Bursaria for biodiversity: its distribution, attributes and propagation

Rod Bird

Of the dozen or so local species that should be the basis for re-establishment of native vegetation on the basalt plains, Sweet Bursaria (*Bursaria spinosa*) ranks with Blackwood (*Acacia melanoxylon*), Black Wattle (*A. mearnsii*), Silver Banksia (*Banksia marginata*), Drooping Sheoak (*Allocasuarina verticillata*), Swamp Gum (*Eucalyptus ovata*) and Manna Gum (*E. viminalis*), all of which were widespread on the plains and hills before European settlement.

Sweet Bursaria, known as 'Box' or *Myrtus australis* by the early settlers and travellers, was a widespread species but is now severely depleted. Remnants can be seen on many roadsides and farms, particularly in areas inaccessible to stock. Local sources include areas on Hensley Park Rd and adjacent paddocks about 4 km from Hamilton, Picnic Rd at Tarrington, land near the Old Lutheran Cemetery and RMIT on Chatsworth Rd in Hamilton, the banks on the north shore of Lake Linlithgow, the banks of the Wannon River and the Mount Napier State Park.

This species is usually seen as a shrub, although it can grow to 10 m or more in height and with a trunk of 20-30 cm diameter near the base. Trees like that can be seen off Chatsworth Road, opposite RMIT campus.

Bursaria usually carries spines on the small branches and trunk, although some bushes are thornless. Invariably about 5% of seedlings grown in a nursery have no thorns. The species is attractive to small birds and, perhaps, not so attractive to cats and foxes, so it may be a useful plant to have in shelterbelts and gardens. It is, however, not suitable for areas close to paths or play areas, because of the sharp thorns that usually break off in the wound. One way of reducing the problem, where the tree has been planted too close, is to snip the thorns off the trunk and lower branches.

Summer-flowering species like Sweet Bursaria and Silver Banksia supply butterflies , wasps and other insects with nectar, and many of these insects are agents for biological control of pasture grubs. The wasps are presumed to only work up to about 200 m from a source of nectar, giving rise to the suggestion that shelterbelts containing Bursaria should not be greaterthan 400 m apart . *Scolid* wasps (hairy flower wasps) or *Thynnid* wasps (flower wasps) parasitise various pasture scarabs – the female wasps burrow into the soil and lays an egg in each grub. Robber flies, Lacewings, Ladybirds, Hover Flies and Mantids all parasitise larvae. The Bee-fly larvae parasitise wingless grasshoppers. Incidentally, Bee-flies lay eggs in knot holes – where timber is removed the Bee-fly numbers are reduced – a reason for not being too tidy.

Seed collection

Bursaria flowers profusely in the summer and produces flat, brown, plate-like seeds about 1.5 mm in diameter in seed capsules that ripen in autumn, usually releasing the seed on hot and windy days in April. The seed is, where possible, best harvested by placing an inverted umbrella beneath a branch bearing seed capsules and tapping the branch sharply with a stick to release the seeds.

The capsules can be stripped by hand from the shrub but too many contacts with the short, sharp spines on the branches is a disincentive. Moreover, one must then dislodge the seed from the capsules, which must be done because weevils will rapidly convert the seeds to dust if the material is stored without separation. The dry seed should be stored in the refrigerator in a tight jar to exclude water and air. A few naphthalene flakes can be added to kill any weevils that may be present. Evidence suggests that the seed will remain viable for 1-2 years but not 4. The species typically has 435-500 seeds/g with a viability of about 44-80%.

Germinating the seed

One reason for the failure of landholders to plant this important species has been the failure of nurseries to stock these plants. Nursery operators have found it difficult to grow Bursaria because it does not fit into their normal propagation routine.

In 1987-1989 we found that Sweet Bursaria seed sown in spring (Sep-Oct) in a direct-seeding program conducted on farms mostly failed to germinate that year (Bird, Kearny & Jowett 1996). For 9 large sites only 3 produced seedlings at 7 months; a miserly 0.007- 0.14% of the viable seed sown. Standard 28-day seed viability tests at the former Seed Testing Centre at Burnley had indicated that the seed was all "dead" but we knew this to be unlikely, since seed left in pots germinated in the following year.

Research in 1989, 1993, 1994 and 1999

We set up some experiments to resolve the question as to how best to germinate the seed in nursery practice and what might need to be done to use it successfully in direct-seeding operations. That research is outlined below.

Table 1. 1989 germination of Bursaria (% of seed sown) in relation to time of year after sowing.

