Germination and dormancy trends in collections held at the Millennium Seed Bank from Mediterranean and Oceanic regions of the world

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Outline

- Robin’s definition of seed dormancy
- Dormancy trends in Mediterranean and cool temperate woodlands from published literature
- Dormancy trends for Mediterranean, Oceanic and MAVA Island collections held at MSB
- Predicting germination and dormancy from climate data

Contemporary definition of dormancy based on time

- A *dormant* seed ……. is one that does not have the capacity to germinate in a specified period of time under any combination of normal physical environmental factors …… that otherwise is favourable for its germination (Baskin and Baskin 2004)

Former definitions of dormancy based on growth

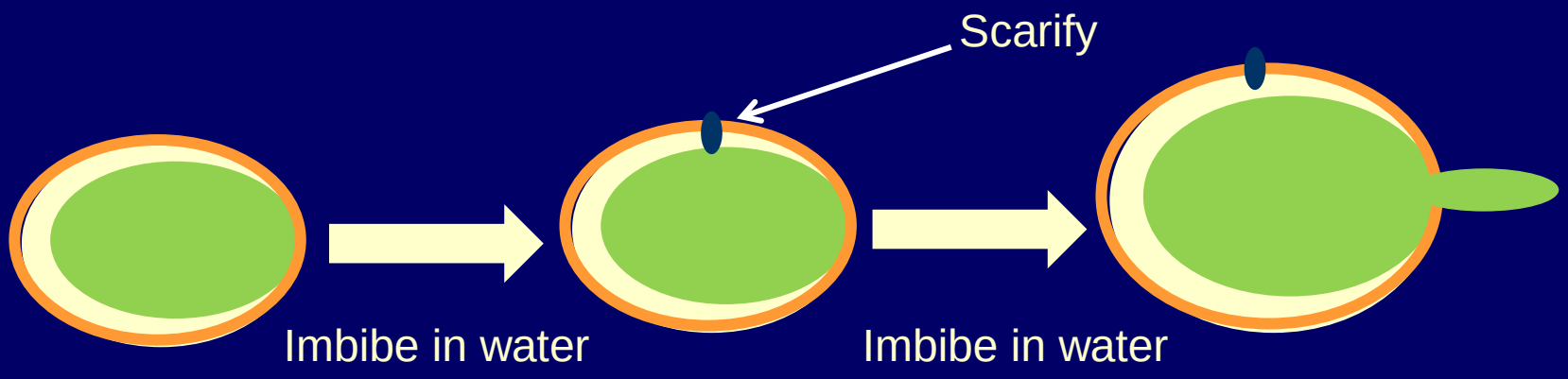
- Dormancy is a temporary suspension of visible growth of any plant structure containing a meristem (Lang *et al* 1987)
- An arrest in development of seed embryos …… under conditions otherwise suited for growth (Taylorson and Hendricks 1987)
- etc. etc.

Physiological dormancy

Seeds with a physiological inhibiting mechanism of the embryo that prevents radicle emergence. Evolved to synchronise germination with a particular season.

Physical dormancy

If seeds posses a hard seed coat that is impermeable to water they have physical dormancy



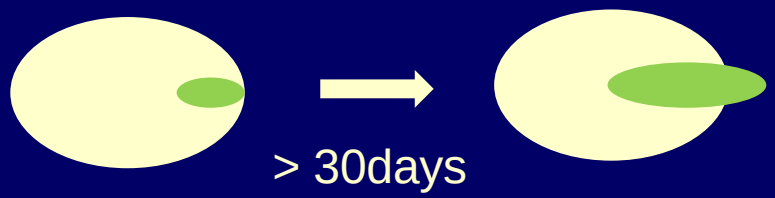
Time for new thinking ?

- When seeds with small embryos germinate within 30 days (B&B MD). This is not dormancy

Dormancy or just slow germination ?

Time for new thinking ?

- When seeds with small embryos take longer than 30 days to germinate (B&B MPD), they are also not dormant



Dormancy or just slow germination ?

Time for new thinking ?

