



Recent advances in seed germination research of Mediterranean plants

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ΠΟΛΛΑ ΣΠΙΤΑΚΙΑ
ΚΑΤΑΦΥΓΙΟ ΕΦΑΝΑΣΤΩΝ
MANY LITTLE HOUSE
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2nd Mediterranean Plant Conservation Week
 "Conservation of Mediterranean Plant Diversity: Complementary Approaches and New Perspectives"
 17-20 October 2018



CIHEAM
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TRAINING JOBS

Seed banking not an option for many threatened plants

The Global Strategy for Plant Conservation requires 75% of threatened plant species conserved ex situ by 2020. Currently, ex situ conservation focuses on conventional seed banking, yet this method is unsuitable for many threatened species. The 75% target is unattainable without urgent investment into alternative techniques.

Sarah V. Wyse, John B. Dickie and Katherine J. Willis

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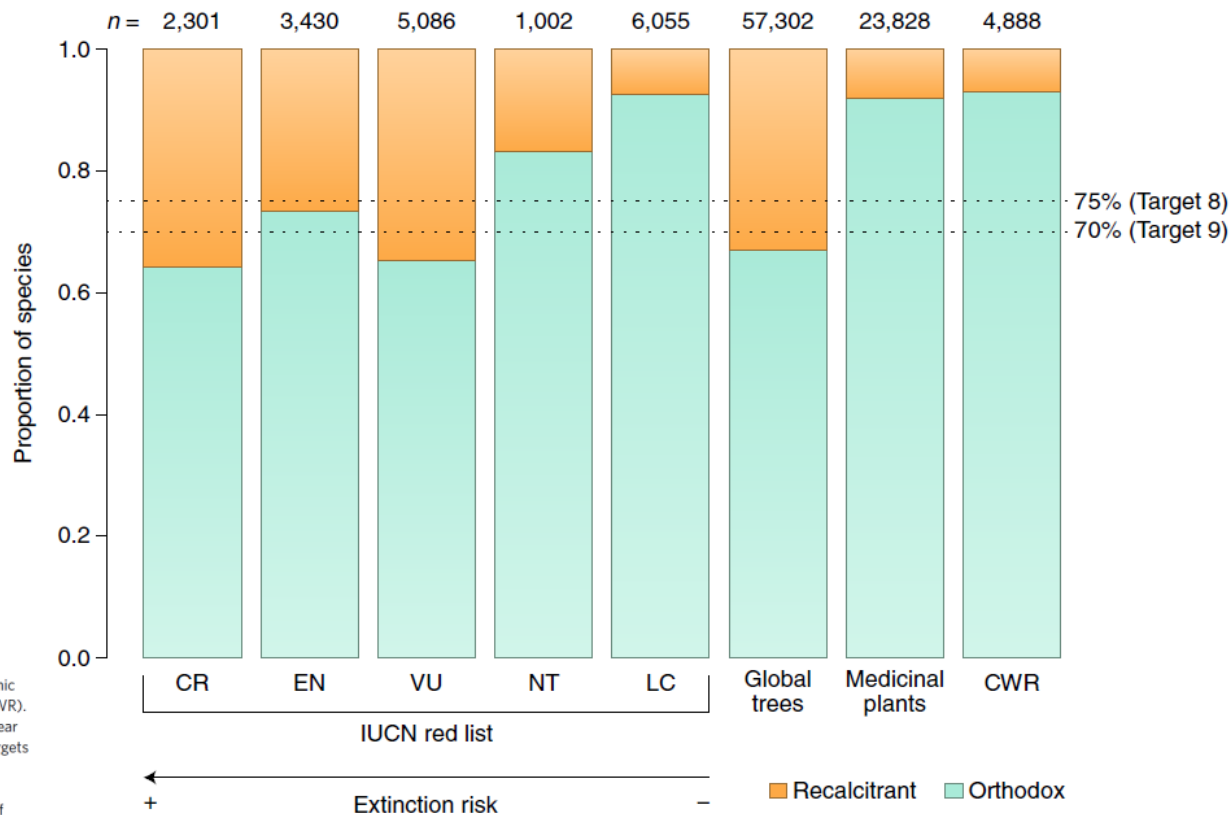
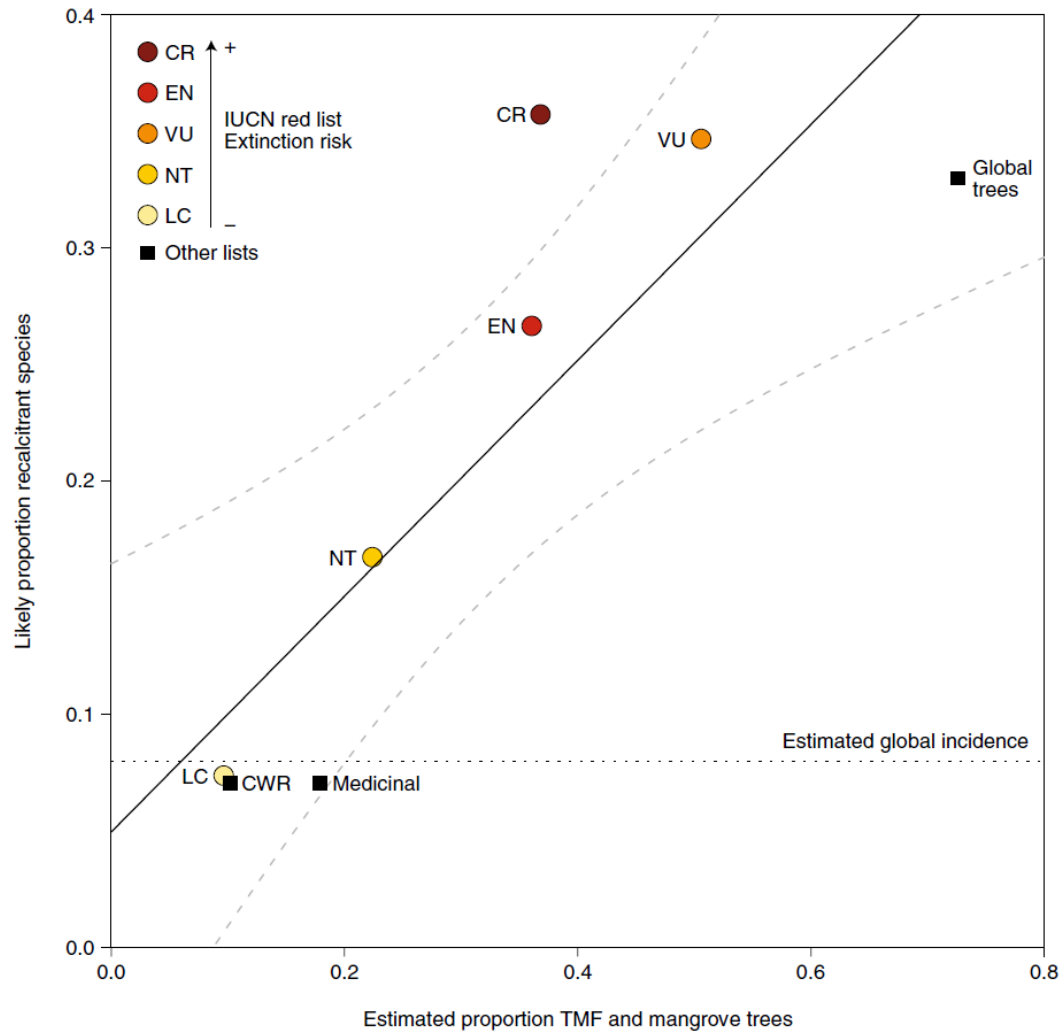


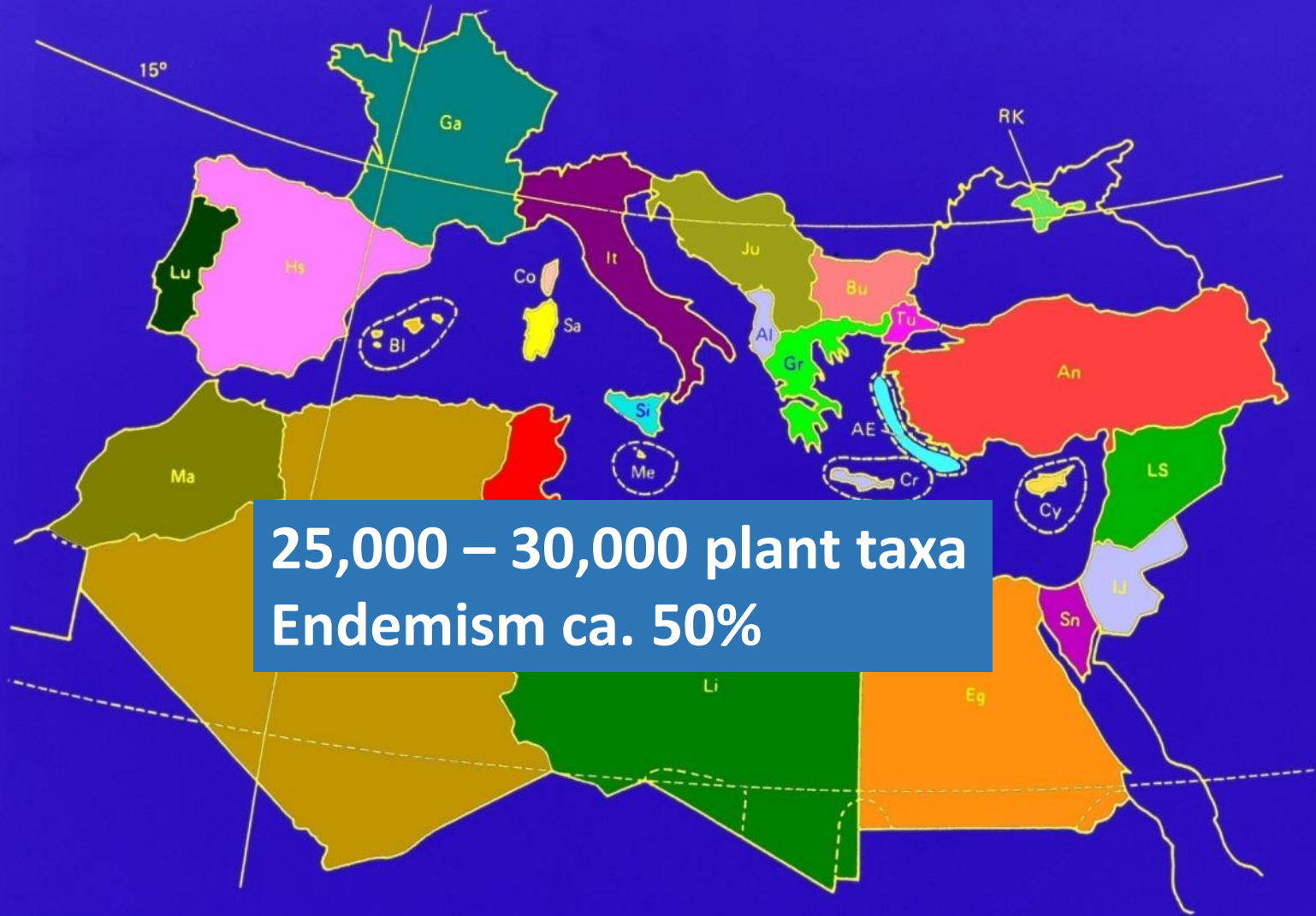
Fig. 1 | The likely proportions of seed storage behaviours across different plant lists. Species lists used are: the IUCN red list; GlobalTreeSearch, a database of all known tree species¹²; the Royal Botanic Gardens Kew's 'Medicinal plants' database; and the Crop Trust's inventory of crop wild relatives (CWR). CR, critically endangered; EN, endangered; VU, vulnerable (the three 'threatened' categories); NT, near threatened; and LC, least concern. Horizontal dotted lines denote the proportions of species that Targets 8 and 9 of the Global Strategy for Plant Conservation aim to conserve. Proportions predicted using models developed by Wyse and Dickie¹¹. Target 8 aims for at least 75% of threatened plant species conserved in ex situ collections; Target 9 aims for the conservation of 70% of the genetic diversity of crops, including CWRs and other socio-economically valuable plant species.



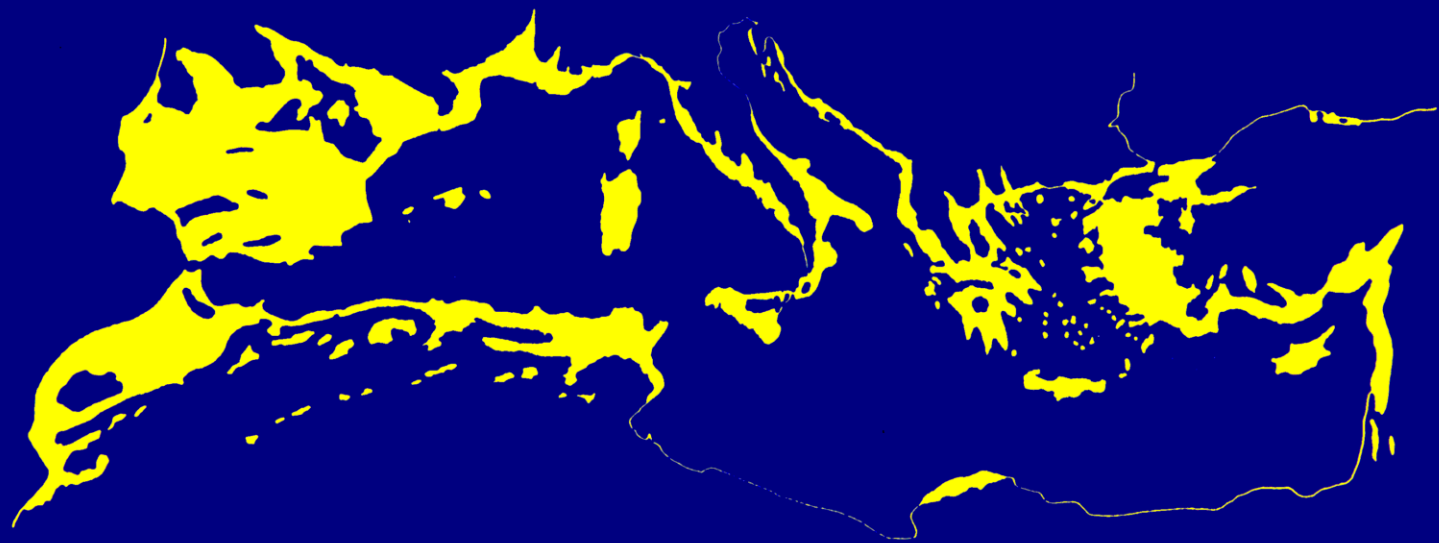
Taxa with recalcitrant seeds constitute between 0.5-1.0% of the Greek Flora.

Projected value of seed recalcitrance occurrence in the flora of the Mediterranean Rim: 1-2%

Fig. 2 | The likely proportions of recalcitrant species on different plant lists in relation to the estimated proportion of the list made up of trees from tropical moist forest and mangrove habitats. Solid black line is a linear model fitted for these two variables ($r^2 = 0.73$, $P = 0.007$); dashed grey lines represent the upper and lower 95% confidence bounds. Horizontal dotted line is the estimated global incidence of recalcitrant seed plants⁹, storage behaviour was predicted using models developed by Wyse and Dickie¹¹. Estimated proportion of tropical moist forest (TMF) and mangrove tree species calculated using data from GlobalTreeSearch, a database of all known tree species¹², the Global Biodiversity Information Facility (GBIF; www.gbif.org) and the Terrestrial Ecoregions of the World¹⁷. Species lists used are: the IUCN red list; GlobalTreeSearch, a database of all known tree species¹²; the Royal Botanic Gardens Kew's 'Medicinal plants' database; and the Crop Trust's inventory of CWRs. CR, critically endangered; EN, endangered; VU, vulnerable (the three 'threatened' categories); NT, near threatened; and LC, least concern.



