SEEDS, SEED RIPENING, GERMINATION AND VIABILITY IN SOME SPECIES OF *HEBE*

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SUMMARY: Times necessary for development of ripe seed in some species of *Hebe* are reported together with the results of experiments investigating the effects of light and temperature on germination and the duration and periodicity of viability of seeds.

INTRODUCTION

The genus *Hebe* of *c.* 100 species is mostly endemic to New Zealand with 80 species recognised from the flora. Two species, *H. salicifolia* and *H. elliptica* are shared with South America and the latter extends to Falkland Island. Species occur in widely different ecological niches ranging from coastal rocks to alpine grassland, fellfield and scree. Many have a restricted distribution both geographically and in habitat preference. Seeds of most species are small, flattened, smooth and very light but one group of three species, *H. raoulii, H. lavaudiana* and *H. hulkeana* has "narrow, wrinkled, spindle-shaped seeds with only a trace of a wing" (Moore in Allan, 1961) (Fig. 1). Numbers of seeds per gram of eight species, counted shortly after collection, are shown in Table 1. While flowering times are indicated for most species of *Hebe* by Moore (in Allan, 1961) fruiting times are not given apart from a general note referring to the whole genus ". . . capsules develop quickly and seed is shed not long after corolla fall, but old capsules often remain on the bush throughout the non-flowering period".

TABLE 1. *Fresh seed weights of eight species of* Hebe.

Species	Seeds per gram
Hebe lavaudiana 269	2,286
,, *raoulii*	2,552
,, *pinguifolia* 266	5,320
,, *haastii* 273	7,760
,, *epacridea* 274	12,080
,, *traversii* 277	14,740
,, *pimeleoides* 272	20,120
,, *salicifolia* 739	21,022