- Seeds with big embryos, that need to avoid an unfavourable season, require dormancy (programmed shut down of growth) because as soon as the embryos begin growth they emerge (*plants in open habitats*)
- Many species with small embryos do not need dormancy to avoid precocious emergence (*plants in moist temperate woodlands*)

A personal view

- Physiological dormancy YES
- Physical dormancy YES
- Morphological dormancy NO
- Morphophysiological dormancy NO

Dormancy patterns in Mediterranean and Oceanic species

Review of published literature

Baskin and Baskin (1998)

Sclerophyllous woodlands with winter rain

Baskin and Baskin (1998)

	Sclerophyllous woodlands with winter rain		
	% of species in each dormancy category		
	Non dormant	Physiological (PD)	Physical or physical + Physiological
Trees (26)	77	15	7
Shrubs (117)	15	42	43
Herbaceous (51)	0	88	12

Baskin and Baskin (1998)

Temperate deciduous forests

Baskin and Baskin (1998)

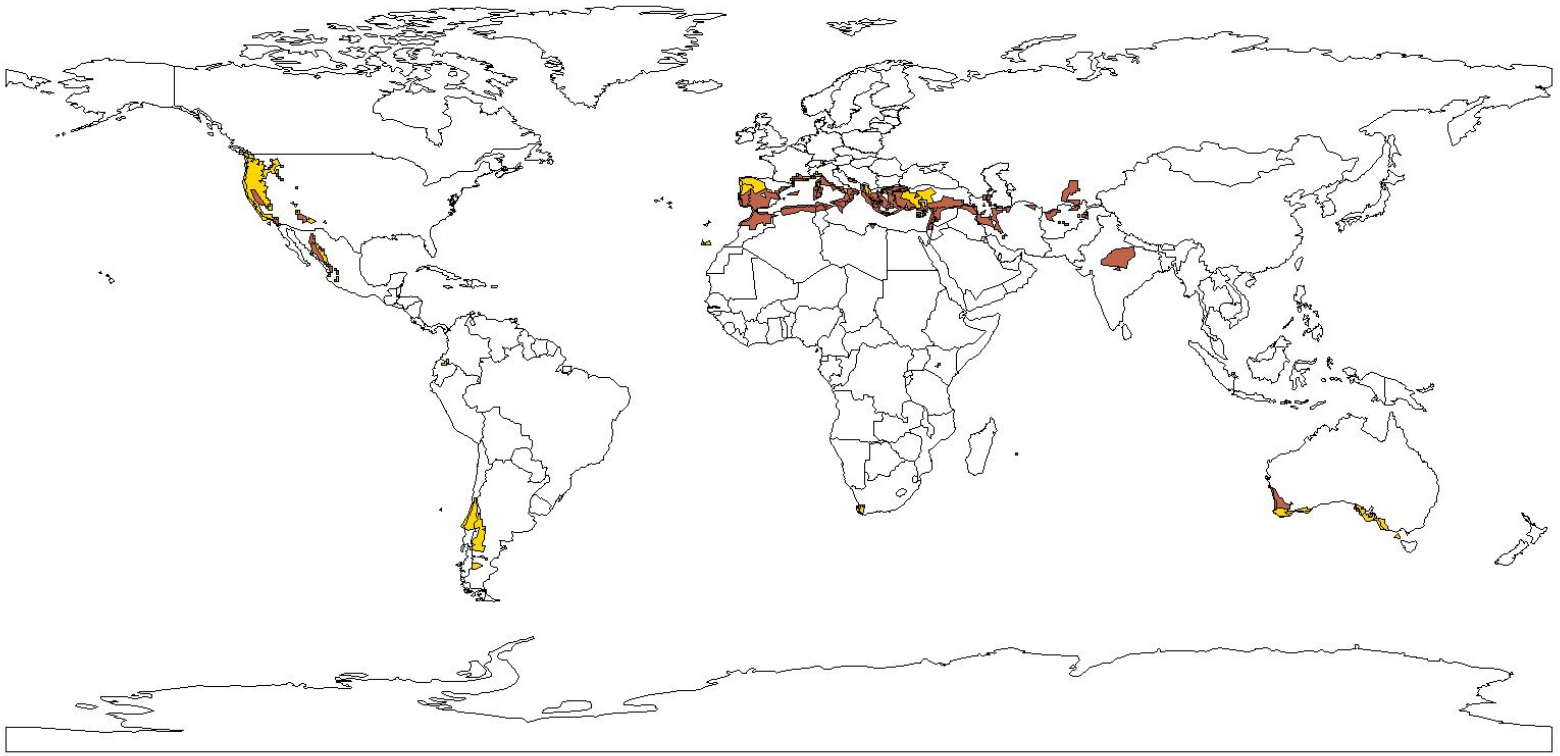
	Temperate deciduous forests (N hemisphere only)		
	% of species in each dormancy category		
	Non dormant	Physiological (PD)	Physical or physical + Physiological
Herbaceous (326)	13	76	11
Shrubs (96)	4	84	12
Trees (131)	14	74	12