25,000 – 30,000 plant taxa
Endemism ca. 50%



DURING THE LAST 3 DECADES:

**AN IMPRESSIVE INCREASE OF
RESEARCH GROUPS WORKING
ON SEED GERMINATION (AND
SEED BIOLOGY IN GENERAL)
AROUND THE MEDITERRANEAN.**

**ACCOMPANIED BY AN
EXPLOSIVE SURGE OF
PUBLICATIONS (RESEARCH
PAPERS, REVIEWS, MSc & PhD
THESES, PAMPHLETS, MANUALS,
TECHNICAL REPORTS, BOOKS
etc)**



Research review

A research agenda for seed-trait functional ecology

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Anissa Sanyanti^{4,7,19}, Karen D. Somerville¹⁷, Ryan Tangney^{4,12},
Sean Tomlinson^{4,12}, Shane Turner^{4,5} and Jeffrey L. Walck²⁰

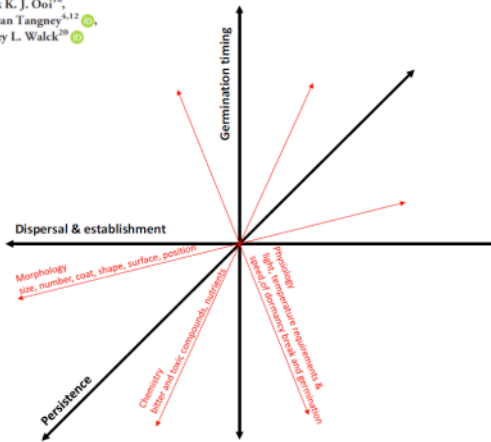
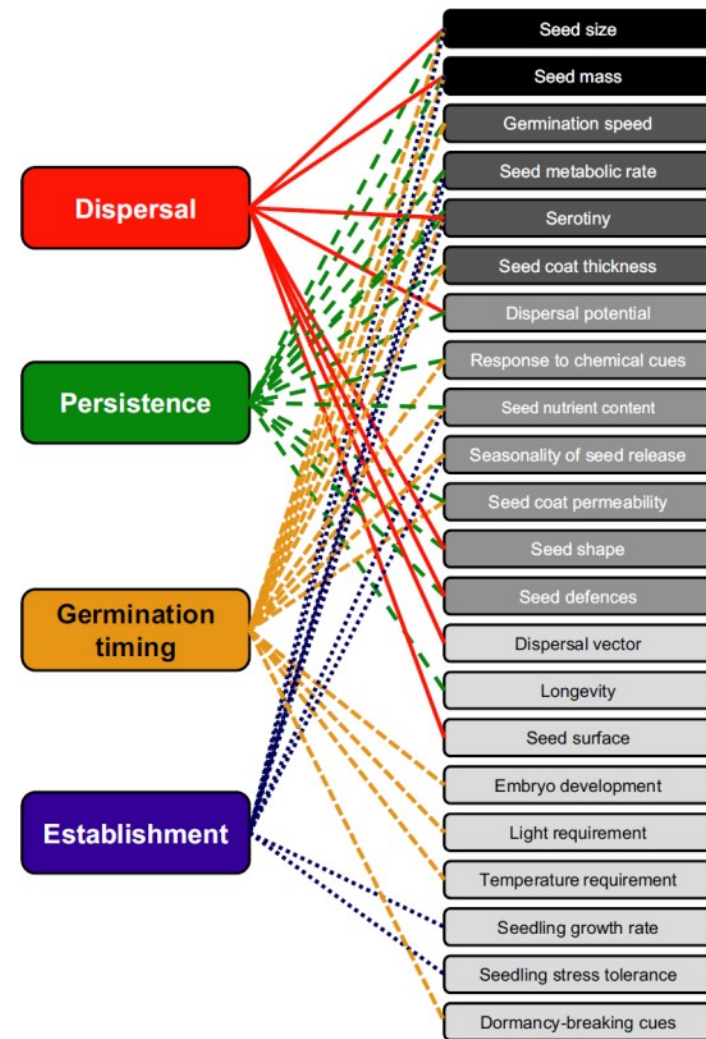


Fig. 2 The seed ecological spectrum. We hypothesize that seed traits (red arrows) exhibit trade-offs and axes of covariation linked to several major functions (black arrows). Together, these spectra help to characterize key dimensions of the regeneration niche. A range of seed traits may feed into these spectra (Fig. 3), and whereas the seed size–number trade-off is a well-identified trait set underpinning dispersal and establishment functions, the axes of trait covariation that generate dormancy and germination phenology as well as persistence are still to be quantified. Note that direction and traits on axes are hypothetical.

Fig. 3 Network between seed functions (left) and seed traits (right). Lines indicate direct links between traits and functions (coloured). The shading of trait boxes refers to the number of links with seed functions. Dispersal (red) is defined as the horizontal movement of diaspores away from the parent plant. Persistence (green) is the ability of seeds to remain alive in the canopy or soil seed bank and reduce granivory and fungal attack. Germination timing (orange) is the time after dispersal when germination – that is, radicle emergence – occurs; it bridges unfavourable conditions and matches seedling emergence to the optimal moments for regeneration. Seeds can schedule their emergence by dormancy traits and breaking requirements that interact with the seed environment and, once nondormant, with germination traits, such as light and temperature requirements. Establishment (blue) comprises all subsequent functions after germination (emergence, establishment) that result in the successful recruitment of individuals into a population, and also includes seedling traits. Seed traits shown here represent traits broadly (e.g. 'seed metabolic rate' is the CO_2/O_2 gas exchange of seeds under standardized conditions; 'dispersal potential' is an index based on the percentage of seeds dispersed beyond a reference distance by a specific vector; 'embryo development' includes embryo: seed size ratio and embryo growth parameters; 'seed nutrient content' represents carbon (C), nitrogen (N), and phosphorus (P) content; 'response to chemical cues' include germination response to nitrate, karrikins, etc.; 'seed surface' includes seed appendages, hairs, mucilage, etc.; 'seed defences' includes content of repellent or toxic substances in the seed coat, e.g. phenols, and mechanical resistance). We plan to publish a handbook that complements this work with detailed definitions, methods of measurements, and standardized data reporting for seed functional traits.



Dormancy types

Dormancy classification is
an endless source of
confusion and
misunderstandings

Endogenous
Innate
Organic
Embryonic
Morphological
Physiological
Morphophysiological
Exogenous
Seed-coat imposed
Physical
Combined
Double
Chemical
Mechanical
Primary
Secondary
Induced
Photodormancy
Skotodormancy
Thermopdormancy
Osmodormancy
Enforced
Imposed
Apparent
Partial
Full
Nondeep
Intermediate
Deep
Very deep

Germination Characters

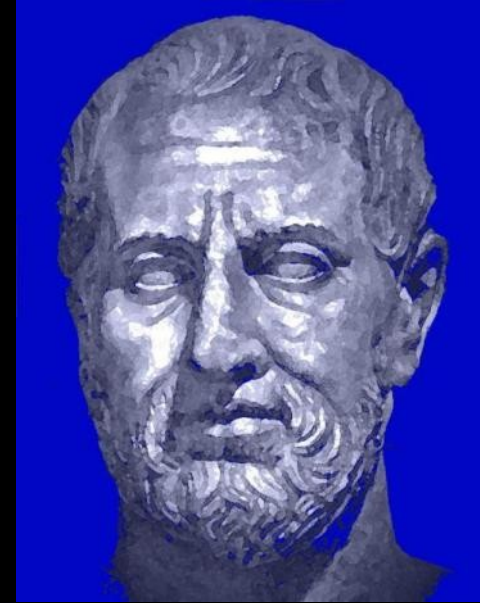
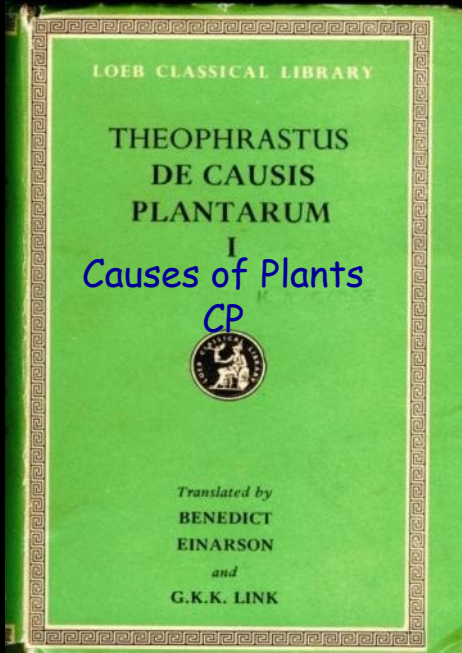
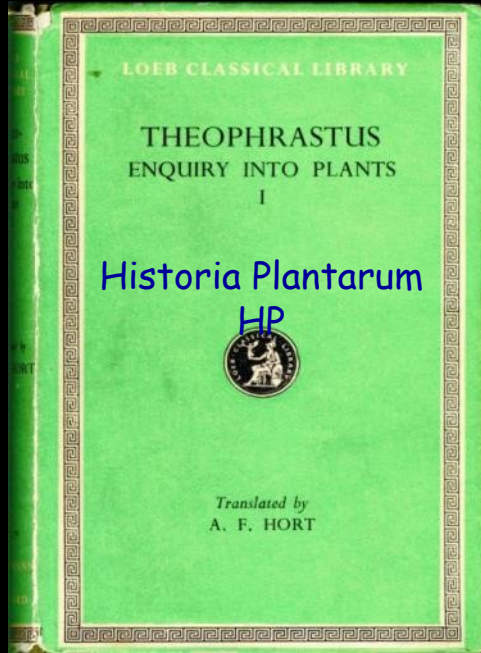
The distinctive types of germination behaviour

Germination Functional Types



**Carl von Linnaeus
(1707-1778)**

**“Theophrastus
is the
father of
Botany”**



**Θεόφραστος ο Ερέσιος
(371-286 πΧ)**

ΘΕΟΦΡΑΣΤΟΥ
ΧΑΡΑΚΤΗΡΕΣ
ΗΘΙΚΟΙ.

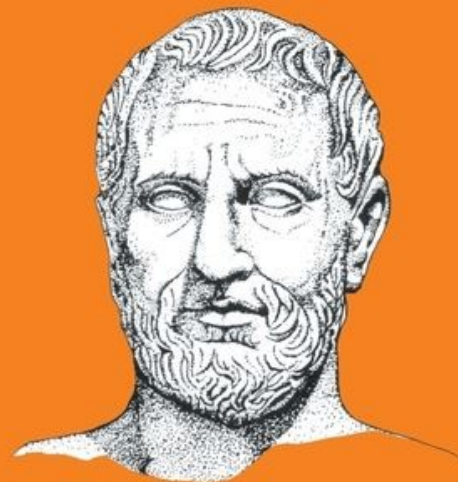
THEOPHRASTI
CHARACTERES
ETHICI.

EX RECENSIONE
PETRI NEEDHAM,
ET VERSIONE LATINA
ISAACI GASAUBONI.

GLASGUAE:
IN AEDIBUS ACADEMICIS
EXCUEBANT ROBERTUS ET ANDREAS FOULIS
ACADEMIAE TYPOGRAPHI
MDCCLVIII.



THE CHARACTERS
OF THEOPHRASTUS



EDITED WITH INTRODUCTION
COMMENTARY AND INDEX
BY R.G. USSHER

ΘΕΟΦΡΑΣΤΟΥ ΧΑΡΑΚΤΗΡΕΣ ΗΘΙΚΟΙ

ΘΕΟΦΡΑΣΤΟΥ ΧΑΡΑΚΤΗΡΕΣ ΗΘΙΚΟΙ

	εἰρωνείας α'	δεισιδαιμονίας ις'
	κολακείας β'	μεμψιμοιρίας ιζ'
	ἀδολεσχίας γ'	ἀπιστίας ιη'
	ἀγροικίας δ'	δυσχερείας ιθ'
5	ἀρεσκείας ε'	ἀηδίας κ'
	ἀπνοοίας ς'	μικροφιλοτιμίας κα'
	λαλιᾶς ζ'	ἀνελευθερίας κβ'
	λογοποιίας η'	ἀλαζονείας κγ'
	ἀναισχυντίας θ'	ὑπερηφανίας κδ'
10	μικρολογίας ι'	δειλίας κε'
	βδελυρίας ια'	ὀλιγαρχίας κς'
	ἀκαιρίας ιβ'	ὀψιμαθίας κζ'
	περιεργίας ιγ'	κακολογίας κη'
	ἀναισθησίας ιδ'	φιλοπνηρίας κθ'
15	αὐθαδείας ιε'	αἰσχροκερδείας λ'

CHARACTERS OF THEOPHRASTUS

1. Ironical	16. Grumbler
2. Flatterer	17. Distrustful
3. Garrulous	18. Offensive
4. Boor	19. Unpleasant
5. Reckless	20. Of Petty Ambition
6. Chatty	21. Mean
7. Gossip	22. Boastful
8. Shameless	23. Arrogant
9. Penurious	24. Coward
10. Gross	25. Oligarch
11. Unreasonable	26. Late Learner
12. Officious	27. Slanderer
13. Stupid	28. Patron of Rascals
14. Surly	29. Avaricious
15. Superstitious	30. Shabby Profiteer



**Peter Thompson
(P.A. Thompson)
died Dec. 2008**

**Pioneer of
germination
ecophysiology
(& seed
banking)**



Ann. Bot. 39, 1-19, 1975

QUALITY CONTROL MARK

Characterization of the Germination Responses of *Silene dioica* (L.) Clairv., Populations from Europe

P. A. THOMPSON

Royal Botanic Gardens, Wakehurst Place, Ardingly, Sussex

Received: 11 March 1974

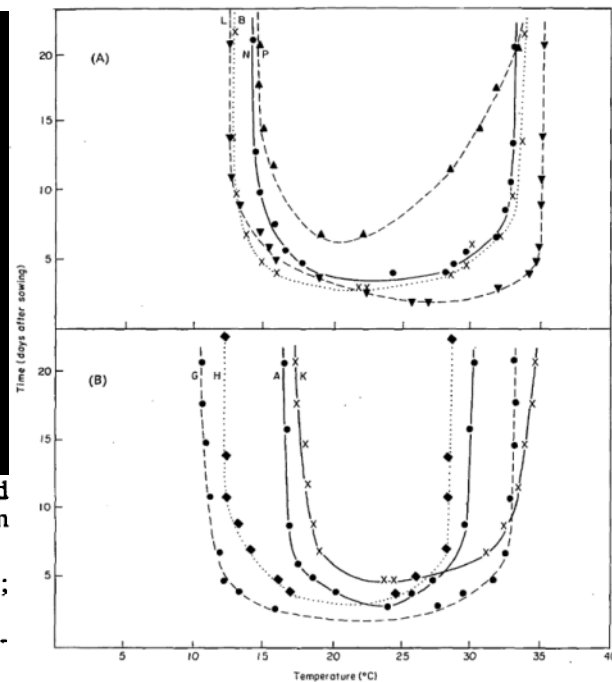


FIG. 3. Germination character curves of populations of *Silene dioica* plotted as maximum and minimum temperatures on successive days which resulted in 50 per cent of final maximum germination rates.