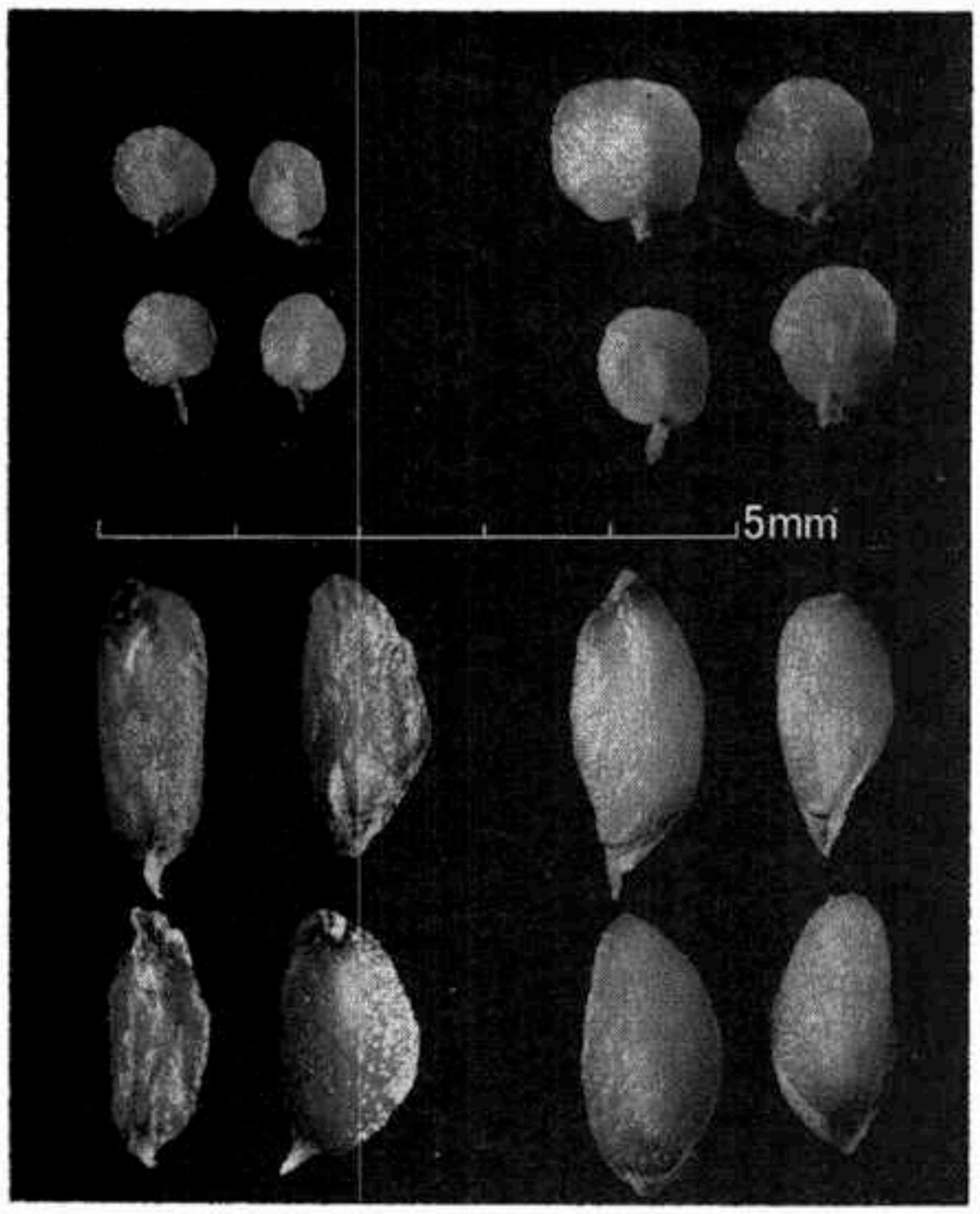

FIGURE 1. *Seeds of* Hebe salicifolia *and* H. elliptica *(above),* H. lavaudiana *and* H. raoulii *(below).*
Photo: C. J. Miles

SEED RIPENING

Plants of 4 species were marked when flowering and records were kept of the time required for seed to develop.

For *H. salicifolia,* a species widespread in South and Stewart Island, the flowering time is given as January-February-(April). In Canterbury, some flowering spikes can often be found on bushes of this species in most months of the year. A plant in full flower was marked in Montgomery Bush, Banks

Peninsula, in early January 1968 and the first ripe seed was collected in mid April 1968.

H. elliptica is recorded from western coastlines from Cape Egmont southwards and eastern coasts from Otago southwards and from outlying southern islands. A plant in flower was marked at Totaranui, Abel Tasman National Park in December 1969, and ripe seed collected in March 1970.

H. lavaudiana is endemic to Banks Peninsula where it grows among the higher rocks. Flowering times are given as November-December. Observations were made on the ripening of seed of this species over three summers. Spring in 1971 in Canterbury followed a mild winter when erratic early flowering of many garden plants was common, and by mid-January capsules were formed but barely showing above the calyx. A month later capsules were still quite green and not much larger. By April 27 capsules had ripened fully, dehisced and most of the seed was shed.

The following year marked plants were examined at intervals of two weeks. Sites chosen were (a) The Monument, above Purau on the northern part of Banks Peninsula and (b) a rock outcrop to the south east of Stony Bay Saddle exposed to periodic cold southerly conditions. At site (a) early flowering (22.10.72) plants had capsules 2.4 mm long, just showing above the calyx lobes by 11.1.73. Succeeding measurements were 30.1.73, 2 x 3 mm; 13.2.73, 2 x 3.5 mm; 1.3.73, 3 x 4 mm. On 1.3.73, the first capsules opened and these contained some ripe seed. At site (b) plants in flower on 14.11.72 had first ripe seed by 15.3.73.

At both sites most seeds were fully ripe within a fortnight after the first capsules had opened. Observations continued during the following summer confirmed that the final stage of capsules development and seed ripening is rapid and that capsules dehisce and most seed is shed soon after ripening.

H. vernicosa is a plant of beech forests and extends from sea level to timberline. Plants marked in Travers Valley (Nelson Lakes National Park), during December 1971 experienced an unseasonal snowfall which destroyed their flowers. An abnormal autumn flowering followed but seed did not develop before the onset of winter. These plants did not flower the following summer.

Plants of a further eight species were examined for seed in the vicinity of Nelson Lakes National Park during the last week of February 1972. At 1800 m *H. haastii* and *H. epacridea* had immature, green capsules. In alpine grassland at 1350 m and higher *H. coarctata* was in full flower and so too were *H. ciliolata* and *H. lycopodioides* in fellfield at 1500 m. *H. canterburiensis* which in this area occurs at timberline, *c.* 1350 m, was also in full flower. *H. vernicosa* in the beech forest had not flowered and at *c.* 600 m *H. traversii* (sens. lat.) and *H. parviflora* var. *angustifolia* were both in full flower. In these alpine areas there can be continuous snow cover for four to six months and snow falls and lies briefly down to below timberline on occasions in all months (Coulter in Post, 1965). With such late flowering and the possibility of early onset of winter, many plants, especially those at higher altitudes, would not have sufficient time for seed to fully develop unless there was a very rapid ripening.

For other species used in the present experiments dates and localities of seed collection are shown in Table II.