Dormancy patterns in Mediterranean, Oceanic and MAVA Island species

Review of MSB collections

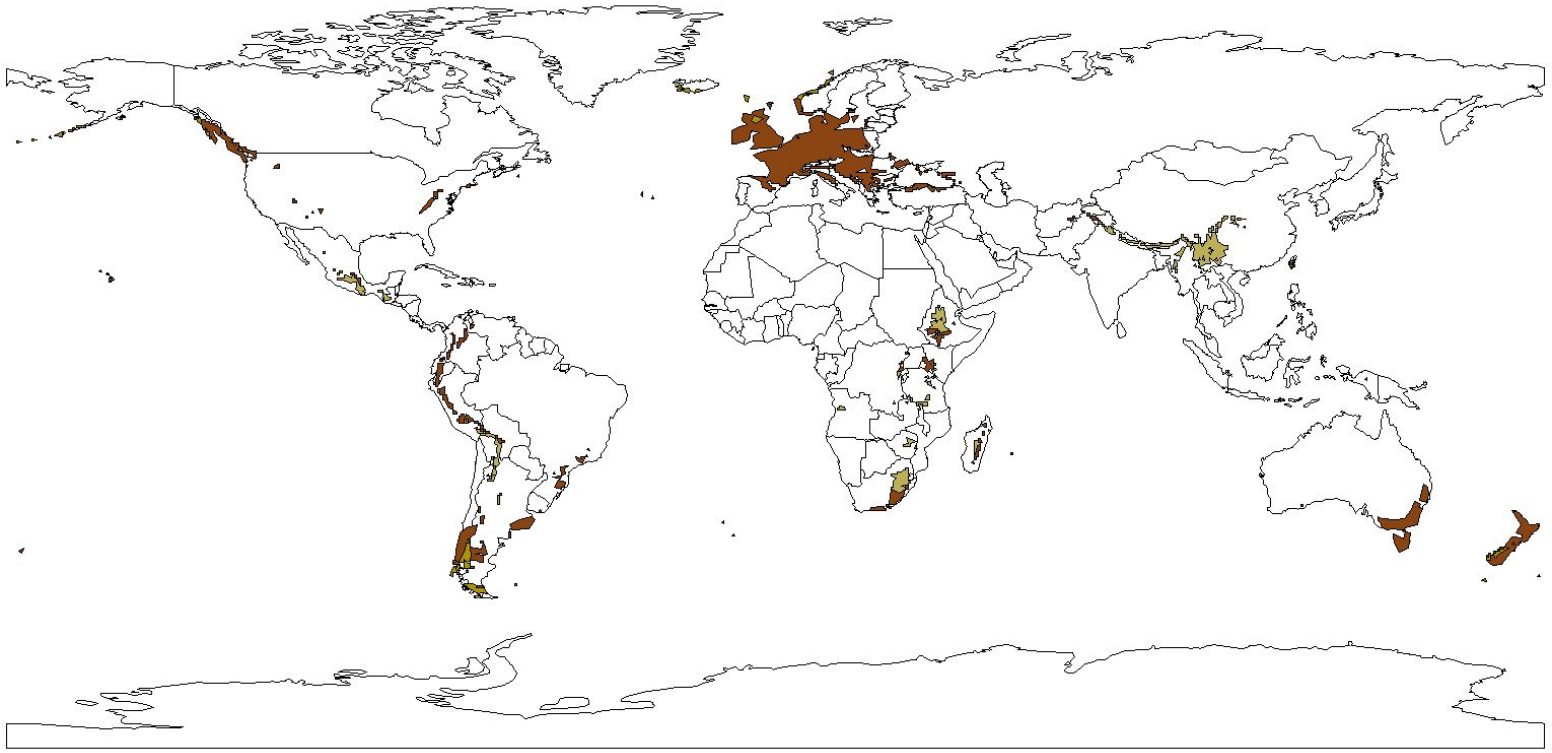
Köppen climate classification

Dry-summer subtropical or **Mediterranean climates** (*Csa/Csb*):