- (A) Seed collected from populations growing in Germany (L); Finland (B); Czechoslovakia (N); and Poland (P).
(B) Seed collected from populations growing in England (G and H); Norway (A) and Switzerland (K).

A COMPARISON OF THE GERMINATION CHARACTER OF SPECIES OF CARYOPHYLLACEAE COLLECTED IN CENTRAL GERMANY

By P. A. THOMPSON

Jodrell Laboratory, Royal Botanic Gardens, Kew, Richmond, Surrey

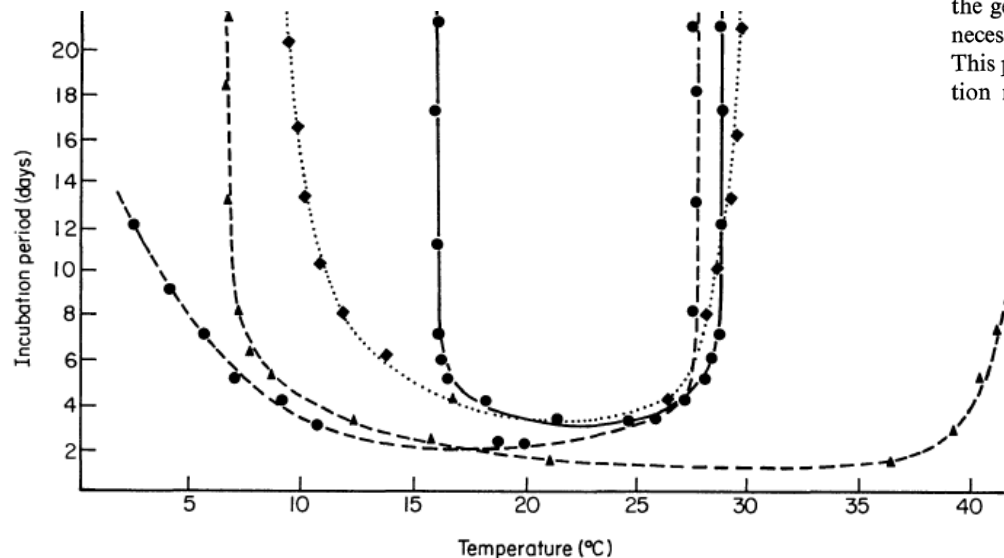


FIG. 5. Germination response curves for maximum and minimum temperatures providing a 50% germination rate on successive days. Tests were made, for four species, on thermo-gradient bars set to cover the range 2–42°C. *Agrostemma githago* (---●---); *Silene dichotoma* (▲); *Lychnis viscaria* (◆); *Silene noctiflora* (—●—).

of the other species, and minima lower than any apart from *Agrostemma githago*. It could be argued that these three species, which have already been identified as possible adventives within the region, each possessed germination characters which were outside the normal range found for those species considered to be typical of deciduous woodland zones of Europe. More information on the correlations existing between geographical distribution and germination character is presented elsewhere (Thompson 1970a, b).

The preservation within a species of an alien character, as implied here, suggests that the germination responses of adventives, in this case well established as weeds, may not necessarily show obvious signs of adaptation in response to a changed environment. This point was examined in more detail for these three species by comparing the germination responses of populations of seed obtained from different parts of Europe. Two

This implies that the fundamental germination character of a species may not necessarily change on transposition by man, even when the species has been maintained for a lengthy period in an alien environment, as is the case with *A. githago*. This interpretation must be accepted with reservation in view of a conflict of evidence on the point arising from the results of other workers. Thus Stearns & Olson (1958), McNaughton (1966), McWilliams, Landers & Mahlstede (1968) working with *Tsuga canadensis*, *Typha* species and *Amaranthus retroflexus* respectively have reported differences in the germination responses of populations from different parts of North America, and Harper (1965) notes that the germination requirement of a species may differ markedly over its geographical range, although Lauer (1953) found few differences in the responses of *Agrostemma githago* and *Datura stramonium* collected in various parts of Europe.

However, ecotypic variations in the physiological responses of European species are well authenticated with respect to plant height and flowering time (e.g. Turesson 1930) and a recent review by Hiesey & Milner (1965) has spotlighted the wide range of adaptive responses found in natural populations to variations in nutrient status, photoperiod, temperature and rates of photosynthesis and respiration. These examples of physiological adaptations to environment prevent an easy acceptance of the suggestion that the physiological responses involved in germination may be relatively non-plastic. But it is suggested that the examination of this problem depends largely on a concise, simple method of making comparisons of germination responses to different conditions such as the one described in this paper.

5 Germination Characters

Postdevelopers

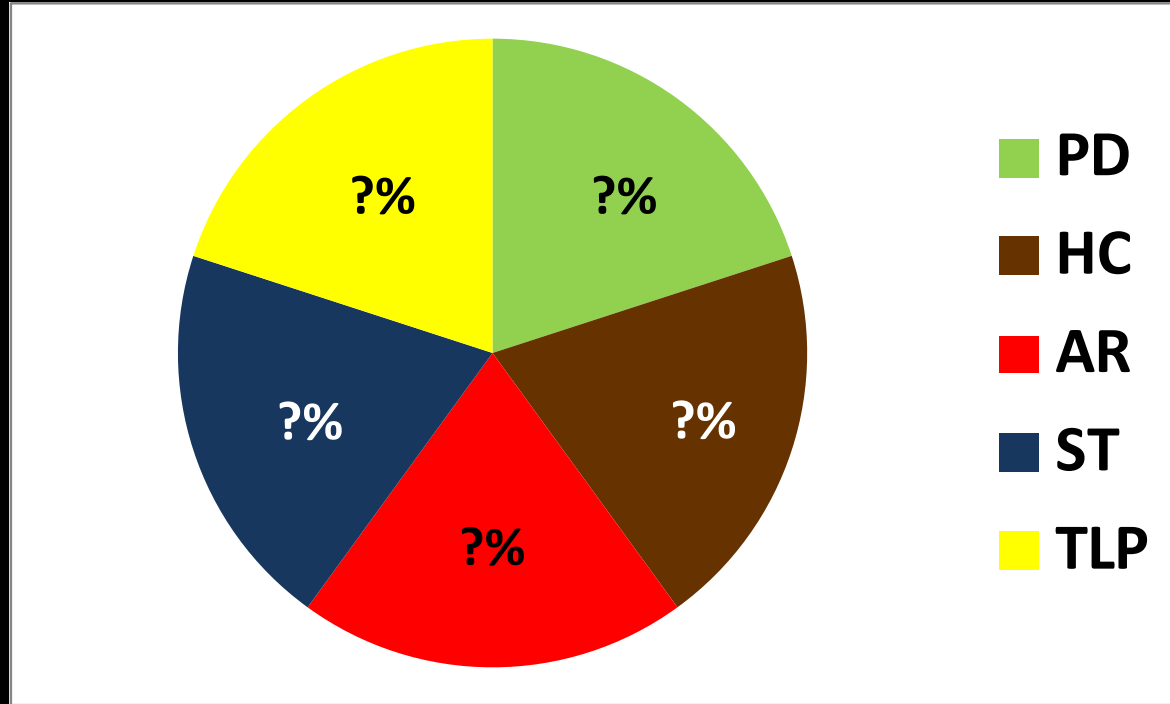
Hardcoaters

Afterripeners

Stratificationers

Temperature(and light)-probers

5 Germination Characters IN THE MEDITERRANEAN



Postdevelopers

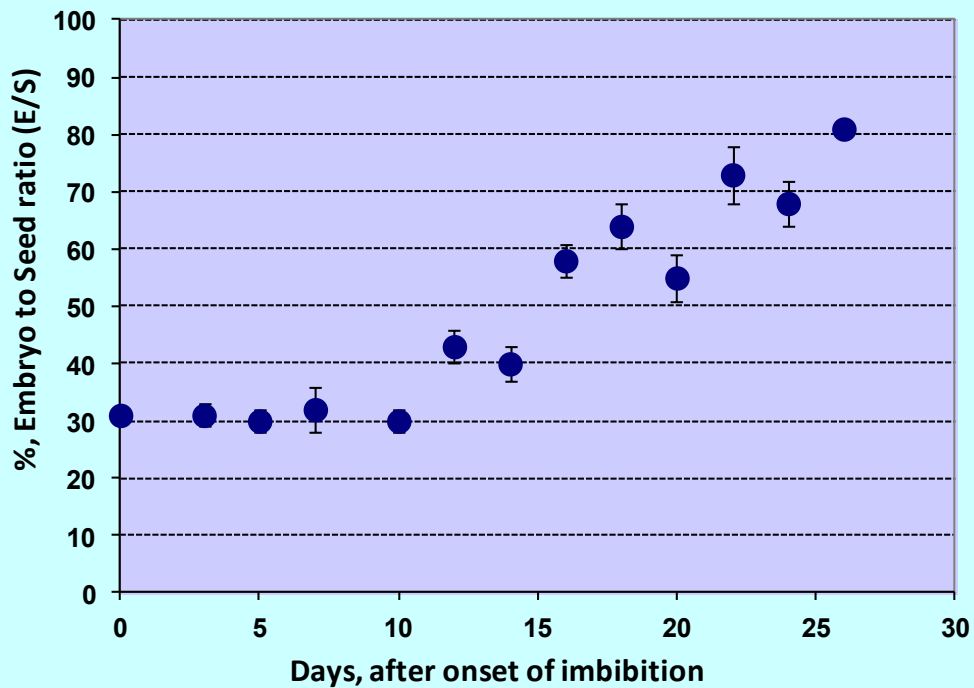
Seeds with underdeveloped or undifferentiated embryos

Bupleurum kakiskalae
(Apiaceae)

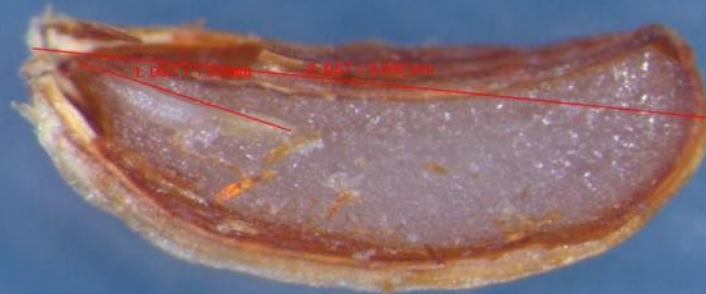


Bupleurum kakiskalae (Apiaceae)

Bupleurum kakiskalae



0 d



22 d



Postdevelopers

37 Families / 200

Considerably determined by phylogeny

Plus the undifferentiated embryos:

Orchidaceae c. 500 spp.

Orobanchaceae c. 150 spp.

c. 5-10% of the Mediterranean Flora

Seeds with underdeveloped or undifferentiated embryos are associated with delayed, WINTER or SPRING germination

Apiaceae	52
Asparagaceae	10
Campanulaceae	13
Gentianaceae	15
Liliaceae	11
Papaveraceae	12
Ranunculaceae	45
	158
total number	209

Hardcoaters

Seeds with water impermeable seed coats

Legumes in the Fire-Prone Mediterranean Regions: an Example From Greece*

Margarita Arianoutsou¹ and Costas A. Thanos²

The frequency of LEGUMES tends to increase along decreasing altitudinal and latitudinal gradients. In drier Mediterranean environments, therophytes (and among them annual papilionoid legumes) dominate the local floras

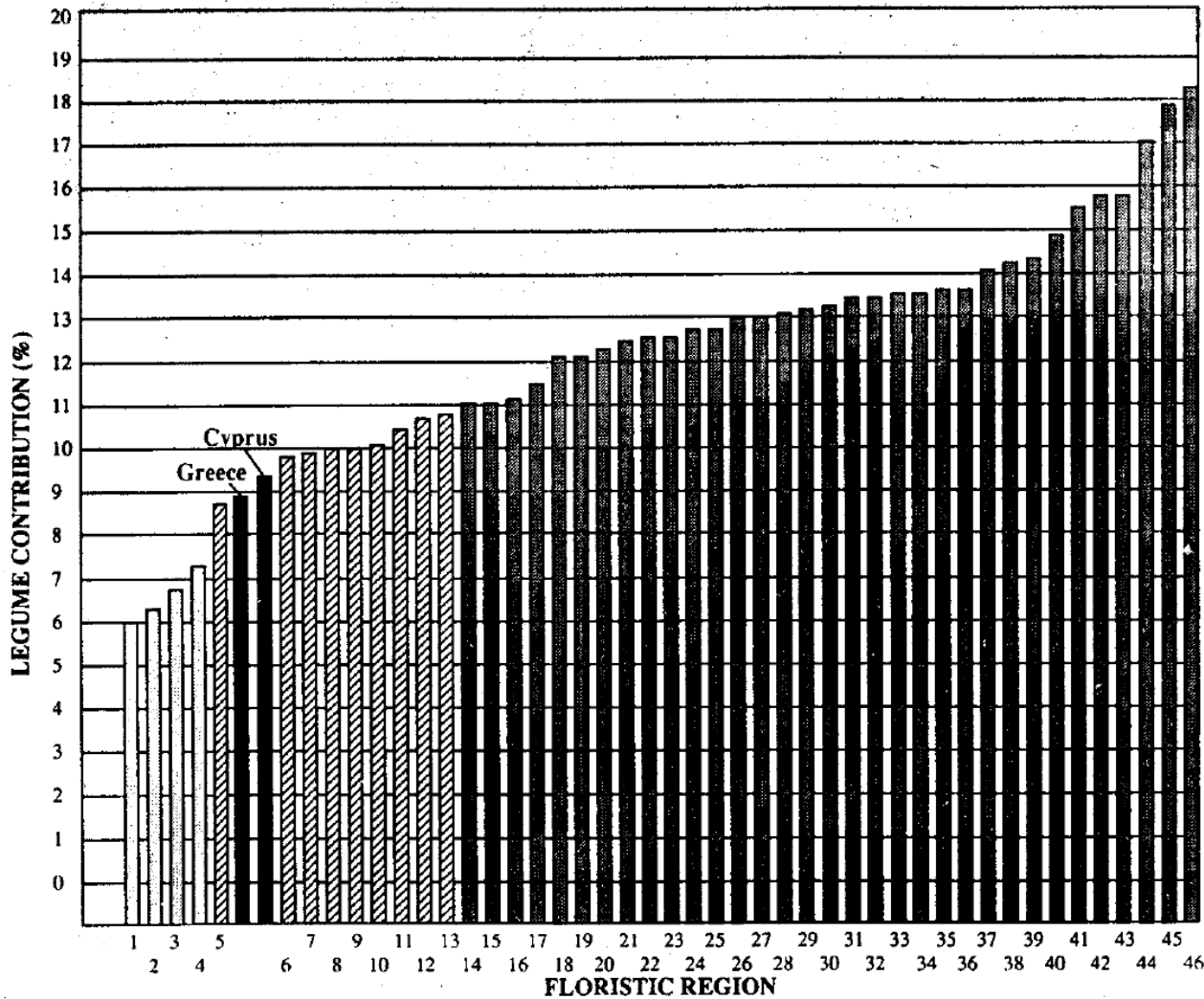
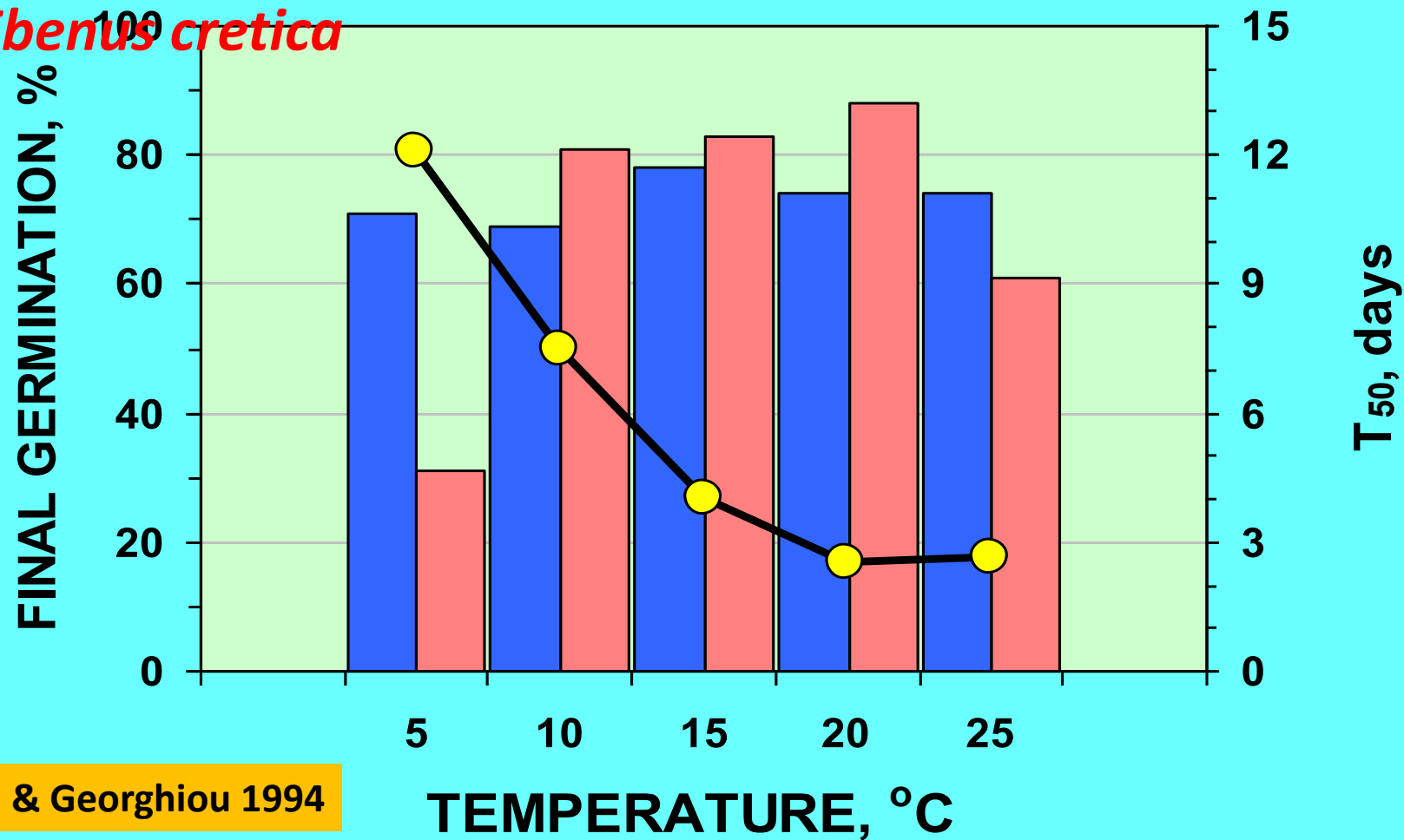