When conditions were favourable there was good seed set on plants growing in their natural environment in all species studied. Only a little insect and no fungal damage was noted and practically all seeds in each capsule were well formed and apparently viable. This contrasts with many New Zealand genera where seeds are destroyed by insects before reaching maturity and where percentage of seed set is low, e.g. *Celmisia* (Scott, 1975, Molloy, 1975). However, in a collection of garden plants at Lincoln most species did not set much good seed. Insect damage and uneven ripening were contributory factors. Exceptions were plants of *H. bollonsii* and *H. stricta,* which produced plenty of well formed seed.

Little is known of the breeding system in *Hebe,* although Hooker (1864) pointed out that many species "probably are, if not bisexual, at least partially so . . .", and Frankel (1940) recorded male sterility in many species. Moore in Allan (1961) notes that ". . . one of the peculiarities of the semi-whipcords is that flowers are apparently regularly unisexual and the plants are almost completely dioecious".

DEHISCENCE AND SEED DISPERSAL

In all species studied the capsules split when mature but the method of seed dispersal varies. On bushes of *H. salicifolia* the flowering spikes tend to be semi-upright but turn over when the capsules ripen so that seeds fall directly to the ground and seedlings are common in the vicinity of the parent bush. *H. lavaudiana* is a short, open, semi-woody plant with spikes of crowded sessile flowers on stiff, upright stems. It grows in habitats exposed to severe buffeting winds and seeds are dispersed simply and efficiently by the wind shaking the stems and seed

TABLE II. *Results from first tests after seed collection with percentage germination in light (L) and dark (D) at treatments indicated. G = garden grown.*

Collecting No.		*Locality and Date of Collection*		*Date Tested*	*Germination Conditions*	*Stratification*	*Weeks*	*Percentage Germination*	*Weeks to Final Germination*
445	Hebe albicans	Queenstown G	28. 3.74	2. 4.74	25° L			4	2
				2. 4.74	0° D			0	
				2. 4.74	10° D			20	9
				2. 4.74	12° D			12	10
				2. 4.74	15° D			0	
263	Hebe allanii	Lincoln G	4.71	17. 8.71	25° L			12	2
286	Hebe amplexicaulis	Lincoln G	3. 4.73	14. 5.73	25° L			91	4
285	* Hebe bollonsii	Lincoln G	5.72	26. 5.72	25° L			0	
					25° D			0	
449	Hebe buchananii	Queenstown G	27. 3.74	5. 4.74	25° L			4	6
				5. 4.74	10° D			20	9
				5. 4.74	12° D			10	9
				5. 4.74	15° D			0	
36	Hebe canterburiensis	Cobb Valley, Nelson	24. 4.74	3. 7.74	25° L			33	16
83	Hebe carnosula	Cobb Valley, Nelson	24. 4.74	24.10.74	25° L	5° D	12	0	
					25° L	5° D	45	0	
39	Hebe cheesemanii	Queenstown G	2. 2.75	14. 3.75	25° L	—		0	
3	Hebe ciliolata	Mt Alexander, Westland	1. 4.74	8. 5.74	25° L			0	
					25° L	5° D	12	0	
					25° L	5° D	45	0	
99	Hebe ciliolata	Travers Range, Nelson	15. 3.75	26. 3.75	25° L			0	
					25° L (8 weeks) → 25° L (4 weeks)	5° D	6		
						5° D	15	35	33
9	Hebe coarctata	Cobb Valley, Nelson	24. 4.74	30. 5.74	25° L			0	
				30. 5.74	15° D			0	
					25° L	5° D	6	20	
					25° L	0° D	14	0	
				24. 7.75	25° L			0	
106	Hebe cupressoides	Fairlie G	3.75	14. 3.75	25° L			96	3
265	Hebe decumbens	Lincoln G	4.71	17. 8.71	25° L			20	2
444	Hebe decumbens	Queenstown G	28. 3.74	2. 4.74	25° L			15	10
				2. 4.74	10° D			30	11
				2. 4.74	12° D			26	11
				2. 4.74	15° D			10	11
37	Hebe diosmifolia	L. Rotokawau, N. Auckland	1. 3.74	3. 7.74	25° L			80	10
236	Hebe elliptica	Totaranui, Nelson	3.69	8. 5.69	25° L			98	3
					25° D			6	