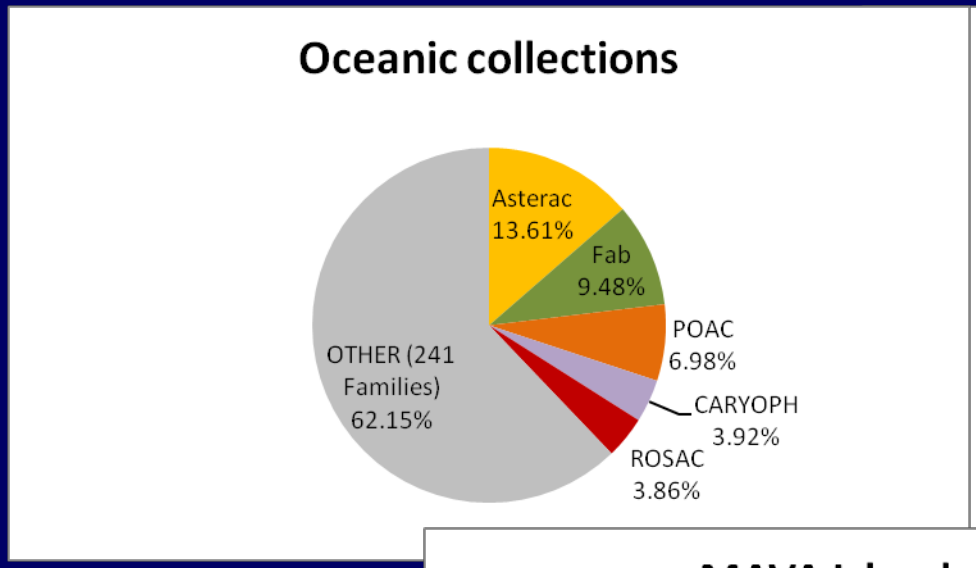


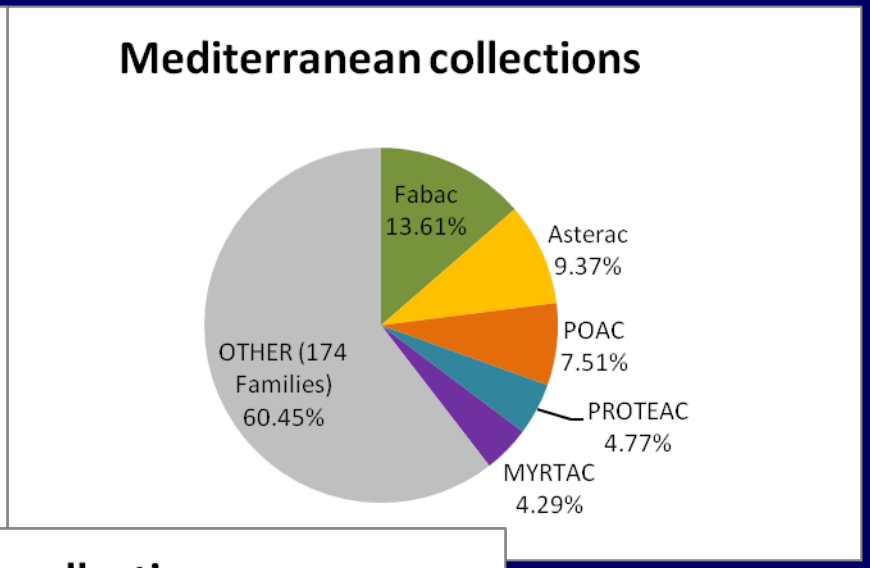
Köppen climate classification

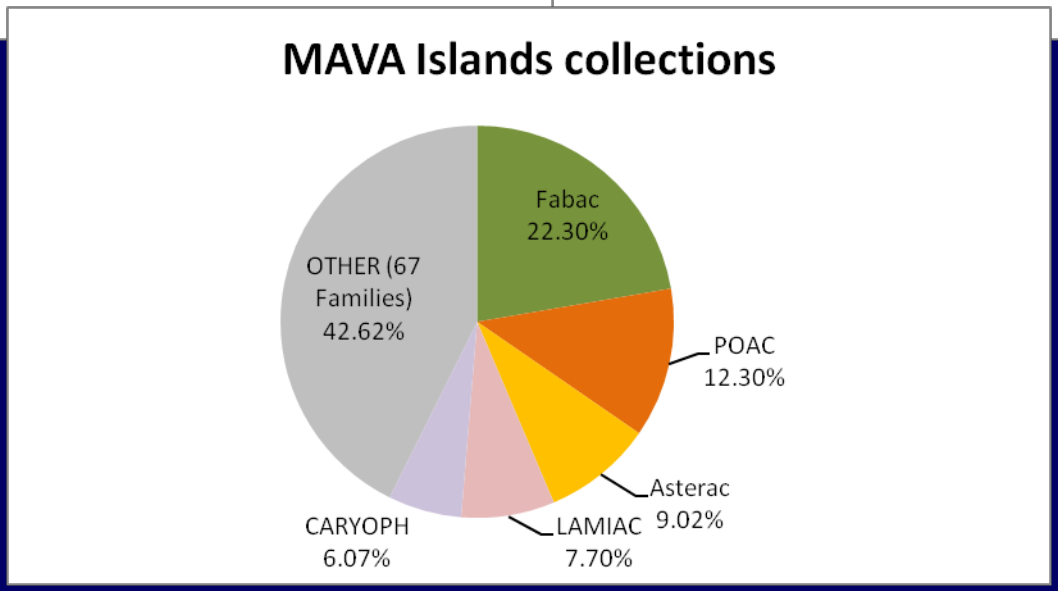
Maritime Temperate climates or Oceanic climates (*Cfb*, *Cfc*, *Cwb*, *Cwc*):



