A possible sustainable harvesting regime for Poroporo (*Solanum aviculare*)

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Abstract

Solasodine is an alkaloid that was extracted from leaves and young stems harvested from poroporo (*Solanum aviculare*) crops grown in north Taranaki during the late 1970's and early 1980's. The standard harvest regime was to wait for crops to reach a height of about 75 cm and then cutting back to a height of about 60 cm. There were a maximum of 4 cuts per season between late spring and late autumn. The low yield related to a lack of plant vigour in the second and subsequent seasons was identified as a serious economic problem. In the 1982-83 season 'reinvigorating' harvest regimes involving cutting second year plants back to a height of 30 cm or 45 cm in August (when plants were growing very slowly) and to the same heights in October (when plants had first reached a height of 75 cm for the season). Subsequent cuts to a height of 60 cm after plants had reached about 75 cm again were stopped in late February 1983. The trial stopped because solasodine had begun to be produced synthetically in the Netherlands and the factory extracting solasodine from poroporo in North Taranaki was abruptly closed. When the trial stopped the plants cut to a height of 45 cm in October had yielded as well as plants cut using the standard harvest regime, suggesting that a more sustainable harvest regime for harvesting poroporo is possible.

Additional keywords: Solasodine, alkaloid, cutting height, medicinal plants

Introduction

Poroporo (*Solanum aviculare* Forst) was grown commercially on farms in the Waitara district of north Taranaki from 1978 to early 1983. Leaves and young stems were harvested about four times during a 6-8 month season for the extraction of solasodine which was being used as basic component of steroids in medicines, mostly contraceptives. Low yield related to a lack of plant vigour in the second and subsequent seasons in commercial crops was a serious economic problem and various causes were suspected including nutrient imbalance, weed competition and severity of harvest (Alspach *et al.*, 1983). Commercial crops were cut several times during the season to a constant height of about 60 cm after plants had first grown to about 75 cm. The harvest regime in trials in New Zealand during the 1970's and early 1980's included variable patterns of multiple harvesting (e.g. Fryer, 1972; Mann *et al.*, 1980, 1985; Beatson *et al.*, 1985).

A ‘reinvigorating’ harvest regime to help maintain plant vigour in the second and subsequent years of a commercial crop was seen as an approach to manipulate plants. This was so that the plants had more current season growth with leaves on unharvested stems than had been achieved by the harvest regimes used commercially or previously trialled. The ‘reinvigorating’ regimes tested are described and discussed in this paper. The trial was halted in late February 1983 very soon after solasodine was first produced synthetically by chemists in the Netherlands and the commercial production of solasodine from poroporo leaves and young stems in a factory in Waitara abruptly ceased.

While it is currently not economic to grow poroporo in New Zealand for solasodine production, should economic factors become favourable the problem of low yield will need to be addressed. This historic research into the agronomy of poroporo will provide a useful starting point.

Materials and Methods

The trial was set up in a small paddock in the Waitara district (38° 59’S, 174° 19’E) where a poroporo (cv. NA38) crop had already been harvested for the 1980-81 season. For the trial crop, plants had been transplanted in beds 2 m wide with three rows 50 cm apart and plants 50 cm apart within each row on 22 October 1981. The crop was harvested by cutting plants back to a height of 60 cm every time they reached 75 cm during the 1981-82 season. There were five replicates arranged in a randomised block design for each harvesting treatment to be practiced in the 1982-83 season. The treatments were:

1. Cut to a height of 60 cm after first reaching 75 cm in every harvest of the season, i.e. the standard harvesting method.
2. Cut to 30 cm (with material discarded) for harvest 1 in August. Cut to 60 cm after reaching 75 cm in later harvests.
3. Cut to 45 cm (with material discarded) for harvest 1 in August. Cut to 60 cm after reaching 75 cm in later harvests.
4. Cut to 60 cm after first reaching 75 cm and then further cut to 30 cm for harvest 1. Cut to 60 cm after reaching 75 cm in later harvests.
5. Cut to 60 cm after first reaching 75 cm and then further cut to 45 cm for harvest 1. Cut to 60 cm after reaching 75 cm in later harvests.

The harvest dates up until when the trial was abandoned in late February 1983 are given in Table 1. A 5 m long section of each plot was harvested for drying and solasodine content determination by Solexin Ltd, Waitara. Fertiliser and agrichemical records are no longer available for these trials.

Table 1: Harvest dates and accumulated solasodine yields (kg/ha) in 1982-1983 season.