TABLE II—*continued.*

Collecting No.		*Locality and Date of Collection*		*Date Tested*	*Germination Conditions*	*Stratification*	*Weeks*	*Percentage Germination*	*Weeks to Final Germination*
274	Hebe epacridea	Fog Peak, Canty.	22. 3.73	23. 3.73	25° L			62	9
105	Hebe epacridea	Travers Range, Nelson	15. 2.75	14. 3.75	25° L			54	4
273	Hebe haastii	Fog Peak, Canty.	22. 3.73	23. 3.73	25° L			0	
					12° D			0	
				15. 8.73	25° L			0	
					12° D			0	
				6.11.73	25° L			0	
				12. 2.74	25° L			0	
				11. 7.74	0° D			0	
					5° D			0	
					10° D			0	
					15° D			0	
					25° L			0	
					25° L	0°	6	0	
					25° L	5°	6	0	
					25° L	10°	6	0	
					25° L	15°	6	0	
406	Hebe hulkeana	Clarence R, Marlb.	1.74	26. 2.74	25° L			72	12
					0° D			85	6
					5° D			100	8
					10° D			85	8
					12° D			100	5
					15° D			60	7
267	Hebe lavaudiana	Banks Pen., Canty.	27. 4.72	5.72	25° L			0	
					25° D			0	
269	Hebe lavaudiana	Banks Pen., Canty.	1. 3.73	2. 3.73	12° D			85	
				2. 3.73	15° D			35	
				2. 3.73	25° L			3	
288	Hebe lavaudiana	Banks Pen., Canty.	22. 3.73	23. 3.73	12° D			85	
					25° L			4	
459	Hebe lavaudiana	Queenstown G	27. 3.74	5. 4.74	12° D			75	6
100	Hebe lavaudiana	Fairlie G	8. 3.75	14. 3.75	25° L			24	12 .
	Hebe macrantha	Lincoln G	28. 3.73	7. 5.73	0° D			0	
					5° D			0	
					10° D			0	
					12° D			0	
					15° D			0	
					25° L			0	
2	Hebe macrantha	L. Sylvester, Nelson	24. 4.74	16. 7.74	25° L			0	
					25° L	5° D	6	0	
					25° L	10° D	6	0	
				24.10.74	25° L				
					25° L			0	

TABLE II—*continued.*

Collecting No.		*Locality and Date of Collection*		*Date Tested*	*Germination Conditions*	*Stratification*	*Weeks*	*Percentage Germination*	*Final Germination*
					25° L	5° D	14	0	
					10° D			0	
				20.11.74	0° D			0	
					5° D			0	
					10° D			0	
					25° L			0	
				12. 2.75	0° D			0	
					5° D			0	
					10° D			0	
					25° L			0	
279	Hebe obtusata	Mercer Bay, nr. Auckland	31.10.72	11. 4.73	25° L			24	4
453	Hebe pauciramosa	Queenstown G	28. 3.74	5. 4.74	25° L			13	4
				5. 4.74	25° L	10° D	4	40	10
					25° L	12° D	4	20	10
				5. 4.74	25° L	15° D	4	40	10
38	Hebe parviflora var. angustifolia	Leatham R., Marlb.	15. 5.74	3. 7.74	25° L			98	6
454	Hebe pimeleoides	Queenstown G	27. 3.74	5. 4.74	25° L			16	7
					12° D			80	4
					15° D			60	4
272	Hebe pimeleoides	Lincoln G	20. 2.73	13. 3.73	25° L			22	4
					25° D			2	4
					10° D			68	4
					12° D			86	4
					15° D			65	4
262	Hebe pinguifolia	Lincoln G	5.71	3. 6.71	25° L			60	2
					25° D			2	
275	Hebe pinguifolia	Fog Pk., Canty.	22. 3.73	23. 3.73	0° D			0	
					5° D			0	
					10° D			0	4
					12° D			80	4
					15° D			63	4
					25° L			0	4
456	Hebe pinguifolia	Queenstown G.	27. 3.74	5. 4.75	25° L	5° D (dry)	6	36	3
					25° L	5° D (dry)	12	40	3
					25° L			31	6
270	Hebe pubescens	Lincoln G	4.71	17. 8.71	25° L			10	2
266	Hebe raoulii	L. Taylor, N. Canty.	9. 6.72	12. 6.72	0° D			0	
					5° D			0	
					10° D			80	4
					12° D			80	4
					15° D			100	4
					25° L			0	
276		Avoca, Canty.	26. 3.73	15. 5.73	15° D			73	4
					25° L			0	