Distribution of families held at MSB







Review of MSB collections

	Oceanic	Med	MAVA Islands
Number of collections with an accepted test	8405	6051	283
% of collections from PY families	14.2	18.1	24.6
% accepted with scarification alone	16.6	20.0	34.8
% accepted with smoke treatment	0.3	1.1	0.0
% accepted with cold stratification	5.2	2.3	1.3
% accepted with alternating temperatures	16.4	10.8	22.4

Review of MSB collections

	% on tested collections		
	Oceanic	Med	MAVA countries
% coll. with PD only	15.7	13.7	8.0
% coll. with PY or PY + PD	13.2	16.4	34.5
% coll. Not Dormant	53.3	51.5	47.9
% coll. With no accepted test	17.8	18.4	9.6

Review of MSB collections

	% of total collections with accepted test		
	Oceanic	Med	MAVA countries
Herbs	81.2	83.2	88.2
Shrubs	73.3	71.2	50
Trees	75.4	75.2	N/A
Unspecified	89.8	86.4	95.0

Predicting germination and dormancy

Factors that may predict germination requirements

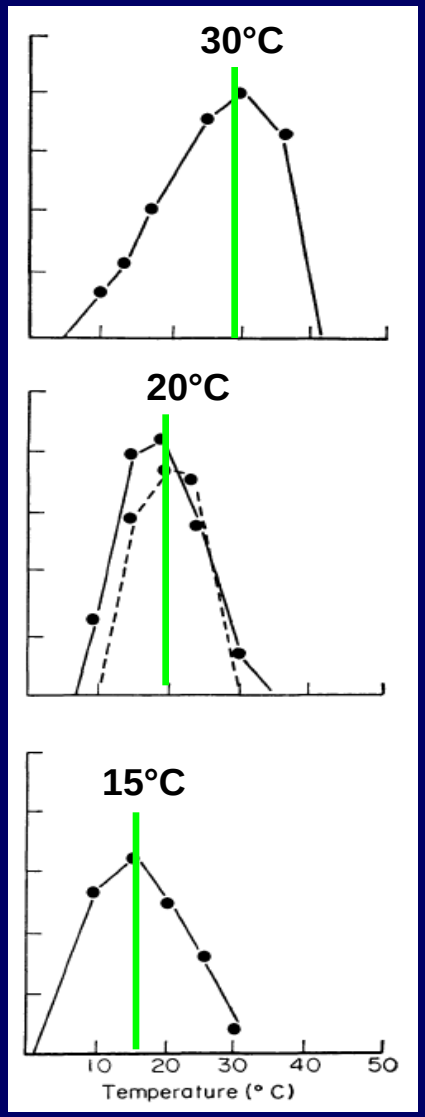
- Taxonomy: family trends
- Climate: temperate / Mediterranean / tropical
- Seed structure: endospermic or non-endospermic, nature of covering structures, location and size embryo
  Life form: tree / herb / annual / perennial
- Habitat: terrestrial (wet or dry) / aquatic

Germination requirements are determined by an integration of:

- What kind of plant it is ?
- The habitat and climate it lives in ?
- What kind of seed it has ?

