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HortResearch

Reuse of farm dairy effluent

The Horticulture and Food
Research Institute of New Zealand Ltd

Coppiced poplars and willows show potential for use in effluent irrigated systems

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Environmental concerns

Many aspects of dairy farming have come under increasing environmental scrutiny and in recent years the management of farm dairy effluent has been of particular concern to the industry, public and Regional Councils. These concerns are heightened where farms are established along waterways that flow into significant catchments or where tile drainage systems can quickly move drainage water from paddocks to waterways.

Practice

Farm dairy effluent is often irrigated onto pasture, a practice that is either encouraged or required by Regional Councils. Irrigation onto pasture provides a source of nutrients for the pasture and renovates the effluent by removing nitrogen and other nutrients and allowing sufficient passage of time that pathogens are killed. Effective renovation depends on correct application of effluent at rates appropriate for the local soil, climate and pasture growth.

Dangers

If effluent is applied incorrectly, ponding and surface runoff can occur, nitrate concentration in the drainage can reach unacceptable levels, and groundwater or surface water can become contaminated.

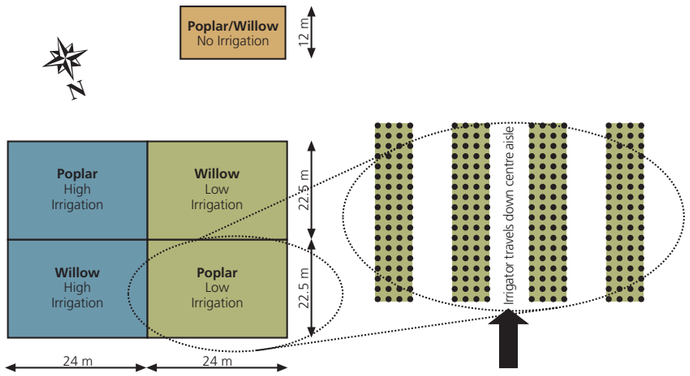
Poplars and willows are used extensively in New Zealand for soil conservation and riverbank plantings because of their ability to grow quickly in wet areas, establish extensive root systems and remove large amounts of water.

Their ability to coppice repeatedly makes them promising candidates for use in effluent irrigated systems; either as vegetation to be directly irrigated by the effluent, or as riparian buffer zone plantings to capture nitrogen from seepage or re-irrigated tile drainage. A further advantage of the trees is that the foliage can be cut and fed to stock, either milking or dried-off cows, or other livestock systems.

Testing the potential of cut and carry coppiced hardwoods in taking up nitrogen from fresh dairy shed effluent and providing fodder on a dairy farm.

Three blocks each of Argyle poplars and Tangoio willows were planted as 1.2 m stakes on a dairy farm in Southern Wairarapa in September 2001. One block of each species was irrigated with fresh farm dairy effluent at a high rate, about 5 mm per week, the second irrigated at a low rate of about 2.5 mm per week, and the third block of each species was left unirrigated.

The trial was continued for three growing seasons finishing in May, 2004. The trees were coppiced once per growing season (Feb-Mar). There was some growth following coppicing but not enough to warrant a second harvest.



Harvest 1 – 27 March 2002

Harvest 2 – 4 February 2003

Harvest 3 – 10 February 2004

Growth in the no irrigation and high poplar or willow treatments at the time of the three harvests.

Potential advantages and challenges

The prospects for using coppiced blocks of willow and poplar for effluent control on dairy farms will depend on the capacity of the coppiced trees to remove more N than would grazed pasture. The capacity will depend on the long-term average growth of the coppice block. Growth rates varied widely during the three years of the study (see photos). The table shows the range of N removed measured for the coppiced trees compared to a typical grazed pasture.

Over the three years of the trial the coppiced trees, particularly willows, removed more N than would a typical grazed pasture. This would reduce the amount of land needed for the irrigation of effluent (see table below).

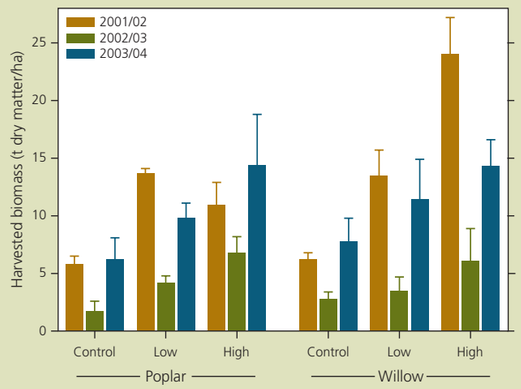
Calculations comparing the area needed per 100 cows for a typical grazed pasture and the likely range of cut and carry coppice blocks.

	Typical (grazed) pasture	Coppice block (cut and carry)	
		Low Range	High Range
Harvestable biomass (t DM /ha /yr)	**12-18**	**7**	**24**
N in biomass (kg N /ha /yr)	**500**	**100**	**440**
Returned to site (kg N /ha /yr)	**350**	**10**	**44**
Removed from site (kg N /ha /yr)	**150**	**90**	**400**
Area need per 100 cows (ha)	**4.0**	**6.7**	**1.5**

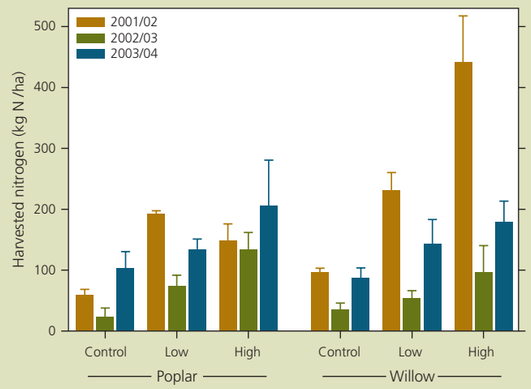
The trees accumulate a large amount of fodder with qualities similar to maize silage, that is available in late summer when many farms experience feed gaps. Some willow and poplar species have high levels of condensed tannins which are considered to be effective in deworming stock. There are challenges associated with disease and pest management of coppiced willow and poplar blocks as well as with harvesting and feeding out. There may be need for rust and sawfly control, and the cut stools can be susceptible to silverleaf fungus attack.

The coppice blocks may be more useful as a wet weather safety valve, particularly in unproductive areas of the farm. Another potential use is in re-treating tile drainage to reduce N movement to surface water.

Time of harvesting is important. The photograph above was taken in October 2003. The larger trees in the background were harvested in the previous February while the smaller trees were harvested later, in April. Early harvesting allows some regrowth, formation of buds, and allocation of carbohydrate to roots before winter leading to faster growth in spring and summer. This grows more fodder and suppresses weeds better than late harvesting.



Harvested biomass (average and maximum) in the poplars and willows for the three years of the trial.
The harvested biomass in tonnes of dry matter per hectare is shown above. Poplar yields in 2001/02 were depressed by rust infection, all yields were reduced in 2002/03 by an unusual number of frosts in October followed by a dry summer.



Harvested nitrogen (average and maximum) in the poplars and willows for the three years of the trial.
Nitrogen stored in the harvested biomass was measured. Over the three years N removal in the trees per hectare was greater than would be expected from grazed pasture.