TABLE II—*continued.*

No.		*Locality and Date of Collection*		*Tested*	*Conditions*	*Stratification*	*Weeks*	*Germination*	*Germination Weeks to*
	Hebe recurva	Otari, Wellington G			10° constant			80	16
					18/25° L	5° D	4	72	11
	Hebe salicifolia	Westland	19. 5.65	22. 3.68	25° L			0	
215	Hebe salicifolia	Banks Pen., Canty.	17. 4.68	20. 4.68	25° L			100	2
					25° D			21	
739	Hebe salicifolia	Banks Pen., Canty.	15. 5.73	24. 5.73	25° L			96	2
735	Hebe speciosa	Banks Pen., Canty.	15. 5.73	24. 5.73	25° L			78	5
5	Hebe strictissima	Banks Pen., Canty.	25. 4.74	15. 5.74	25° L			24	10
737		Banks Pen., Canty.	18. 5.73	30. 5.73	25° L			84	4
283	Hebe stricta var. stricta	Huia, Auckland	6.72		25° L			100	2
257	Hebe stricta var. atkinsonii	Lincoln G	4.71	17. 8.71	25° L			86	2
					25° D			4	2
264	Hebe stricta var. macroura	Lincoln G	4.71	17. 8.71	25° L			100	2
448	Hebe subalpina	Queenstown G	23. 3.74	5. 4.74	25° L			7	9
					10° D			0	
					12° D			0	
					15° D			13	4
4	Hebe topiaria	Cobb Valley, Nelson	25. 4.74	8. 5.74	25° L			32	4
277	Hebe traversii	Avoca, Canty.	23. 3.73	26. 3.73	0° D			0	
					5° D			0	
					10° D			0	
					12° D			0	
					15° D			88	
					25° L			0	
				13. 8.73	25° D			6	
	† Veronica X bishopiana	Auckland	1.10.72	30. 4.73	25° L			98	2
400	Parahebe decora	Cragieburn, Canty.	7. 4.73	19. 6.73	25° L			90	4
289	Parahebe lyallii	Arthurs Pass, Canty.	28. 3.73	11. 4.73	25° L			96	2

* *H. bollonsii*. See viability graph.

† *Veronica* X *bishopiana* was recorded by Petrie as *V. obtusata* x *salicifolia*. (= *stricta* var. *stricta*) Allan p. 949.

may be completely shed within a day or two of ripening. No seedlings were found near parent plants.

Seeds of *H. epacridea* collected on Fog Peak, Canterbury, on 22.3.73 and from Juiius Rocks, Nelson Lakes National Park on 15.3.73, were from old spikes that had probably overwintered on the plants. The detached dried fruiting spike of *H. epacridea* may be seen on open screes, emulating a tumbleweed and perhaps ensuring efficient seed dispersal.

Although the light winged seeds of most species of *Hebe* are obviously adapted to dispersal by wind the chances of seed being blown very far can be small because of the sheltered habitats where particular species grow, e.g. *H. salicifolia* and *H. vernicosa.*

GERMINATION AND DURATION OF VIABILITY

The influences of light and temperature were investigated with equipment that included closed incubating ovens held at temperatures of 25°C and 30°C, a Copenhagen type germinator at 25°C in a normal daylight regime and temperature control cabinets ranging from 0°C-15°C with light excluded apart from short periods once a week when seeds were examined for germination.

Good quantities of seed of some species made it possible to investigate their germination in detail (Table 2) but for others only a small amount of seed restricted the kinds of tests possible. In most cases 100 seeds were used in each test. The first eight species were tested at 25°C, in a daylight regime and in cabinets with light excluded but in each case the germination in dark was considerably less than in light and tests in dark were not continued. It was not always possible to test seed soon after collection and as it is later shown that the age of seed affects the percentage germination, the dates of seed collection and of the first tests are shown, together with the results (Table 2). Seeds were stored in paper packets at room temperature and tested at three monthly or six monthly intervals under the optimum conditions of the first test when germination occurred. When however, seed germinated best at lower temperatures initially a control test at 25°C was carried out. For most species no better results were recorded in subsequent viability tests.

Species that germinated readily at 25°C in light included *H. amplexicaulis, H. bollonsii, H. cupressoides, H. pinguifolia, H. speciosa, H. stricta* var. *atkinsonii* and *H. stricta* var. *macroura* from garden grown seed and *H. diosmifolia, H. elliptica, H. epacridea, H. hulkeana, H. parviflora* var. *angustifolia, H. salicifolia, H. strictissima, H. stricta* var. *stricta, H. traversii, Parahebe decora, P. lyallii* and *"Veronica bishopiana"* from seed collected in natural habitats. The results of tests investigating the duration of viability in some of these species are given (Fig. 2). For seven species these continuing tests were