Predicting germination temperatures and dormancy treatments from climate data

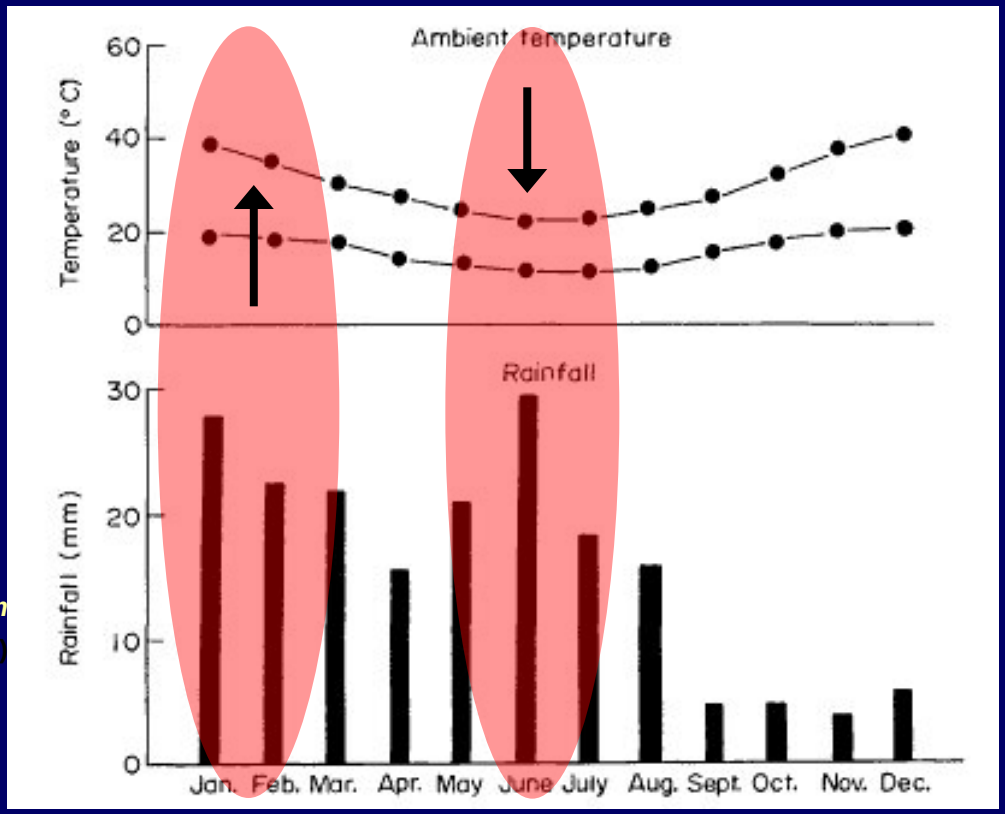
Climate reflects germination temperatures



Aristida contorta
(summer grass)

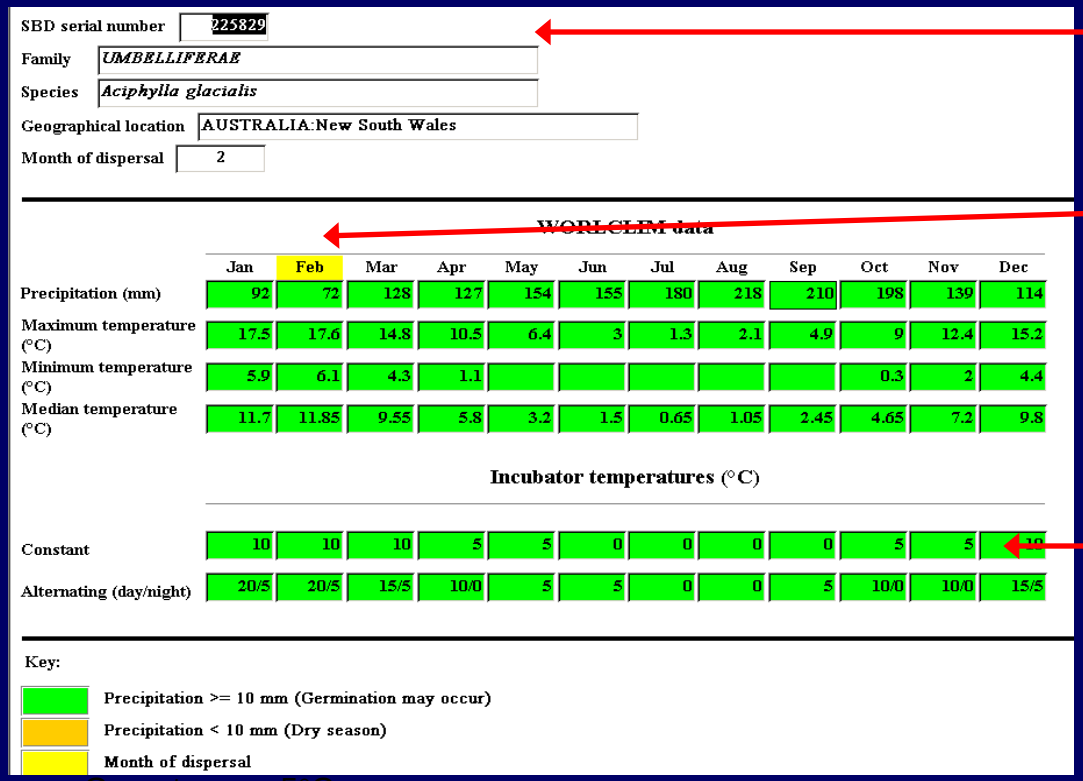
Helicrysum cassinianum
(winter Asteraceae)