Year sown	Date sown	Date of assessment			
1989	3 May 1989	13 June	30 June	13 July	4 August
		0	emerging	25	47

Seed was collected at Tarrington on 8 April 1989 and stored at room temperature until sown in pots containing "Debco" mix and sand.

Table 2. 1993 germination of Bursaria (% of seed sown) in relation to time of year after sowing

Year	Seed source	Pre-sowing storage & Sowing mix	Date	Date of assessment				
				13 Jun	30 Jun	13 Jul	10 Aug	7 Sep
1993	Hamilton 12April	Sown on 22 April - Debco	22 Apr	0	20	67	69	69
	"	Air cond. room (from 22 April) - Debco	21 May	0	0	5	79	80
	"	Air cond. Room (from 22 April) - Sand	21 May	0	0	4	75	76
	"	Dry, in fridge (from 22 April) - Debco	21 May	0	0	2	73	72
	"	Wet, in fridge (from 22 April) - Debco	21 May	0	30	57	78	81
	"	Dry, in fridge (from 22 April) - Debco	Aug,Sep	no germination by late Dec 1993				
	Tarrington 1989	Room temp (from 1989) - Debco	April/May	no germination by late Dec 1993				

Seed was collected at Hamilton on 12 April 1993 and Tarrington on 8 April 1989. Several treatments were imposed, as shown below. Sowing mix was 50% Debco pine bark-sand mix with 50% sand, or 100% sand.

Table 3. 1994 germination of Bursaria (% of seed sown) in relation to time of year after sowing

Year sown	Pre-sowing storage treatment	Date sown	Date of assessment				
			1 June	14 June	28 June	13 July	27 Aug
1994	Room temp	31 March	2	25	63	68	69
	Dry, in fridge	31 March	1	15	71	76	79

Seed was collected at Hamilton on 12 April 1993.

The results from the Bursaria germination tests are summarised below:

1) Bursaria seed is viable for at least a year (Table 3); one collection was dead after 4 years (Table 2).
(2) Dry storage in a fridge appears to increase the longevity of the seed compared with storage at room temperature (compare 79% with 69% in Table 3).
(3) Seed sown in spring (Aug-Sept) will germinate poorly (if at all) in that year. In 1993, the result for autumn v. spring sowing was 80% v. 0%, respectively. In 1999, the result was 44% v. 17% for autumn v. spring (Table 2). This has implications for direct-sowing in spring. .
(4) Bursaria seed sown on 31 March (1994), 22 April (1993) or 19 April (1999) germinated freely in mid-winter. The date when germination was first counted varied among years, as shown below, and appears to be influenced by prior frosts:
    - 30 June (1993) – min. temp. -2.0°C (and terrestrial temp. -4.2°C) as early as 5 May.
    - 1 June (1994) – min. temp. -0.7°C (and terrestrial temp. -3.8°C) as early as 4 May
    - 9 June (1999) – min. temp. -1.0°C (and terrestrial temp. -2.5°C as early as 17 May.
(5) These experiments did not determine whether seed stored damp in the fridge over winter would germinate when planted in spring.