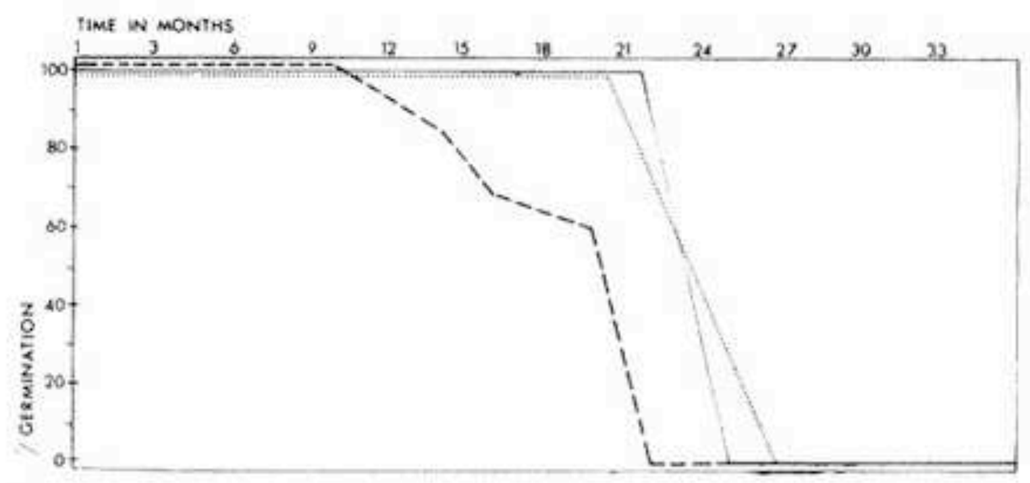

FIGURE 2. *Viability of seeds of* Hebe salicifolia *215,* H. elliptica *236 and* H. stricta *var.* stricta *283.*

not possible but *H. stricta* var. *atkinsonii* and *H. stricta* var. *macroura* showed a similar gradual loss of viability to that exhibited by *H. stricta* var. *stricta.*

Seeds from garden grown plants of *H. bollonsii,* a species restricted to the Poor Knights Island, Mokohinau Island and Hen and Chicken Island gave 94% germination when the seed was nearly a year old but this species along with others (Fig. 3)

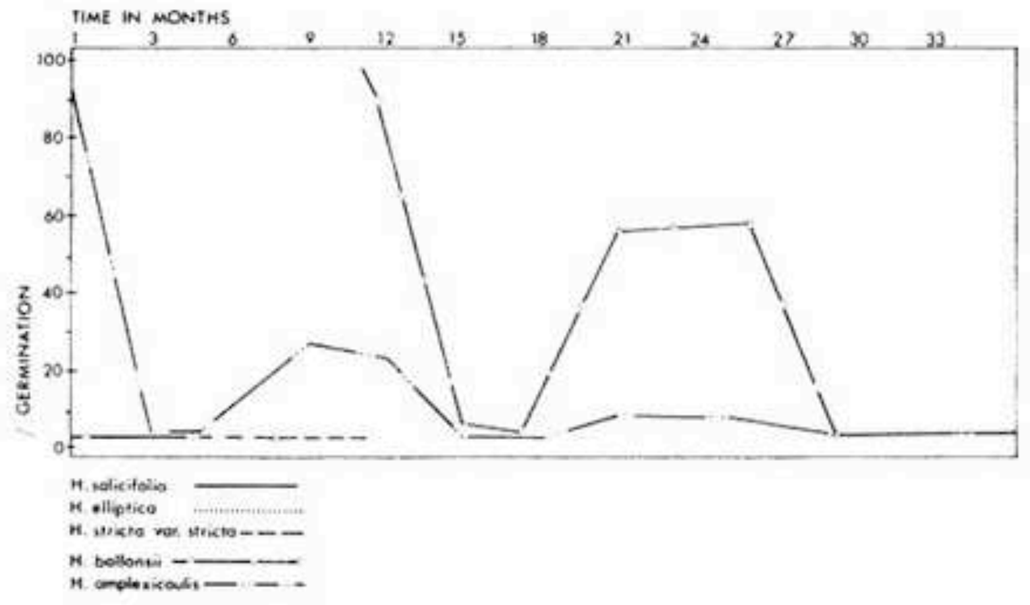

FIGURE 3. *The pattern of germination of* Hebe emplexicaulis *286 and* H. bollonsii *285.*

showed some periodicity of germination with a preference for the months of April to July and during the first year after collection tests were not made in February or March. *H. epacridea* gave 54% from freshly collected seed at 25°C but almost certainly this seed was one year old when collected.