Helipterum craspedioides
(winter Asteraceae)



Summer growing season **Winter growing season**

WorldClim



SBD serial number 225829

Family *UMBELLIFERAE*

Species *Aciphylla glacialis*

Geographical location AUSTRALIA:New South Wales

Month of dispersal 2

WORLCLIM data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precipitation (mm)	92	72	128	127	154	155	180	218	210	198	139	114
Maximum temperature (°C)	17.5	17.6	14.8	10.5	6.4	3	1.3	2.1	4.9	9	12.4	15.2
Minimum temperature (°C)	5.9	6.1	4.3	1.1						0.3	2	4.4
Median temperature (°C)	11.7	11.85	9.55	5.8	3.2	1.5	0.65	1.05	2.45	4.65	7.2	9.8

Incubator temperatures (°C)

Constant	10	10	10	5	5	0	0	0	0	5	5	10
Alternating (day/night)	20/5	20/5	15/5	10/0	5	5	0	0	5	10/0	10/0	15/5

Key:

Precipitation >= 10 mm (Germination may occur)

Precipitation < 10 mm (Dry season)

Month of dispersal

Germ temp = 5°C

Information

Month of dispersal

Incubator temperatures

- Use WorldClim data
- Latitude/longitude coordinates
- Dispersal (collection) month
- Generates equivalent incubator temperatures

Conditions for germination reflect seasonal climate

Microsoft Access - [SBD/WORLDCLIM data]

SBD serial number: 120049

Family: *UMBELLIFERAE*

Species: *Smyrnium olusatrum*

Geographical location: TUNISIA:Cap Bon

Month of dispersal: 6

WORLCLIM data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precipitation (mm)	62	59	43	33	18	11	2	6	29	43	38	60
Maximum temperature (°C)	15.2	16	18	20.9	24.6	28.7	32.5	32.5	30	25.2	20.3	16.4
Minimum temperature (°C)	6.1	6.2	8	10.4	13.4	17	19.3	20	18.8	15	10.4	7.2
Median temperature (°C)	10.65	11.1	13	15.65	19	22.85	25.9	26.25	24.4	20.1	15.35	11.8

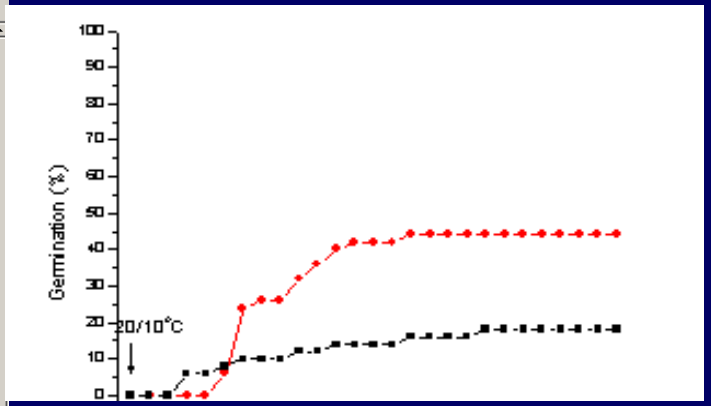
Incubator temperatures (°C)