Table 4. 1999 Bursaria germination research

Lot	Treatment	Tray	Date of sowing	Date of first shoots	Date of max. no. of seedlings	Days to first shoots	Days to max. number of seedlings	Max. number of seedlings	Number germinated in June-July 2000
1	Control	1	19/04	8/06	16/07	50	88	47	
		2	19/04	15/06	28/07	57	100	41	
		3	19/04	8/06	22/09	50	156	52	
		4	19/04	8/06	7/09	50	141	32	
		5	19/04	8/06	22/07	50	94	31	not
		6	19/04	8/06	7/09	50	141	61	counted
2	stored dry 3 months	1	15/07	1/09	29/09	48	76	50	
		2	15/07	1/09	4/10	48	81	18	
3	stored dry 4 months	1	10/08	22/09	10/11	43	92	23	
		2	10/08	22/09	10/11	43	92		
4	stored dry 5 months	1	7/09	5/11	24/11	59	78	15	
		2	7/09	5/11	24/11	59	78	18	
5	3 mths damp from 20/4	1	14/07	7/09	25/10	55	103	11	
		2	15/07	7/09	24/11	54	132	12	
6	3 mths damp from 18/5	1	10/08	22/09	1/12	43	113	5	4
		2	10/08						3
7	3 mths damp from 15/6	1	7/09	17/11	17/11	71	71	1	18
		2	7/09	5/11	17/11	59	71	2	25
8	1 mth damp from 15/6	1	14/07	1/09	18/10	49	96	33	
		2	14/07	1/09	18/10	49	96	42	
9	1 mth damp from 13/7	1	10/08	14/09	18/10	35	69	41	13
		2	10/08	14/09	25/10	35	76	20	14
10	1 mth damp from 10/8	1	7/09	17/11	24/11	71	78	3	6
		2	7/09	24/11	24/11	78	78	3	6
11	Control for smokewater	1	26/08					0	11
		2	26/08	10/11	10/11	76	76	1	10
		3	26/08	10/11	10/11	76	76	1	4
12	1st 12 hr smokewater	1	26/08	5/11	24/11	71	90	4	8
		2	26/08	18/10	17/11	53	83	16	4
		3	26/08	18/10	1/12	53	97	5	11
13	1st 24 hr smokewater	1	26/08	25/10	7/12	60	103	2	2
		2	26/08	1/12	1/12	97	97	1	2
		3	26/08	1/12	1/12	97	97	1	3
14	2nd 12 hr smokewater	1	7/09	10/11	10/11	64	64	5	21
		2	7/09	1/12	1/12	85	85	1	17
		3	7/09	10/11	10/11	64	64	6	12
15	2nd 24 hr smokewater	1	7/09					0	6
		2	7/09	24/11	24/11	78	78	1	11
		3	7/09	17/11	17/11	71	71	2	8

Treatment Means	Date of sowing	Date of first shoots	Date of max. number of seedlings	Time to first shoots (days)	Days to max. number of seedlings	Max. number of seedlings (%)	Number germinated in June-July 2000
Control	19/04	9/06	17/08	51	120	44	
stored dry 3 months	15/07	1/09	1/10	48	79	34	not
stored dry 4 months	10/08	22/09	10/11	43	92	23	counted
stored dry 5 months	7/09	5/11	24/11	59	78	17	
3 months damp from 20/4	14/07	7/09	9/11	55	118	12	
3 months damp from 18/5	10/08	22/09	1/12	43	113	5	4
3 months damp from 15/6	7/09	11/11	17/11	65	71	2	22
1 month damp from 15/6	14/07	1/09	18/10	49	96	38	
1 month damp from 13/7	10/08	14/09	21/10	35	73	31	14
1 month damp from 10/8	7/09	20/11	24/11	75	78	3	6
Control for smokewater	26/08	10/11	10/11	76	76	1	8
1st 12 hr smokewater	26/08	24/10	24/11	59	90	8	8
2nd 12 hr smokewater	7/09	17/11	17/11	71	71	4	17
1st 24 hr smokewater	26/08	18/11	3/12	85	99	1	2
2nd 24 hr smokewater	7/09	20/11	20/11	75	75	1	8
			Means:	59	88		

The seed used was collected from the Wannon River, upstream from Wannon Bridge, on 11April 1999.

The sowing mix was 50/50 coarse sand and 'fern' sand and 100 seeds comprised each test replicate. The seeds in each treatment replicate were spread over 20 tubes in one tray.

This work entailed the following treatments:

- Seed stored dry in fridge for 3-5 months and sown in July, Aug & Sept, respectively
- Seed stored damp in fridge for 1 month (from mid-June, mid-Jul, mid-Aug) and then sown
- Seed stored damp in fridge for 3 month (from mid-Apr, mid-May, mid-Jun) and then sown
- Commercial smoke-water treatment – seeds were soaked in a diluted smoke-water:water solution (1:9) for 12 or 24 hrs. Seeds were sown in late August and early September.

Seedlings in some of the tubes were potted on in summer of 2000 but others were left to see what might germinate in the winter of 2000. Those extra germinants are shown in the last column of the tables.

The conclusions from this research were:

- Smoke-water treatment had no effect on germination of Bursaria seed.
- Storing seed damp in the fridge for any period of time had no positive effect on germination.
- The later the seed (stored dry or wet) was sown the poorer the response.

Research in 2003/04

The aim was to test whether damping seeds and storing at approx. 2-5°C for varying periods (1-4 months) prior to sowing would permit germination in spring or summer – i.e. outside the normal germination period in winter.