Those species which showed a preference for lower temperatures included *H. buchanani* with garden

grown seed producing optimum results at 10°C. *H. raoulii* and *H. lavaudiana* gave best results at 15°C and 12°C respectively. Species responding to stratification were *H. coarctata, H. ciliolata* and *H. pauciramosa. H. recurva* gave similar results following a period of stratification or when tested at 10°C constant. Fresh seed of *H. traversii* gave 88% germination at 15°C with no germination at 25°C but after storage for 5 months 45% germination at 25°C. *H. carnosula, H. cheesemanii, H. haastii* and *H. macrantha* failed to germinate although sufficient seeds of *H. haastii* and *H. macrantha* were available to allow a variety of tests.

Where insufficient seed precluded a full investigation into the requirements for germination or to finalise the duration of viability some information can be given.

H. albicans gave best results at 10°C with 20% germination in April following seed collection in March, 40% in July and nil in October and January.

H. allanii was only tested at 25°C and from seed collected in April 1971 germination was 12% in August, 3% in February 1972, 56% in April 1972, 2% in August 1972, nil in October 1972 and in January 1973.

H. buchanani collected in March germinated best at 10°C with 20% in April and 30% in July.

H. canterburiensis collected in April and tested only at 25°C gave 33% over 16 weeks from a test in July and 20% over 8 weeks from a September test.

H. decumbens collected and tested in March gave 30% germination at 10°, 26% at 12°, 10% at 15° and 15% at 25°. The following July a test at 10° gave 90% and at 25°, 50%. No tests were made at 12° or 15°.

H. obtusata collected in October was not tested till the following April when 24% germinated at 25°C, with 6% in August and nil in October.

Three collections of *H. pinguifolia* responded to a variety of treatments but gave best germination from fresh seed at 12°C.

H. subalpina collected in March and tested at 10°, 12°, 15° and 25°C gave no germination at 10° and 12°, 13% at 15° and 7% at 25° but did not germinate in tests in July and October.

TABLE 3. *Duration of Viability.*

	Date Tested	% Germination
(a) *H. salicifolia* 215	20 4 68	100
	4 10 68	100
	8 5 69	100
	19 8 69	100
	28 11 69	100
	12 2 70	98
	14 5 70	0
	17 8 70	0
	14 1 71	0
H. salicifolia 739	24 5 73	96
	28 8 73	89
	6 11 73	83
	12 2 74	84
	8 5 74	89
	21 8 74	80
	13 11 74	80
	7 2 75	0
	7 2 75	0
H. salicifolia 19	7 11 68	0
H. elliptica 236	8 5 69	100
	19 8 69	100
	28 11 69	96
	14 5 70	100
	17 8 70	98
	14 1 71	91
	17 8 71*	0
H. stricta var. *stricta* 283	— 6 72	100
	— 9 72	100
	— 12 72	100
	11 4 73	100
	15 8 73	85
	30 10 73	72
	12 2 74	60
	24 4 74	0
	24 10 74	0
	15 1 75	0
(b) *H. amplexicaulis* 286	14 5 75	91
	13 8 73	1
	30 10 73	1
	12 2 74	24
	24 5 74	20
	14 8 74	0
	6 11 74	0
	30 1 75	5
	22 5 75	5
	8 10 75	0
	7 1 76	0
H. bollonsii 285	— 6 72	0
	— 9 72	0
	30 4 73	94
	14 5 73	87
	15 8 73	4

* 6 seeds put out radicle but did not develop further.

	Date Tested	% Germination
	30 10 73	1
	12 2 74	52
	11 7 74	54
	2 10 74	0
	8 1 75	0
	22 5 75	0
H. pimeleoides 272	13 3 73	52
	30 10 73	32
	12 2 74	0
	11 7 74	57
	2 10 74	58
	4 11 74	30
	28 2 75	8
	22 5 75	5
	8 10 75	0
	17 12 75	0
(c) ***H. lavaudiana* 269 at 12°	2 3 73	85
	13 8 73	85
	13 10 73	3
	12 2 74	20
	11 7 74	40
	2 10 74	40
	18 12 74	28
	13 3 75	70
***H. lavaudiana* 459 at 12°	5 4 74	75
	24 7 74	70
	16 10 74	48
	8 1 75	35
	3 4 75	70
	16 7 75	99
	8 10 75	52
H. traversii 277 (This species gave 88% germination at 15°C when fresh)	26 3 73	0
	13 8 73	45
	30 10 73	22
	12 2 74	14
	24 5 74	56
	14 8 74	20
	6 11 74	5
	30 1 75	0
***H. parviflora* var. *angustifolia* 38	3 7 74	98
	25 9 74	85
	8 12 74	25
	8 1 75	40
	3 4 75	60
	16 7 75	96
	31 12 75	60
(d) ***H. diosmifolia* 37	3 7 74	80
	25 9 74	60
	12 12 74	50
	8 1 75	43
H. epacridea 274	23 4 73	62
	13 8 73	62
	30 10 73	43
	11 7 74	16
	2 10 74	0
	8 1 75	6
***H. epacridea* 105	14 3 75	54
	5 6 75	0
	24 9 75	30
	17 12 75	12
H. hulkeana 406 at 25°	— 1 74	72
	— 7 74	80
	— 10 74	4
	— 1 75	4
	— 10 75	0
	— 12 75	0
	— 2 76	0
H. topiaria 4	8 5 74	32
	31 7 74	40
	24 10 74	32
	15 1 75	2
	8 10 75	—
Veronica bishopiana Seed 6 month old when first tested	30 4 73	98
	13 8 73	49
	30 10 73	46
	12 2 74	7
	11 7 74	1
	2 10 74	0
	8 1 75	0