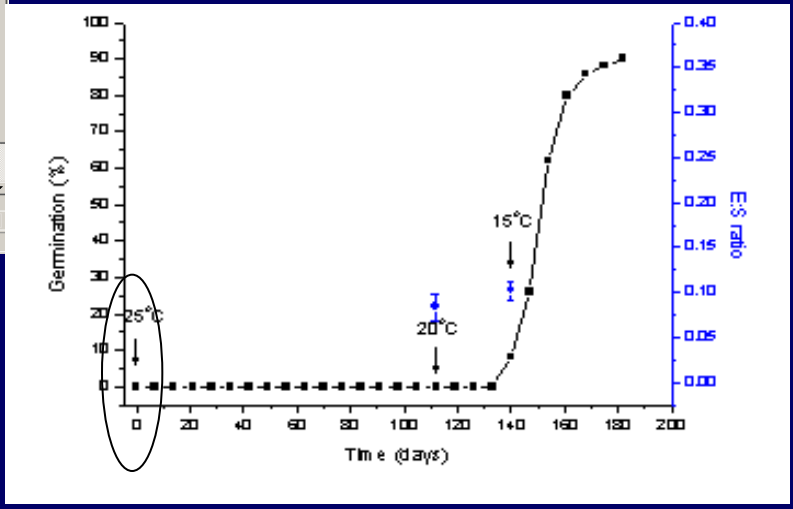
Constant	10	10	15	15	20	25	25	25	25	20	15	10
Alternating (day/night)	15/5	15/5	20/10	20/10	25/15	30/15	30/20	30/20	30/20	25/15	20/10	15/5

Key:

- Precipitation >= 10 mm (Germination may occur)
- Precipitation < 10 mm (Dry season)
- Month of dispersal

Use Down/Up or PgDn/PgUp cursor keys to view WORLDCLIM data for next/previous query serial number





Aciphylla glacialis (Umbelliferae)

SBD serial number: 225829
Family: *UMBELLIFERAE*
Species: *Aciphylla glacialis*
Geographical location: AUSTRALIA:New South Wales
Month of dispersal: 2

WORLCLIM data

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Incubator temperatures (°C)

Constant	10	10	10	5	5	0	0	0	0	5	5	10
Alternating (day/night)	20/5	20/5	15/5	10/0	5	5	0	0	5	10/0	10/0	15/5

Key:
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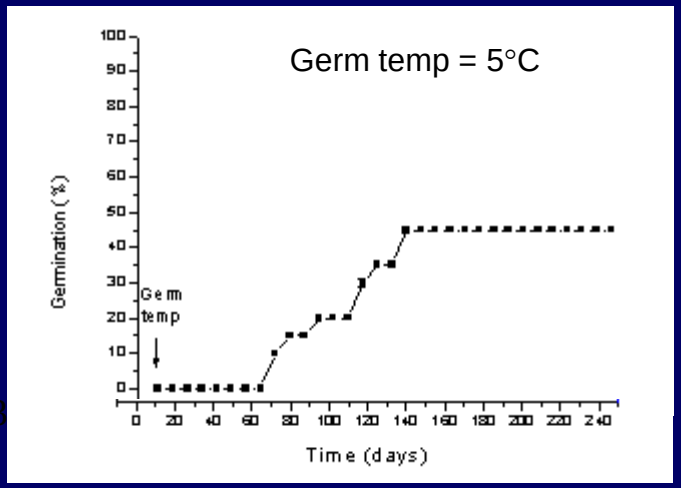
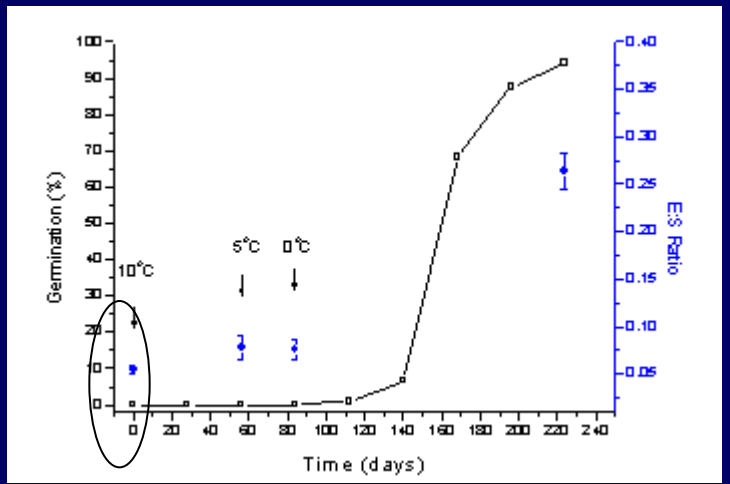
- Precipitation < 10 mm (Dry season)
- Month of dispersal





Other sources of climate data

- http://www.worldclimate.com/
- http://www.bbc.co.uk/weather/world/city_guides/index.shtml?show=h_guides
- http://www.tutiempo.net/en/

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Kew

Thank you