Table 5. Germination percentage of Bursaria seeds in 2003 and 2004

Treatment				Seedling counts (= %)							
	Date	Sub-tr	No.	Dec	Jan	21May	7 Jun*	17Jun*	19Jul*	28Jul	Max
A	16 Aug-10 Oct	SD	9			29	31	33	28		33
	(2 mths)	SD	12			20	34	39	36		39
	Wet	WD	10			19	27	25	21		27
	Sown 10 Oct 03	W	11			15	25	27	23		27
	16 Aug-10 Oct	SD	9			6	3	2	2		6
	(2 mths)	SD	10	1	1	13	11	11	9		13
	Dry	W	11	1	1	2	11	10	6		11
	Sown 10 Oct 03	W	12	3	3	11	10	11	7		11
B	16 Aug-7 Nov	SD	5			64	40	38	22		64
	(3 mths)	SD	7			50	41	45	32		50
	Wet	W	6			1	10	15	6		15
	Sown 7 Nov 03	W	8			8	17	15	7		17
	16 Aug-7 Nov	SD	6			41	45	49	33		49
	(3 mths)	SD	8			42	48	33	21		48
	Dry	W	5			15	30	24	14		30
	Sown 7 Nov 03	W	7			12	13	12	8		13
C	16 Aug- 4 Dec	SD	1			22	43	36	22		43
	(4 mths)	SD	2			6	36	37	28		37
	Wet	W	3			3	20	19	10		20
	Sown 4 Dec 03	W	4			3	37	21	14		37
	16 Aug-4 Dec	SD	3			16	34	34	27		34
	(4 mths)	SD	4			51	67	61	46		67
	Dry	W	1			2	24	21	9		24
	Sown 4 Dec 03	W	2			35	37	35	33		37
F	7 Nov-4 Dec	SD	23			24	47	38	23		47
	(1 mth)	SD	24			27	49	45	36		49
	Wet	W	21			3	13	5	3		13
	Sown 4 Dec 03	W	22			8	21	18	13		21
D	13 Sept-7 Nov	SD	1			52	57	51	46		57
	(2 mths)	SD	2			24	46	44	36		46
	Wet	W	3			22	22	16	10		22
	Sown 7 Nov 03	W	4			14	34	30	18		34
E	13 Sept-4 Dec	SD	6			26	47	46	32		47
	(3 mths)	SD	7			5	52	50	37		52
	Wet	W	5			3	15	6	2		15
	Sown 4 Dec 03	W	8			1	17	11	8		17
G	Sown 23 Apr 04	Apr	37			0	46	58	17		58
	or 28 May04	Apr	38			0	41	73	28		73
	Standard seed	May	39				0	0	9	70	70
	Viability check	May	40				0	0	6	74	74

SD = summer dry (mid Jan to mid April), W = pots kept damp throughout

The seed source was from Lake Linlithgow, collected in April 2002 and stored in an airtight container in a refrigerator at 2˚C.

The experiment tested the following treatments:

- Duration of treatment – 1, 2, 3 or 4 months for seeds stored wet or dry in the refrigerator
- Time of sowing in relation to time of application of cold storage treatment – i.e. seeds were sown directly after removing from the refrigerator:
  - 2 months duration: Aug-Oct (A) *v* Sept-Nov (D), sown in Oct and Nov, resp.
  - 3 months duration: Aug-Nov (B) *v*. Sept-Dec (E), sown in Nov and Dec, resp.

In addition, from mid-Jan 2004 until mid-April 2004, half the replicates were allowed to dry out (SD sub-treatment). These trays were replaced under watering in mid April.

The seedlots (100 seeds per seedlot) were placed in flat plastic containers. Seedlots receiving wet/cold treatment were dampened in boiled water, with a little sand added to cover. The sand had been sterilised by heating in an oven at 200˚C. The containers were then placed in cardboard shoe boxes (to exclude light) in a refrigerator at about 2˚C.

There were 4 replicates of each main treatment (2 replicates for each sub-treatment). The 100 seeds per replicate were spread over 20 tubes prepared with a potting mix comprising one third peat and two thirds sand, plus 1 g of Osmocote slow release fertiliser pellets. The seeds were lightly covered with sieved fine potting mix and the trays put under sprinklers in the outdoor nursery.

The trays were retained into the winter of 2004, to see whether the seeds would germinate then. This also gave a check on the viability of seed sown. There was some loss of non-germinated seeds over the 12 months, as a result of accidental removal in weeding the pots and rotting in pots kept continuously damp. Therefore, as a check on the viability of the seeds sown, untreated seed from the original bulk source (stored dry in the refrigerator) was sown in 24 April/28 May 2004.