** insufficient seeds to complete tests.

DISCUSSION

Three to four months was required from time of flowering to time when seed was ripe in most of the species of *Hebe* discussed in this paper. While it was not possible to continue observations on late flowering alpine species, seed ripening in these plants must either be accelerated or continued throughout the winter, e.g. *H. epacridea*. The seed production potential is high in most species and in favourable seasons large quantities of good seed are set e.g. *H. salicifolia, H. elliptica, H. traversii, H. parviflora, H. stricta, H. lavaudiana, H. raoulii, H. hulkeana.* Difficulty was experienced in obtaining seed of some alpine species because of the rapid shedding of ripe seed from the capsules in many species, and also due to no seed being produced in a particular year. Nothing is known of any possible periodicity of flowering in *Hebe.* Prevailing weather conditions can upset the flowering pattern as e.g. in *H. vernicosa* in Nelson and seed development must often be arrested, particularly in mountain habitats. The chances of a particular plant producing viable seed each year are low.

Thieret (1955) discussing the evolutionary changes to be traced in the seeds of Veronica and allied

genera regarded *Hebe* as an advanced member of the *Veronicastrum-Hebe* series partly because of the loss of reticulation on seeds. Faint reticulation however is present on seeds of *H. salicifolia* and *H. elliptica.* An evolutionary trend may be traced within the genus *Hebe* from the small, light seeds of *H. salicifolia* produced in numbers of from 25-42 in the capsules examined to the larger, heavier seeds of *H. lavaudiana* with usually 4 and sometimes 6 per capsule (Table 1, Fig. 1).

The optimum conditions for germination have not been established for all species studied but some trends can be recognised. While light is necessary for germination for those species that respond to a temperature of 25°C this requirement is overcome for some species by exposure to low temperature, e.g. *H. raoulii.* In general seed of species from lowland and lower mountain habitats gave good germination at 25°C. Seed of some mountain species collected from garden grown plants also germinated at 25°C but most mountain species required either colder temperatures for germination or some cold pretreatment.

In the extended tests for duration of viability four patterns can be recognised; (a) a sustained, high, even germination at all times of the year for periods of up to 22 months with a complete loss of viability between 22 and 24 months, *(H. elliptica, H. salicifolia). H. stricta* followed a similar pattern for the first year then viability decreased gradually. (Fig. 2); (b) periodicity of germination with little or no germination at some times of the year, *(H. amplexicaulis, H. bollonsii, H. pimeleoides)* (Fig. 3); (c) periodicity of germination but with some germination at most seasons, *(H. lavaudiana, H. traversii, H. parviflora* var. *angustifolia;* (d) a gradual decline of germination with sensecence of seeds, *(H. diosmifolia, H. epacridea, H. hulkeana, H. topiaria, Veronica bishopiana).* For many species the pattern of germination can be related to habitat conditions but while April to August would appear to be a suitable time for *H. bollonsii* seedlings to appear and spring for those of *H. pimeleoides* and *H. raoulii,* seedlings of *H. amplexicaulis,* a species restricted to Rangitata-Mt Peel, Canterbury, would be exposed to severe winter conditions following an autumn germination. *H. elliptica* and *H. salicifolia* were the only species to show a sustained high germination percentage for nearly two years and only a few species including *H. lavaudiana, H. raoulii, H. amplexicaulis* and *H. bollonsii* have so far been shown to have a longer duration of viability.

When conditions are optimum germination is even and rapid, sometimes completed in eight days but with unsuitable conditions and older seeds germination can be protracted over many weeks.

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