Figure 1. Contribution of legumes to the total flora of various geographic regions of Greece (in the cases marked with * the contribution has been estimated on a species plus subspecies basis). 1 Mountains of Greece * (Strid 1991) 2 Lailias Mt. (Voliotis 1977) 3 Macedonian Mts (Quezel and Contandriopoulos 1968) 4 Prespas Lakes Nat. Park (Pavlidis 1985) 5 Psathura Isl. (Snogerup et al. 1980) 6 Cholomon Mt. (Voliotis 1967) 7 Crete Isl. (Barclay 1986) 8 Lesbos Isl. (Cantrary 1889) 9 Euboea Isl. (Rechinger 1961) 10 Veriscos Mt. range (Pavlidis 1982) 11 Sivofilia hydrobiotope (Georgiadis et al. 1990) 12 Cephalonia Isl. (Philos and Damboldt 1985) 13 Central Euboea Isl. (Philos 1960) 14 Yioura Isl. (Kanan et al. 1988) 15 Armathia Isl. and 15 islets (Kauz 1989) 16 Corfu Isl. (Georgiou 1988) 17 Syros Isl. (Sarris 1994) 18 Skopelos Isl. (Economou 1973) 19 Hyettos Mt. (Zelendis 1973) 20 Ag. Evratios Isl. (Snogerup 1991) 21 Schinias pine forest (Brofas and Kartsois 1991) 22 Yiros Isl. (Tzanoudakis 1981) 23 Skithos Isl. (Economidou 1969) 24 Cythera Isl. (Yanitsaras 1969) 25 Mt. Paikon grasslands (Drosos and Athanassiadis 1989) 26 Kira Panagia Isl. (Snogerup et al. 1991) 27 Aetoloacarnanian lakes (Koumpli-Sovantzi 1983) 28 Cassandra Peninsula (Lavrentiadis 1961) 29 Dicosyadas Isl. (Christodoulakis et al. 1990) 30 Chios Isl. * (Meikle 1954) 31 Santorini Isl. (Hansen 1971) 32 Sithonia Peninsula (Pavlidis 1976) 33 Samos Isl. (Christodoulakis 1986) 34 Kos-Kalymnos-Psytros-Telendos Isl. (Hansen 1980) 35 Spetses Isl. (Oikolaidou and Yantitsaras 1992) 36 S. Euboeic Gulf islands (Sarris 1981) 37 Elaphonisos Isl. (Yanitsaras 1971) 38 Piperi Isl. (Otsinburla and Yantitsaras 1992) 39 Skantzoura Isl. (Gustafsson and Snogerup 1974) 40 Nisyros Isl. (Papatzou 1975) 41 Paxi Isl. (Georgiadis et al. 1986) 42 Cassandra pine forests* (Taitoni and Karagiannakidou 1987) 43 Seven islets of N. Dodecanese (Panitsa and Tzanoudakis 1991) 44 Kastellorizo Isl. (Greuter 1979) 45 Psara Isl. (Greuter 1976) 46 Oinousses Isl. (Panitsa et al. 1994).

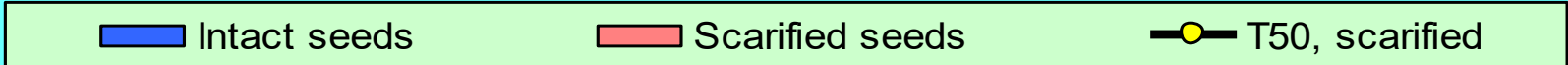
Ebenus cretica



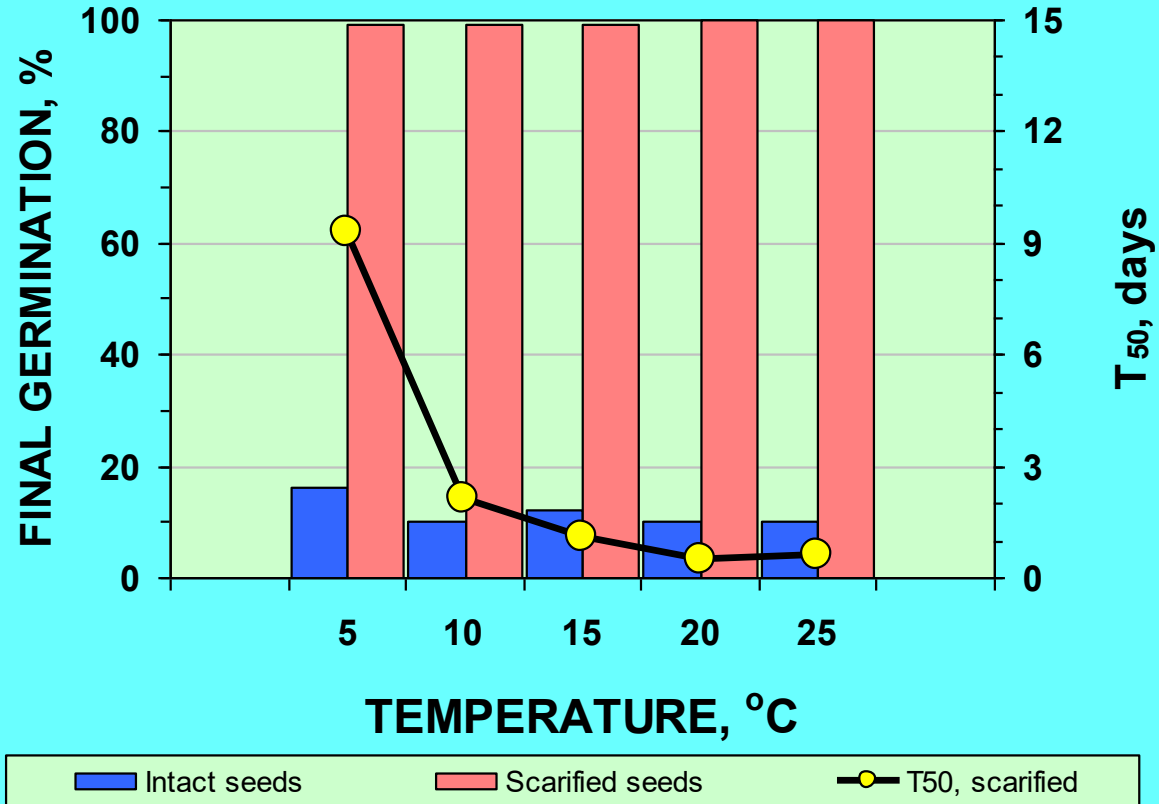
Ebenus cretica

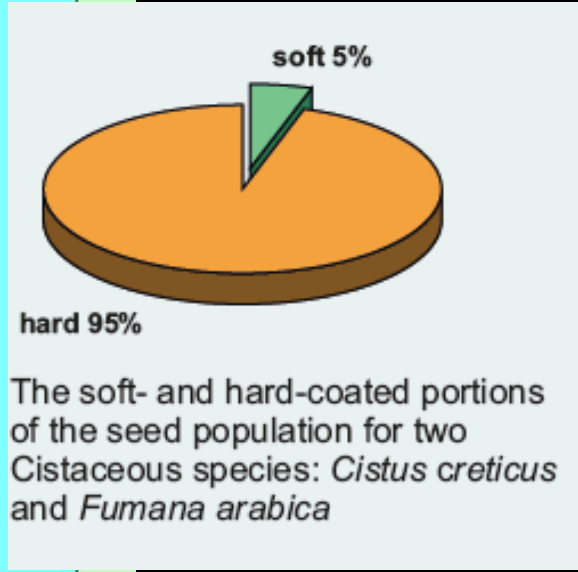
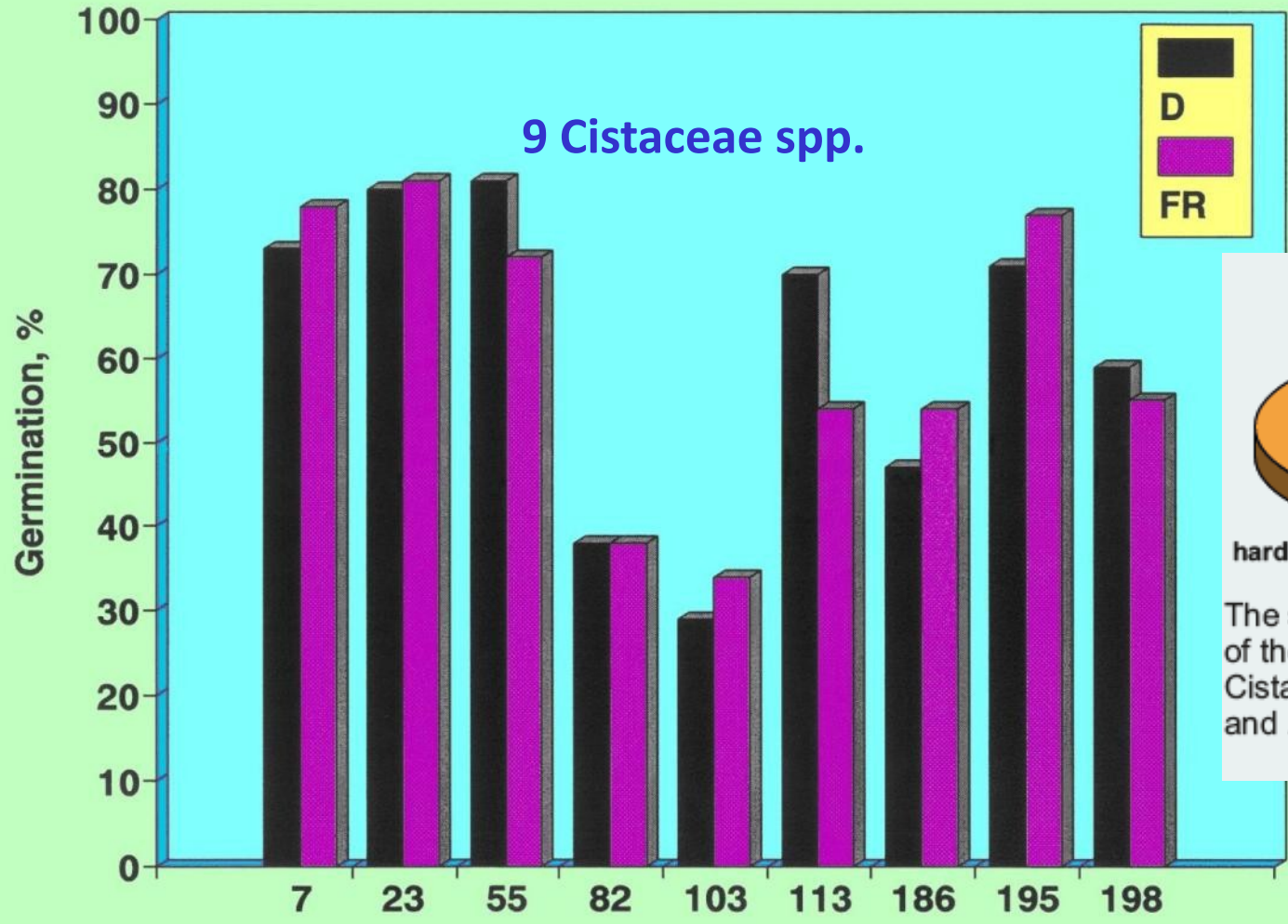


Doussi & Georghiou 1994



Ebenus sibthorpii





Hardcoaters

9 Families / 200

Strongly determined by phylogeny

10.4% of the Greek Flora

c. 11% of the Mediterranean Flora

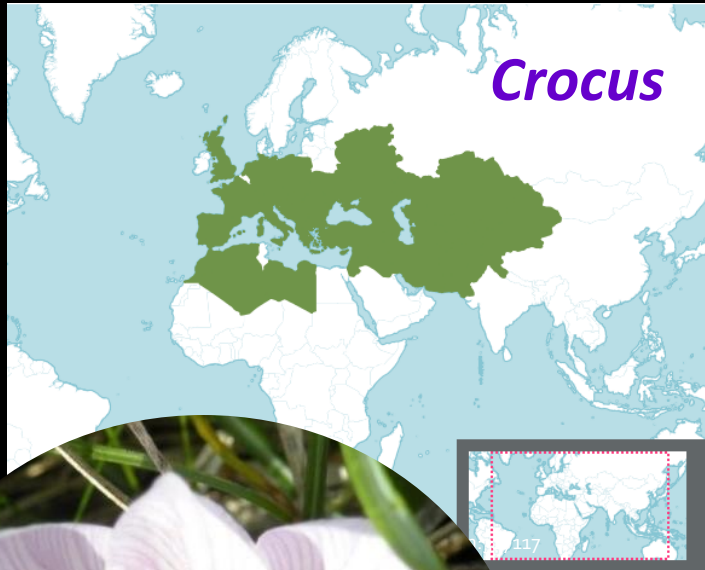
Hard (water-impermeable) coats are affiliated to:
EPISODIC (postfire) or
ERRATIC germination (after animal consumption,
drought, freezing/thawing, weathering ...)