Damping off probably accounts for the difference between pots left dry over summer (SD) compared with those watered throughout the trial. Damping off was noted at the 7 June inspection (some seedlings were cut off at base but green) – that explains how counts later were often lower than in June. Further damping off occurred later. The estimate of max. Germination are therefore minimum estimates.

Conclusions from the 2003-04 experiments:

- Neither pre-sowing wet or dry refrigeration (2-5°C) improved germination in summer or autumn. Germination in summer is normally required for production of seedlings in a nursery, if those plants are to be ready to plant in winter or early spring.
- If a cold treatment is to replicate the effect of a severe frost in the field then probably the seed should be exposed to some duration of freezing to break dormancy.
- Alternatively, the species can be reproduced by sowing the seeds in summer, waiting for germination after the first frosts and then carrying those small plants through another year. We found from nursery production work that a significant percentage of seeds sown in spring germinated in the following winter (this is usually not recognised because most of these 'failed' tubes become overgrown with moss, liverwort and weeds and are discarded after the summer).

Research in 2009: Freeze-treatment to promote Bursaria germination

Bursaria seed was collected from Hensley Park Rd in March 2009 and sown then in pots. Germination occurred a couple of weeks after an unusually heavy early frost in April, in contrast with our previous experience when germination mostly occurred in mid-winter.

In previous years we did not detect any effect of seed storage, damp or dry, at fridge temperatures of 2-5°C. The current conjecture was that the effect of a frost on Bursaria seed may be simulated by placing the seed in a freezer, and that might promote the germination of the seed. That could be an explanation why we previously got germination in mid-winter but could not get significant germination of seed sown in late spring or summer. It might also explain why we sometimes got germination much earlier than June.

The seed was sown into small pots containing sand and soil in late November 2009. The pots were placed in the open and watered regularly. Germination was noted about 24 Dec.
The experiment comprised 3 replicates (each of 100 seeds) of each treatment:

[1] control (previously stored in fridge at 2-5 degrees)
[2] dampened seed put in freezer overnight
[3] dry seed put in freezer overnight.

The average maximum germination (as a percentage of seed sown) was:

[1] 14%
[2] 23%
[3] 43%

The actual totals for germination were higher in the freezer treatments because some damping off had occurred before the count was made on 24 Dec 2009. The control [1] result may also have been lower but for ground temperature approaching freezing on the unusually cold nights of 3 Dec. and 4 Dec., (3.6 degree screen temperature at PVI). However, there was a clear improvement in germination as a result of freezing, particularly for the seed stored dry in the freezer.

The test was repeated by putting freezer-treated seed that had been previously stored dry in the fridge for 2 months into pots and observing the outcome. The general result was the same except even more pronounced for seed frozen dry rather than wet. Whether a longer period of storage in the freezer would increase the germination has not been tested.

Conclusions:

- Substantial improvement in germination percentage can be obtained simply by exposing the dry seed to a night in the freezer before sowing.
- There was no advantage in dampening the seed before freezing.

Conclusions from the Bursaria germination research at PVI

In the past, very few nurseries have grown Bursaria, probably because of the difficulties in getting it to germinate.

Direct-seeding of Bursaria in the spring has also proved to be a failure. Poor germination in the year of sowing and weed competition in the following year when seeds might germinate is the cause of the failure.

Intensive research on direct-seeding was conducted in SW Victoria from 1987-89: see *Trees and shrubs for south west Victoria* by PR Bird, GA Kearney and DW Jowett (1996). Over 9 large farm sites, seed sown in Sep. or Oct. in 3 different areas (Basalt Plains, Glenthompson & Dundas Tablelands) in 1987-1989, only 3 sites had any Bursaria seedlings when counts were done at 7 mths. As a percentage of the viable seed sown that amounted to a paltry 0.007, 0.023 and 0.144%. That can be contrasted with a few of the other 37 species sown, e.g. Drooping Sheoak 0.9-29%, Blackwood 3.4-26%, River Red Gum 0.04-3.67% and *M. decussata* 0.003-2.2889% (Bird, Kearney & Jowett 1996).

The research conducted at PVI has shown that the germination of Bursaria seed can be substantially increased by freeze-treatment, so that seedlings can readily be produced in the usual late-spring-summer production run that are large enough for planting out in the next winter or spring.

If landholders want to grow this species – and it is an essential component for biodiversity – then they should provide the nursery with seed, which should be collected in late March or early April. They must also inform the nursery operator that the seed needs to be put in the freezer overnight before sowing.

The species can also now be included in the list for spring direct-seeding (with seed freeze-treated in the dry state immediately before sowing). .

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