Harvest treatment	Harvest dates			Accumulated solasodine yields (kg/ha)		
	1	2	3	1	2	3
1	6 October 1982	26 November 1982	12 January 1983	33.16	84.04	112.50
2	25 August 1982	22 December 1982	25 January 1983	0	21.54	31.00
3	25 August 1982	9 December 1982	25 January 1983	0	34.62	56.70
4	6 October 1982	22 December 1982	25 January 1983	68.68	78.24	90.50
5	6 October 1982	9 December 1982	25 January 1983	47.85	80.34	111.80
[1]$LSD_{(0.05)}$						9.50
$LSD_{(0.01)}$						15.10

[1]LSD's are for comparing accumulated yields at harvest 3.

Results and Discussion

After three harvests in the 1982-83 season the standard treatment (Treatment 1) and cutting to 45 cm in the first harvest in October (Treatment 5) had produced the highest solasodine yield (Table 1). The other three treatments had significantly lower final solasodine yields. Of these, the lowest accumulated yields after three harvests were measured when plants were cut to 30 cm at the first harvest in August (Treatment 2), followed by plants cut to 45 cm at the first harvest in August (Treatment 3). Both August-cut treatments produced less than half the solasodine yield of the best performing treatments, suggesting early and low cutting (30-45 cm) was too harsh a 'reinvigorating' treatment. Cutting plants to 30 cm at the first harvest in October (Treatment 4) resulted in mid-range solasodine yields after three harvests. The good performance of Treatment 5 in this trial suggests some form of plant 'reinvigorating' treatment may be the basis of a sustainable harvest regime for poroporo leaves and young stems. No further studies have been done so no further conclusions can be drawn.

In more recent times solasodine has been extracted from tissue cultured parts of *S.aviculare* (Kittipongpatana *et al.*, 1998) and the closely related *S.lasciniatum* (Bhatnagar *et al.*, 2004), which was also studied in the 1970's, particularly in the South Island of New Zealand, for solasodine production from leaves and stems (Davies and Mann, 1978).

Whether extraction of solasodine from poroporo stems and leaves will become economic again in New Zealand is unknown. However, the experiences in the 1970's and early 1980's from trial and commercial production of solasodine from poroporo leaves and stems should be considered if those plant parts of other New Zealand native shrubs, e.g. kawakawa (*Macropiper excelsum* (G. Forst.) Miq.), horopito (*Pseudowintera colorata* (Raoul) Dandy) and manuka (*Leptospermum scoparium* (J.R. Forst. and G. Forst.)) are ever commercially grown and harvested for medicinal compounds.

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References

Alspach, P.A., Rohrbach, J.F. and Ruth, J. E. 1983. Poroporo (*Solanum aviculare* Forst); a summary and discussion of some recent agronomic research in New Zealand. *New Zealand Journal of Experimental Agriculture* 11: 11-15.

Beatson, R.A. and Rohrbach, J.F. 1985. Genotype-environment interaction in poroporo (*Solanum aviculare*). *New Zealand Journal of Agricultural Research* 28: 125-128.

Bhatnagar, P., Bhatnagar, M., Nath, A.K. and Sharma, D.R. 2004. Production of solasodine by *Solanum laciniatum* using plant tissue culture technique. *Indian Journal of Experimental Biology* 42: 1020-1023.

Davies, D.J.G. and Mann, J.D. 1978. Solasodine production from *Solanum laciniatum* in the South Island of New Zealand. *Proceedings Agronomy Society of New Zealand* 8: 69-71.

Fryer, R.F. 1972. Cultivation of Solanum in Canterbury. *Proceedings Agronomy Society of New Zealand* 2: 73-84

Kittipongpatana, N., Hock, R.S. and Porter, J.R. 1998. Production of solasodine by hairy root, callus, and cell suspension cultures of *Solanum aviculare* Forst. *Plant Cell, Tissue and Organ Culture* 52: 133-143.

Mann, J. D., Edge, E. A., Lancaster, J.E. and Blyth, K. 1980. Growth and solasodine production by *Solanum aviculare* and *Solanum laciniatum* under moisture stress at different temperatures. *New Zealand Journal of Agricultural Research* 23: 361-366.

Mann, J.D., Lancaster, J.E., Douglas, J.A., Goold, G.J. and Brown, N.S. 1985. Preliminary investigation into the solasodine yield from *Solanum aviculare* and *Solanum laciniatum* at 5 sites in the North Island, New Zealand. *New Zealand Journal of Experimental Agriculture* 13: 67-70.