USUALLY indifferent to temperature and light

	GREECE
Anacardiaceae	5
Biebersteiniaceae	1
Bixaceae	
Cannaceae	
Cistaceae	28
Convolvulaceae	41
Cucurbitaceae	
Dipterocarpaceae	
Fabaceae	441
Geraniaceae	43
Malvaceae	28
Nelumbonaceae	
Rhamnaceae	1
Sapindaceae	
Sarcocaulaceae	
Sphaerosepalaceae	
Surianaceae	
	588

Afterripeners

Seeds require a few months at dry, warm conditions

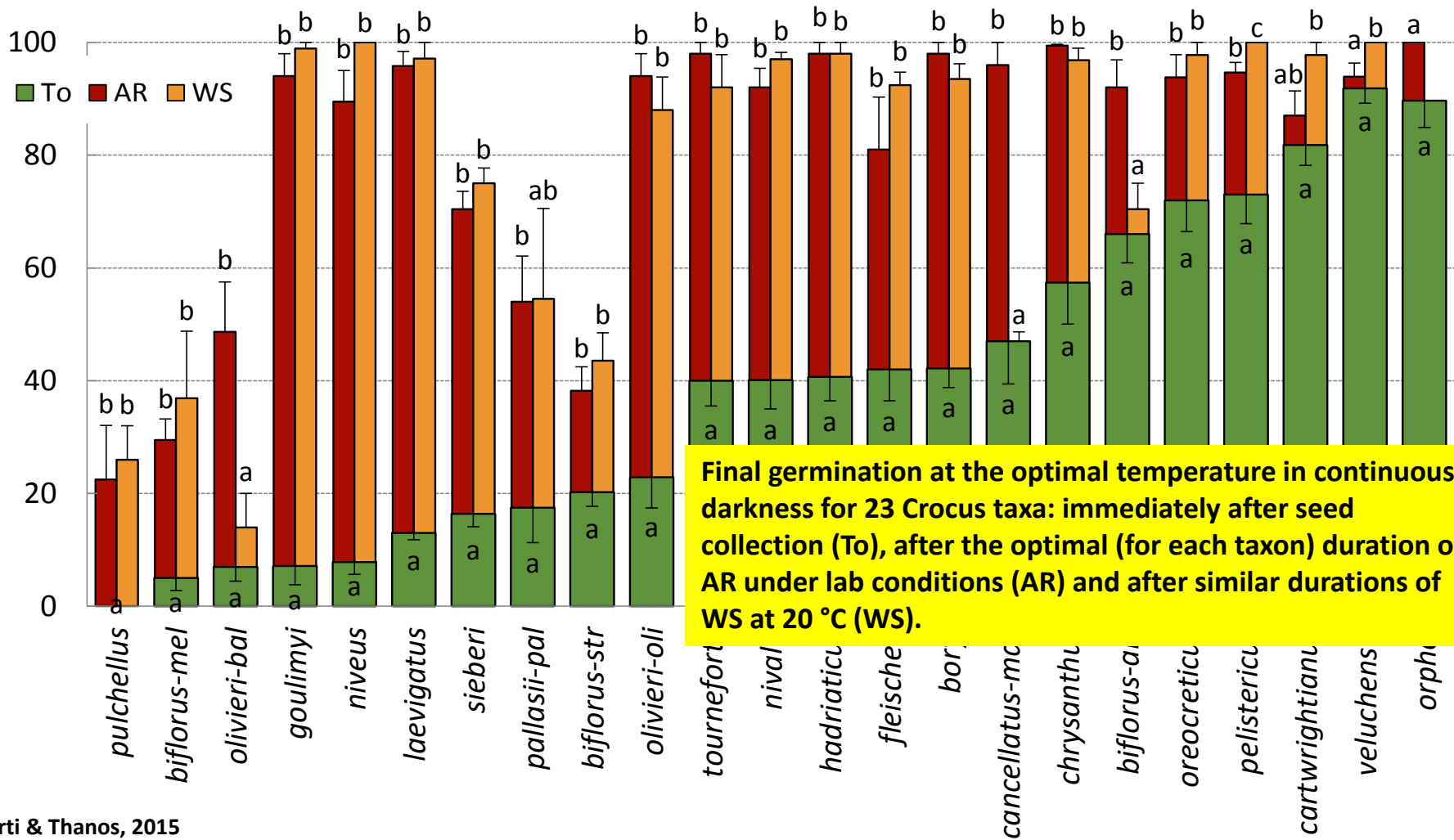


chrysanthus

C. biflorus subsp. *nubiagena*

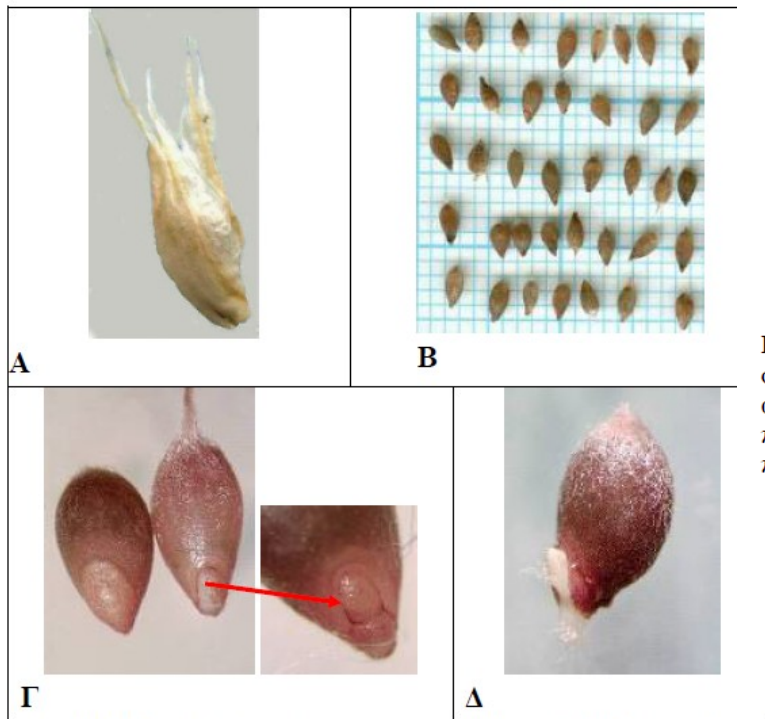
C. cartwrightianus

Final germination, %

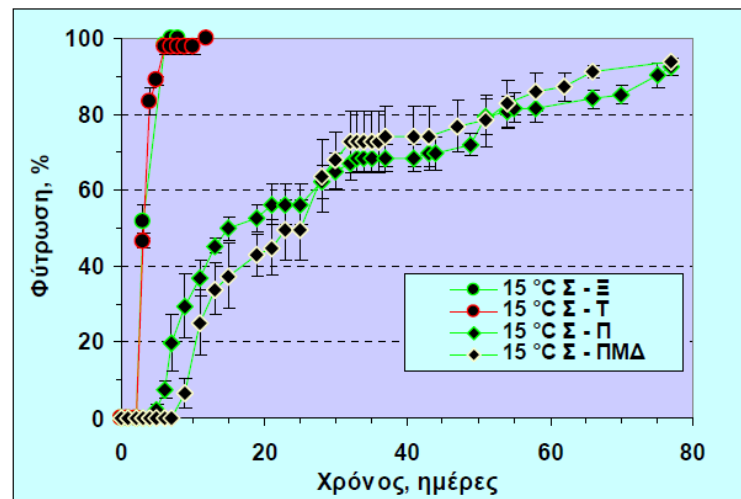


Final germination at the optimal temperature in continuous darkness for 23 *Crocus* taxa: immediately after seed collection (To), after the optimal (for each taxon) duration of AR under lab conditions (AR) and after similar durations of WS at 20 °C (WS).

Sesleria doerfleri (Poaceae)

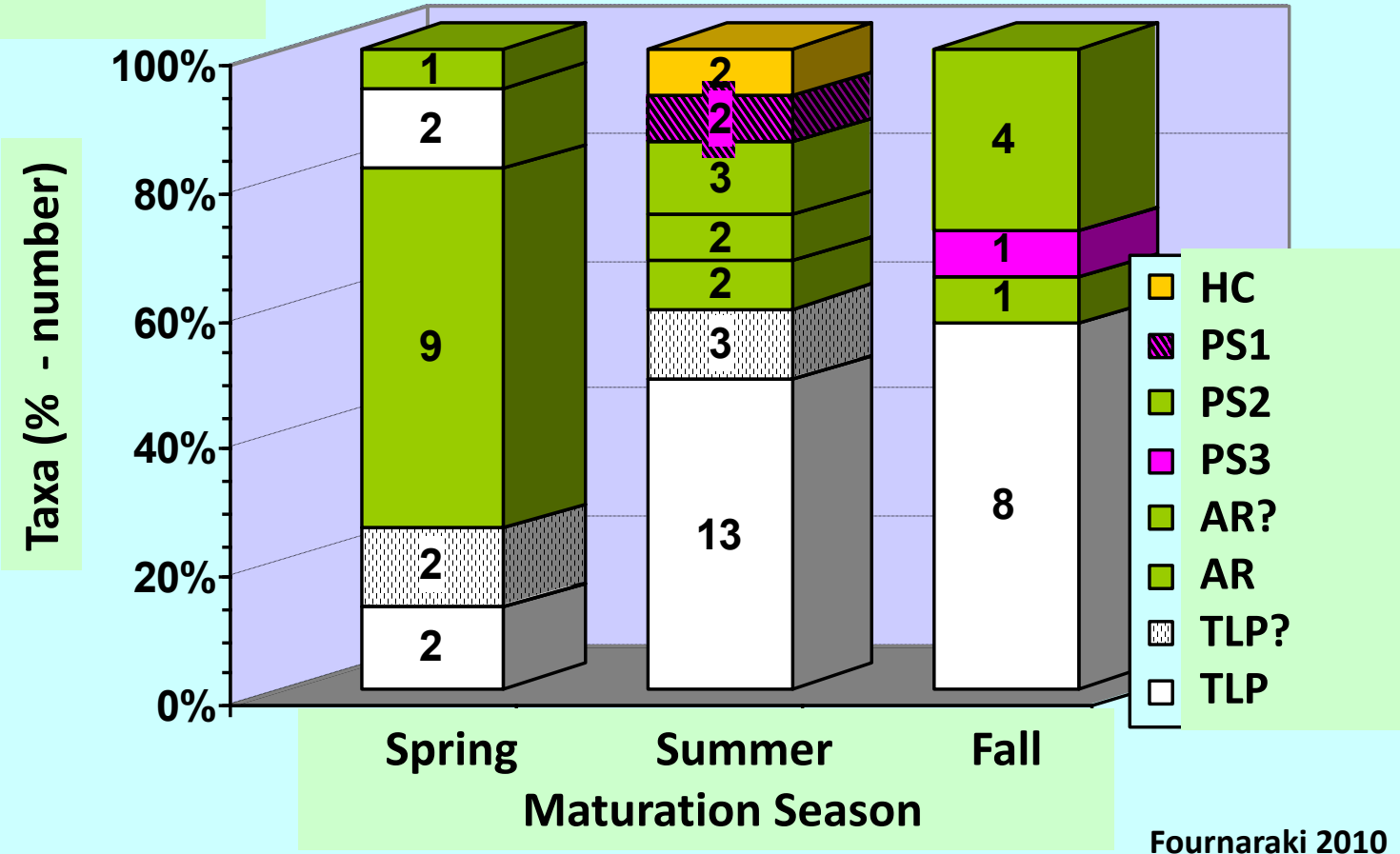


Φωτογραφία 71. Μονάδα διασποράς και καρποί *Sesleria doerfleri*: μονάδα διασποράς (καρύονη που περιβάλλεται από τις λεπίδες) (Α), καρποί (Β), καρποί στη βάση των οποίων διακρίνεται το έμβρυο (Γ), φυτρωμένος καρπός (Δ).



Εικόνα 138. Χρονική πορεία της φύτρωσης σπερμάτων *Sesleria doerfleri* στους 15 °C, σε συνεχές σκοτάδι (Σ). Ξ: Σπέρματα που παρέμειναν στο ξηραντήριο 22 μήνες, Τ: σπέρματα που αποθηκεύτηκαν στην Τράπεζα Σπερμάτων για περίπου 4 μήνες, Π: σπέρματα που συλλέχθηκαν πρόσφατα (πραγματοποίηση πειράματος την επομένη της συλλογής), ΠΜΔ: μονάδες διασποράς που συλλέχθηκαν πρόσφατα. Οι κατακόρυφες γραμμές αντιστοιχούν στο \pm τυπικό σφάλμα.

Threatened plants of Crete



Afterripeners

27 Families / 200

Considerably determined by phylogeny
(very INCOMPLETE data)

c. ??% of the Mediterranean Flora

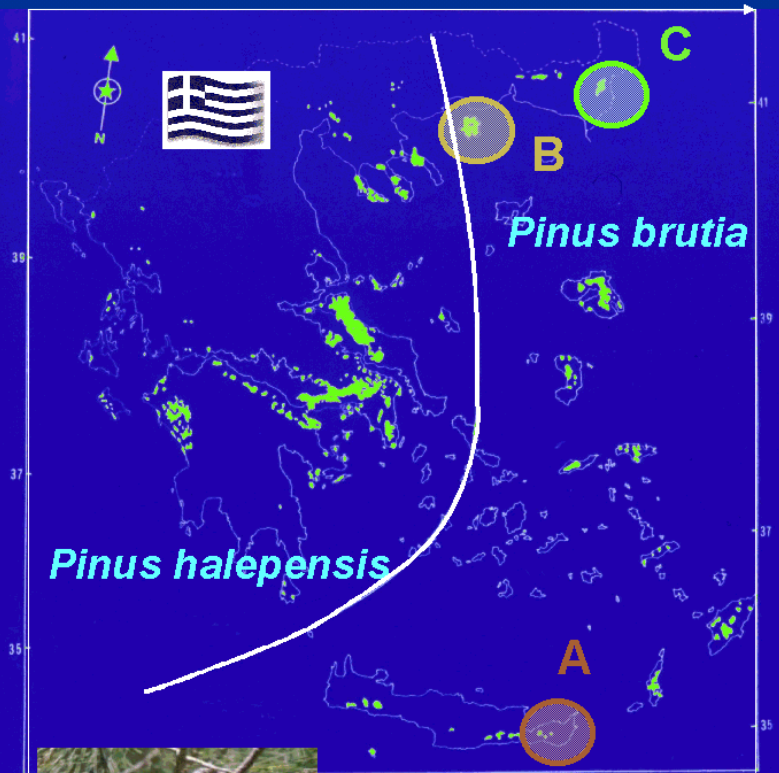
Usually manifested by plants with 'early seed maturation'. AR is believed to safeguard seeds from untimely summer/early autumn germination.

