A report on the storm and flood in February 2004 refers to Doug Hicks' 1992 research and recent erosion mapping by Landcare Research, which showed that the probability of erosion under pasture can be five to ten times higher than under forest. It seems that we still need to learn how to manage established trees for optimum effectiveness during future storms. In the meantime the regional council websites are well worth checking, to find out the latest reports and updates – see www.horizons.govt.nz, www.gwrc.govt.nz and www.hbrc.govt.nz for the lower North Island information.

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Want to know more?

If you are interested in this project and its results and would like someone else to receive future issues of *PWNews*, please contact any of the following:

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