Quite common in the south of Europe.

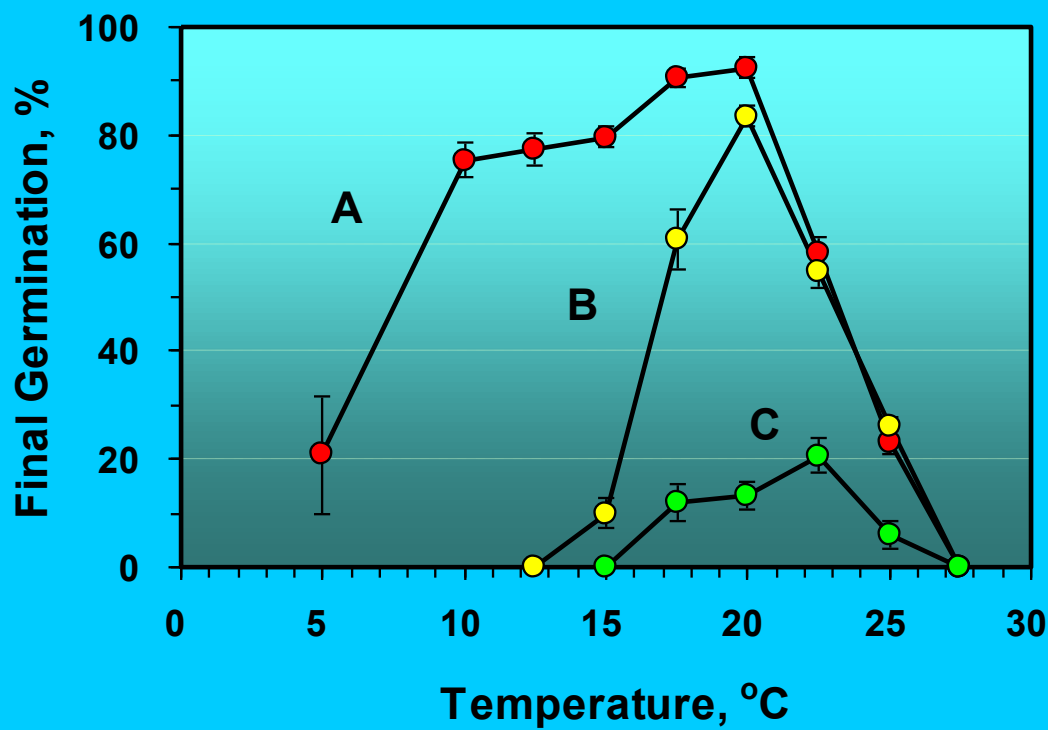
Asteraceae	11
Brassicaceae	32
Caryophyllaceae	20
Iridaceae	37
Poaceae	48
	148
total number	194

Stratificationers

Seeds require a period of weeks or months at wet, cold conditions



Germinability (in the Dark) of seeds from 3 Greek *Pinus brutia* provenances





*Aesculus
hippocastanum*

**CRITICALLY
ENDANGERED (CR)**



*Aesculus
hippocastanum*

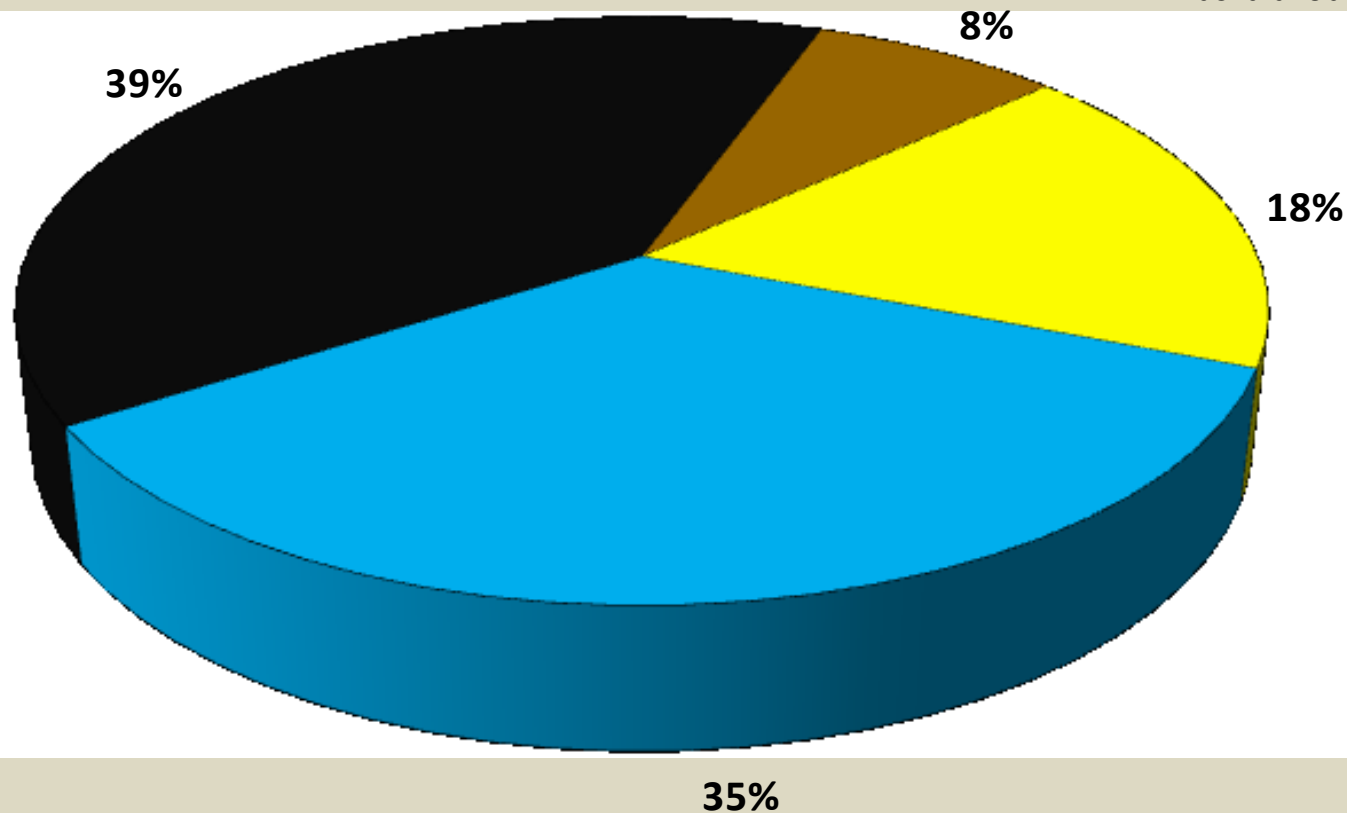
Germination in the Lab
Dormancy is fully
released after a period
of 4-5 months of
stratification at 5 °C



Germination characters

169 TREES OF THE GREEK FLORA

Daskalaku et al. 2018



■ Hardcoaters ■ Temperature (and light)-probers ■ Stratificationers ■ ? unavailable information

Stratificationers

65 Families / 200

Weakly determined by phylogeny

c. ??% of the Mediterranean Flora

A requirement of cold stratification is associated with:

LATE WINTER or

SPRING germination

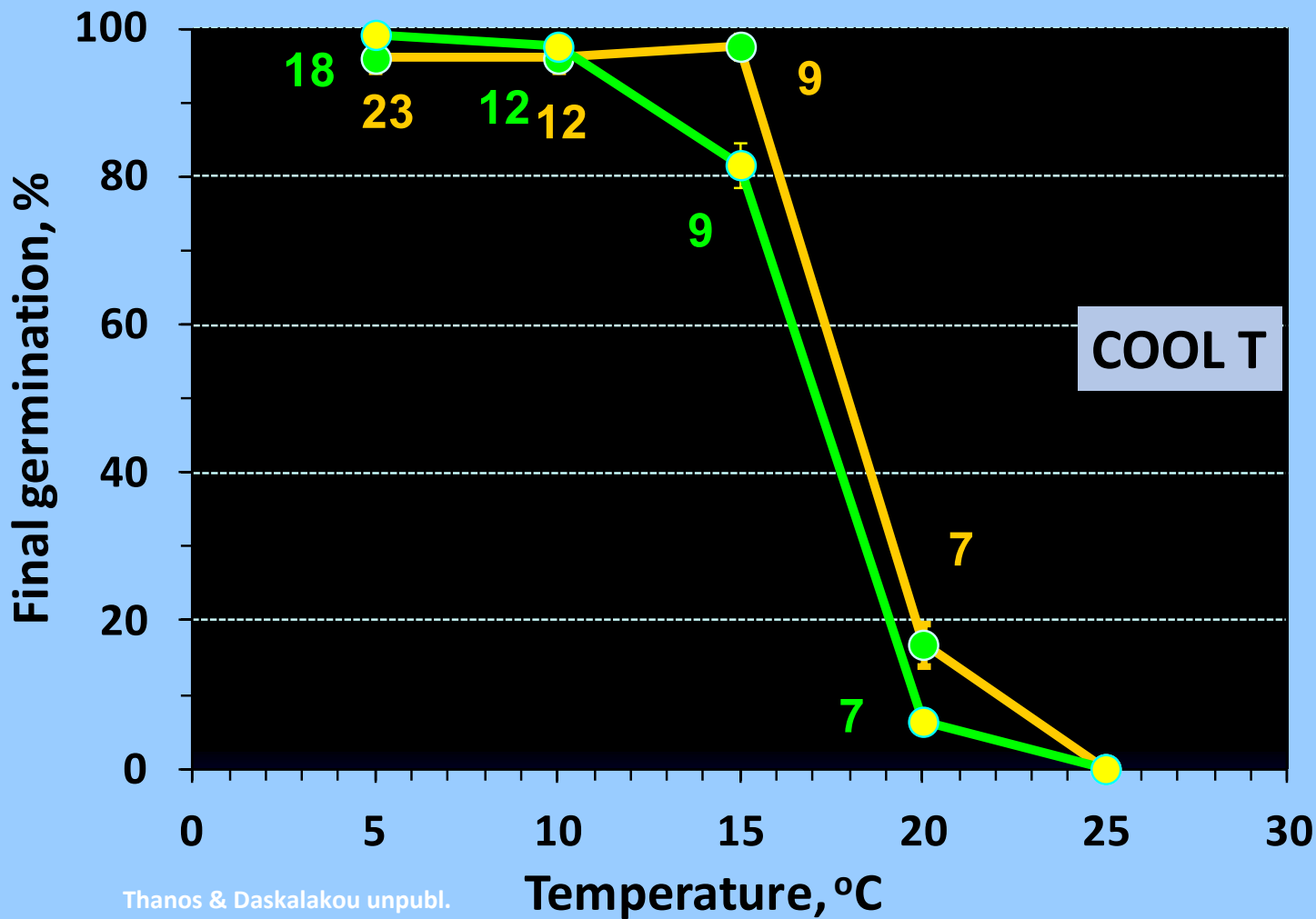
Increasingly more common with increasing altitude and latitude

Amaranthaceae	19
Asteraceae	76
Betulaceae	10
Boraginaceae	12
Brassicaceae	39
Caryophyllaceae	27
Cyperaceae	46
Ericaceae	28
Lamiaceae	42
Orobanchaceae	10
Plantaginaceae	14
Poaceae	39
Polygonaceae	14
Rosaceae	69
	445
total number	605

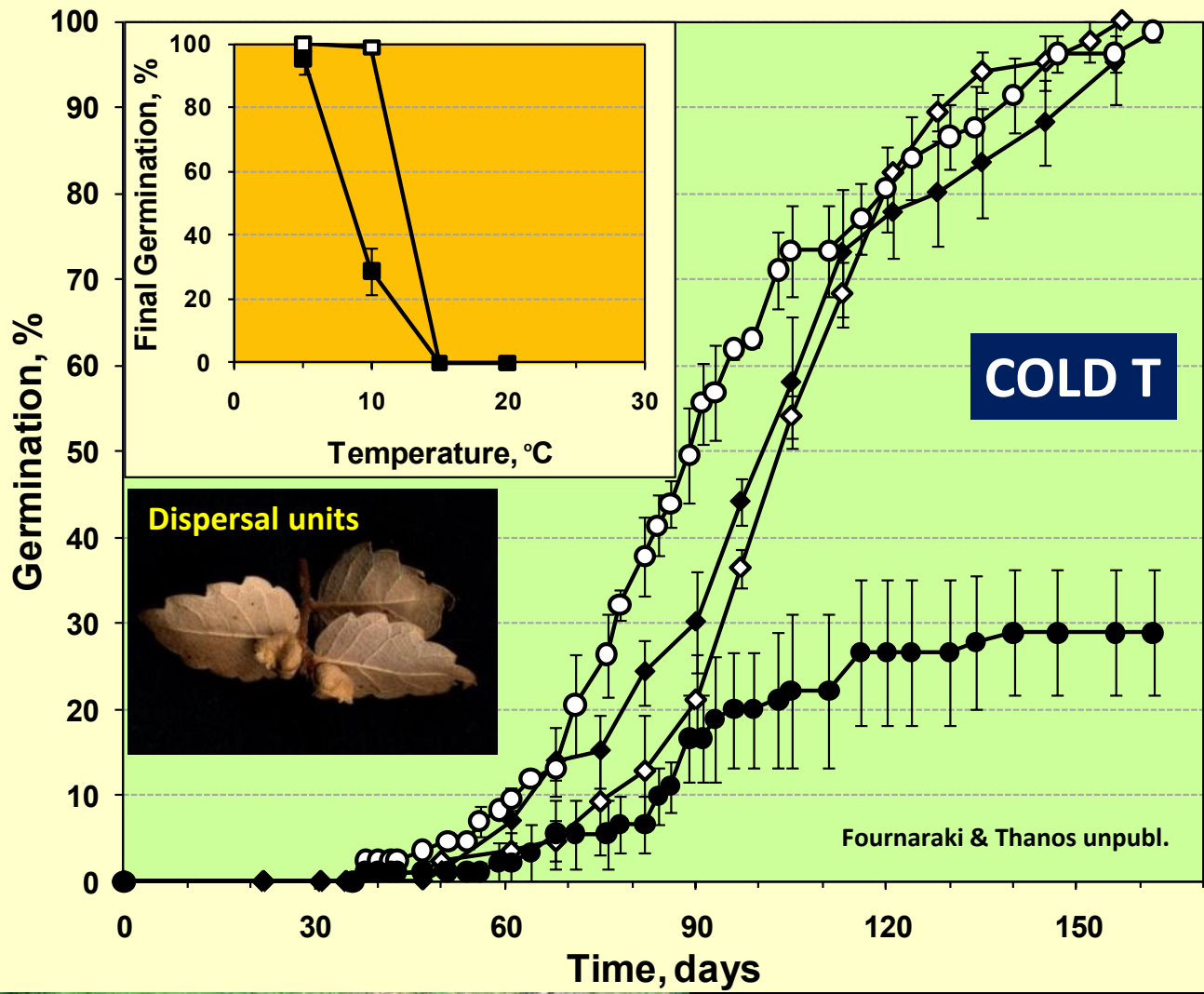
Temperature/light-probers

Seeds germinate under specific, optimal conditions of temperature and/or light

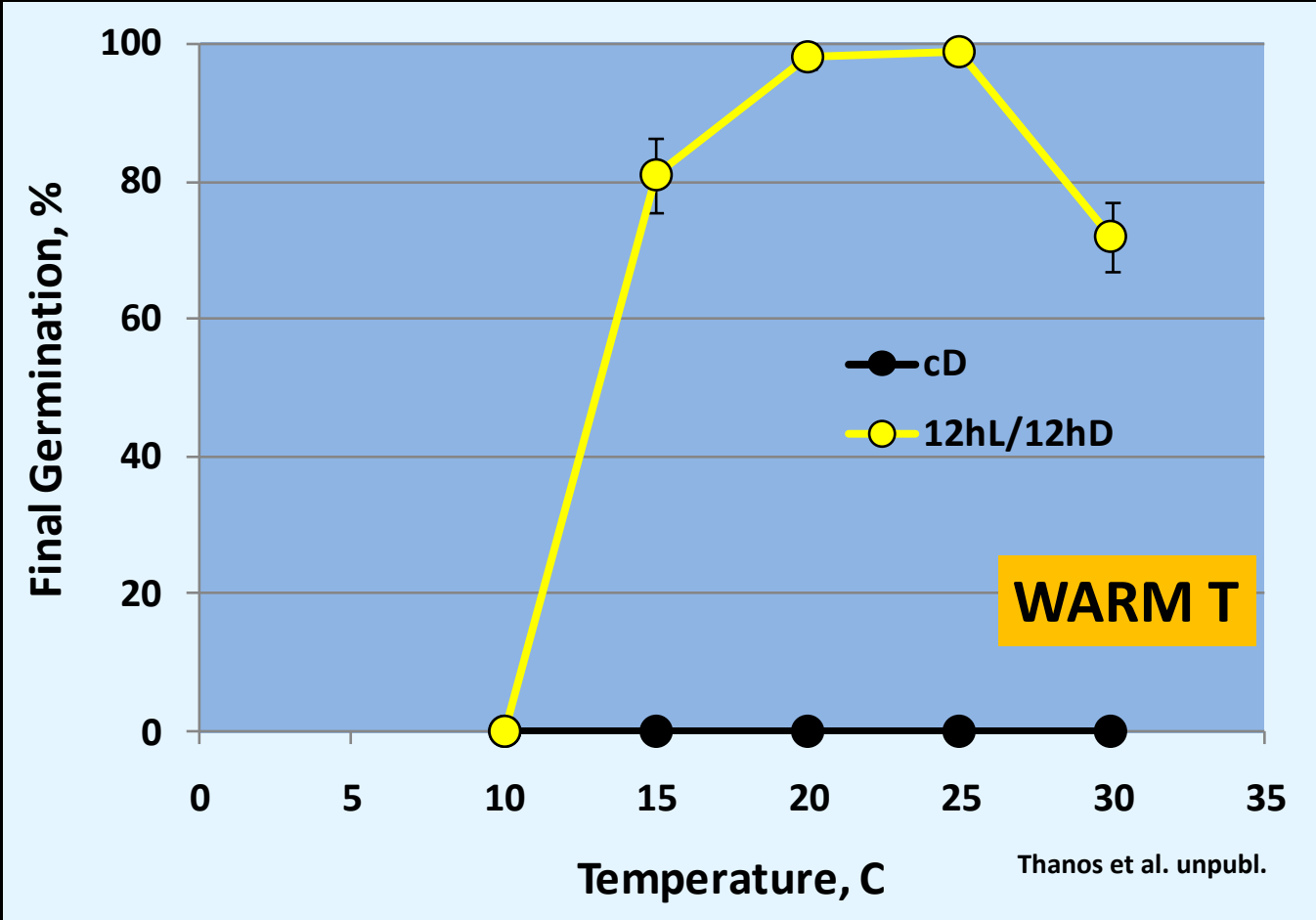
Consolida ajacis



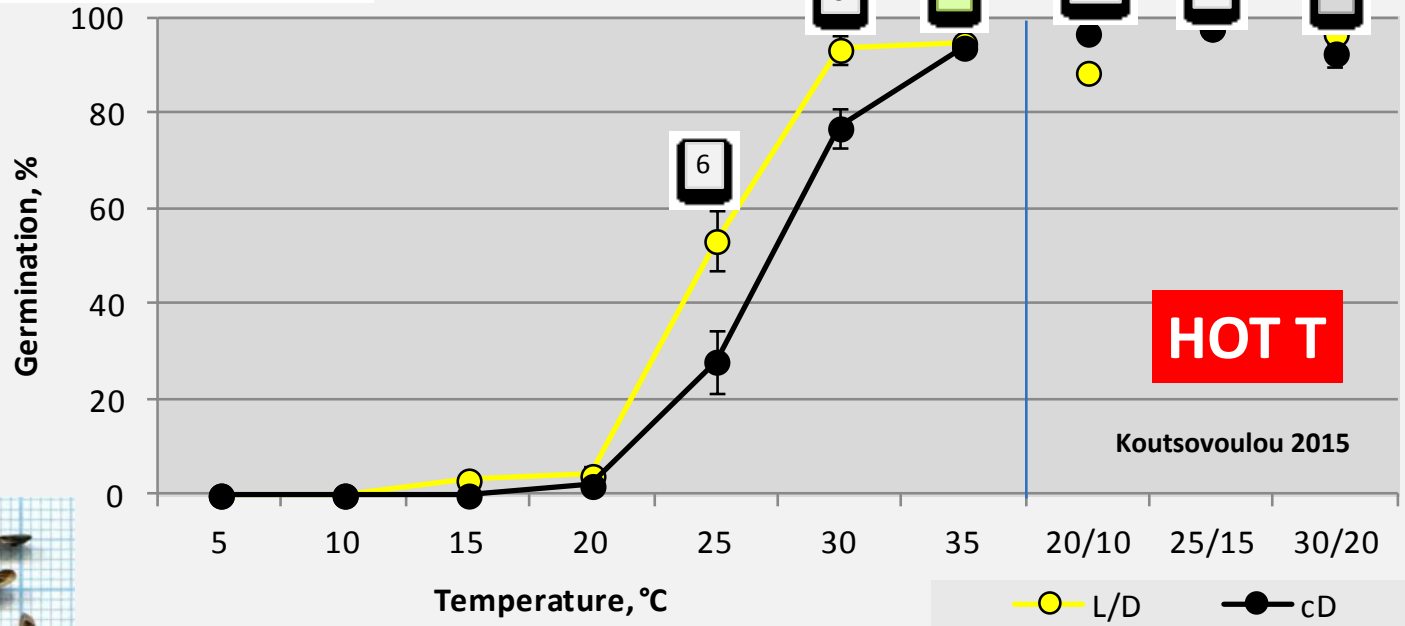
Zelkova abelicea



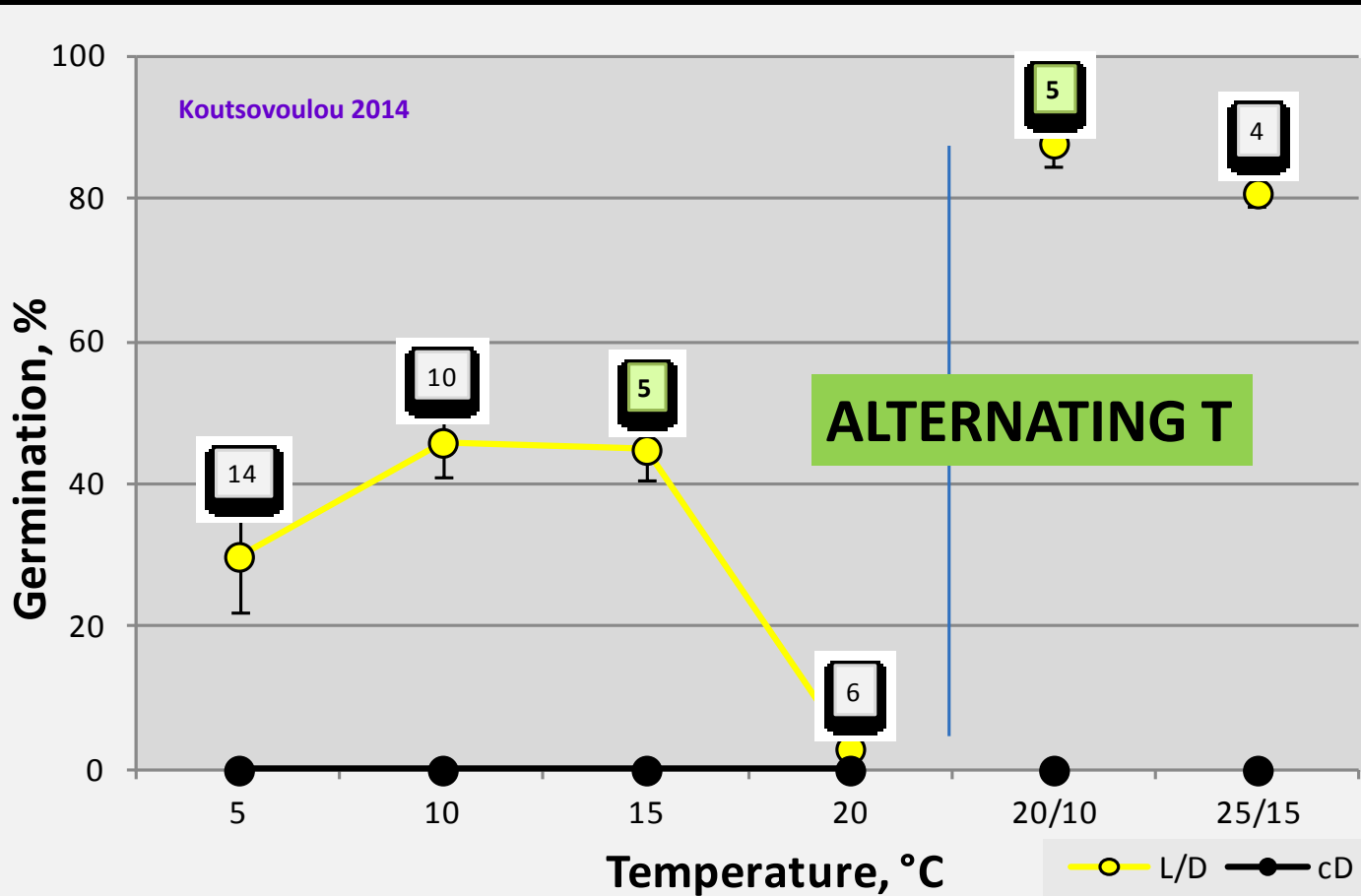
Nepeta sphaciotica
2300 m a.s.l.



Liquidambar orientalis



Campanula creutzburgii

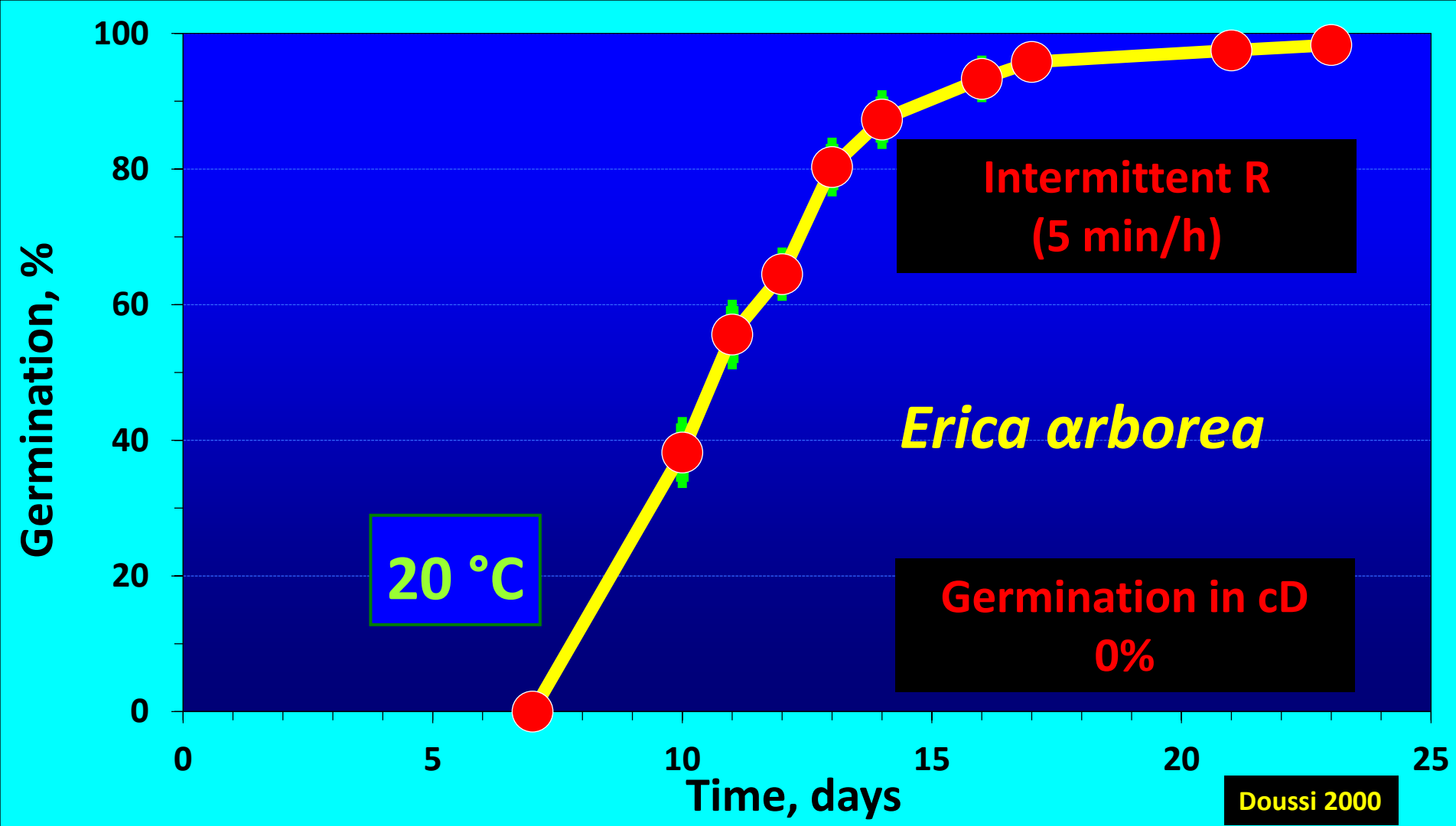


1. Absolute Light Requirement

Erica arborea

Dark
Germination
(5-25 C)
is nil



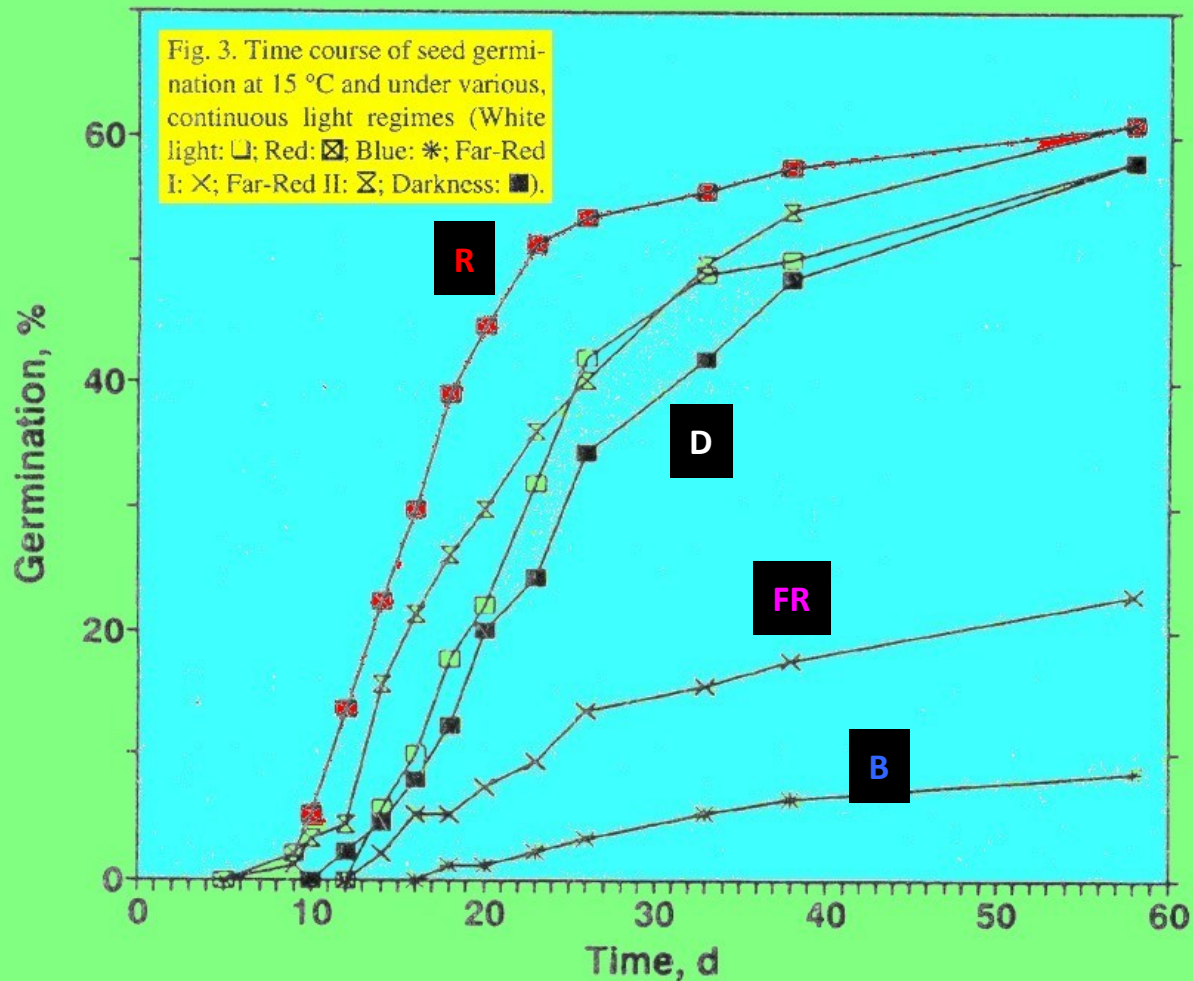


2. Partial Light Moderation promotion by R, inhibition by FR



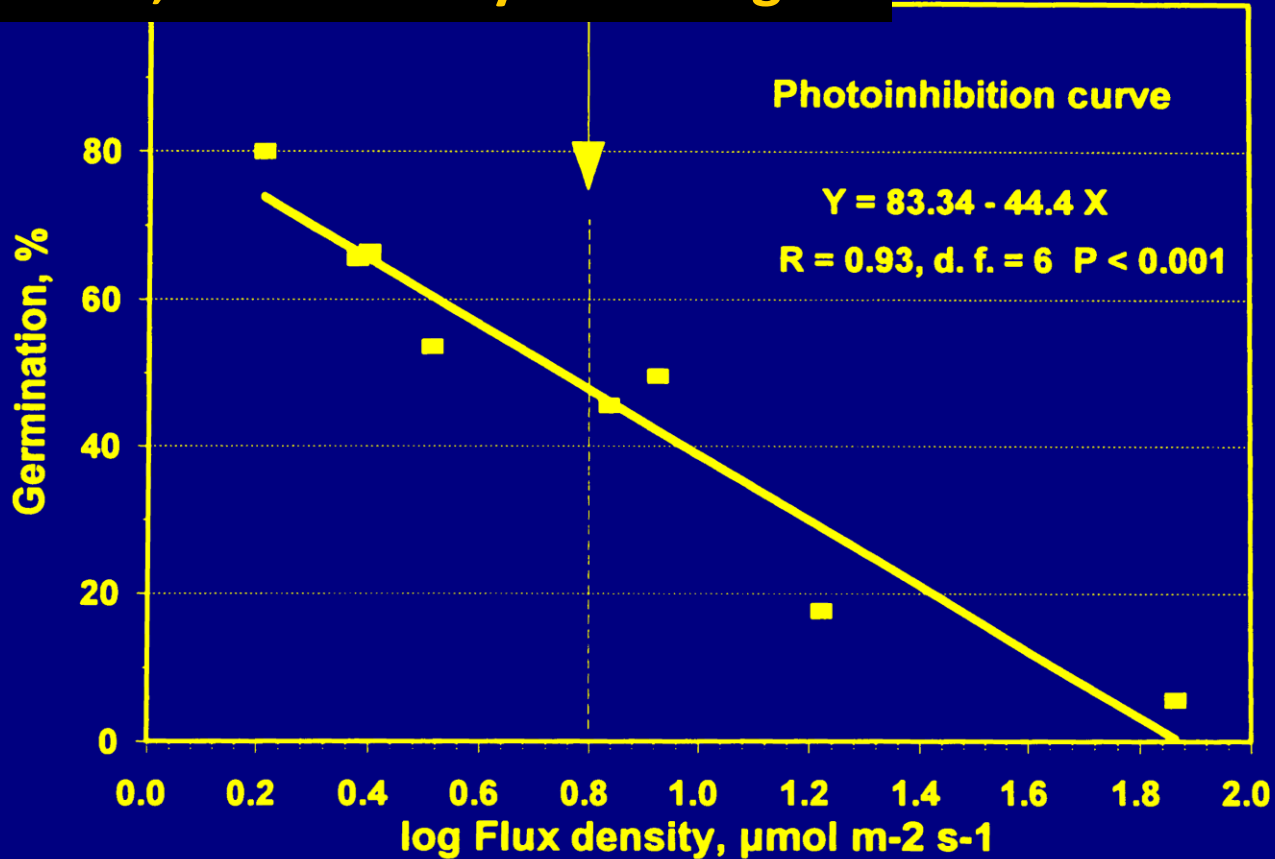
*Origanum
dictamnus*

Origanum dictamnus



3. Photoinhibition

germination in D, inhibition by White Light

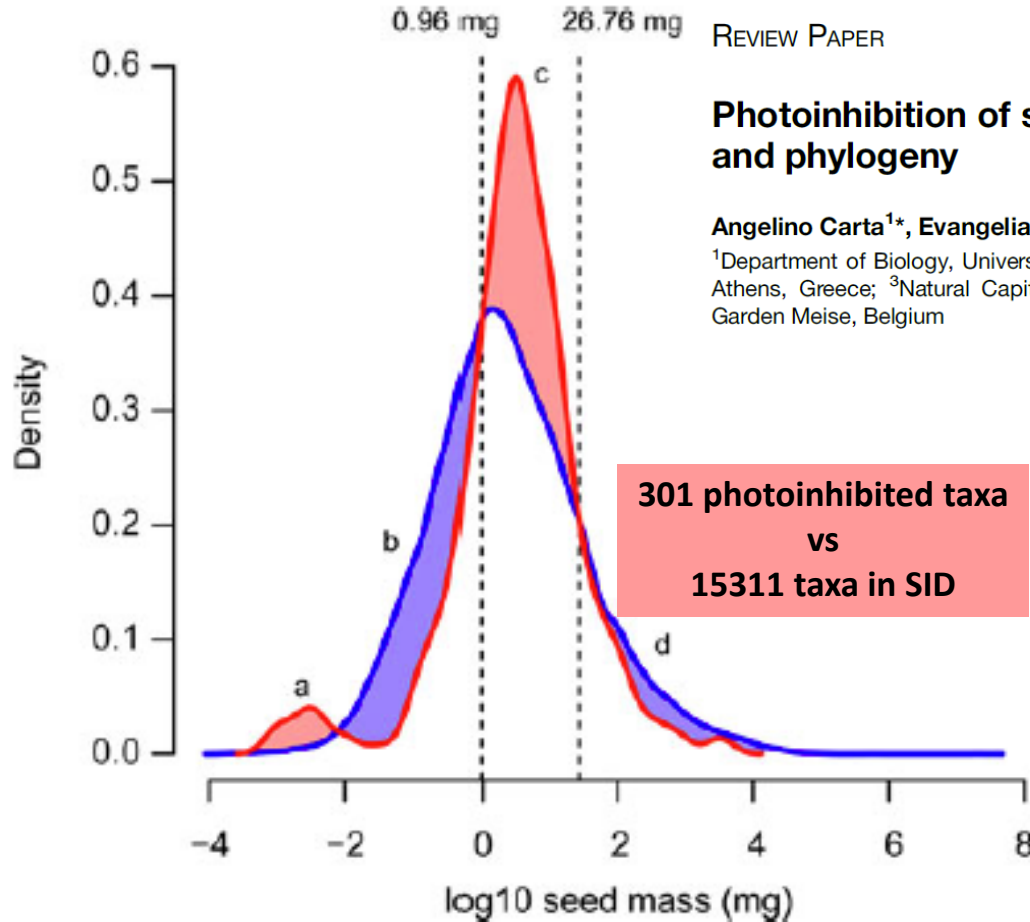


REVIEW PAPER

Photoinhibition of seed germination: occurrence, ecology and phylogeny

Angelino Carta^{1*}, Evangelia Skourti², Efisio Mattana³, Filip Vandeloos⁴ and Costas A. Thanos²

¹Department of Biology, University of Pisa, Italy; ²Department of Botany, National and Kapodistrian University of Athens, Greece; ³Natural Capital and Plant Health Department, Royal Botanic Gardens, Kew, UK; ⁴Botanic Garden Meise, Belgium



**An estimated 2% of the World Flora show
PHOTOINHIBITED SEED GERMINATION
4-5% in the Mediterranean Rim**

Figure 1. Kernel density estimates of seed mass for the world flora (blue line; Royal Botanic Gardens Kew, 2016) and for the photoinhibited flora (red line; present study). Both distributions are significantly different ($P < 0.001$ based on Kolmogorov–Smirnov two sample test). The vertical dashed lines correspond to seed mass thresholds separating seeds whose germination is light stimulated (< 0.96 mg), photoinhibited (> 0.96 and < 26.76 mg) and indifferent to light (> 26.76 mg). The red peak, coinciding approximately with 0.002 mg, corresponds to Orchidaceae and Orobanchaceae taxa. Red areas correspond to seed mass ranges where there is a higher representation of photoinhibited taxa than of the world flora, and blue areas to those where photoinhibited taxa are less represented.

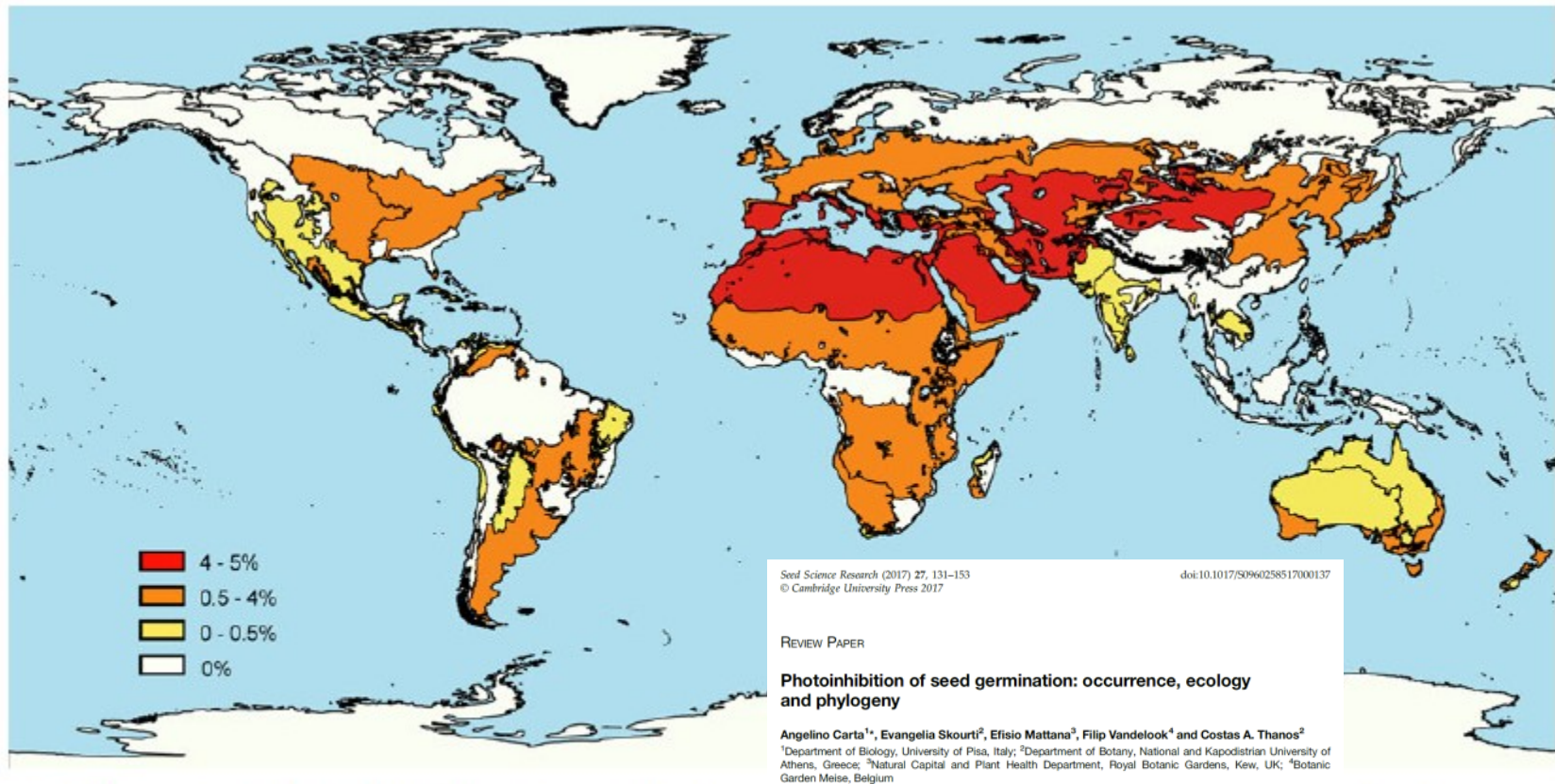


Figure 4. Percentage of photoinhibited taxa in each climatic region within each biogeographical realm (terrestrial ecoregions of the world; see Olson *et al.*, 2001) calculated based on plant richness estimates from Kier *et al.* (2005). Realms: Australasia, Antarctic, Afrotropics, IndoMalay, Nearctic, Neotropics, Oceania, Palearctic. Climatic regions: tropical humid, tropical dry, temperate humid, temperate montane, cold, tropical semi-arid, temperate semi-arid, montane, polar, mediterranean, arid.

Temperature/light-probers

31 Families / 200

Weakly determined by phylogeny
(INCOMPLETE data)

c. ??% of the Mediterranean Flora

Temperature (and light) detecting mechanisms are associated with TIMING OF GERMINATION in:

Autumn (cool T, mediterranean)

Winter (cold T, temperate and mountainous)

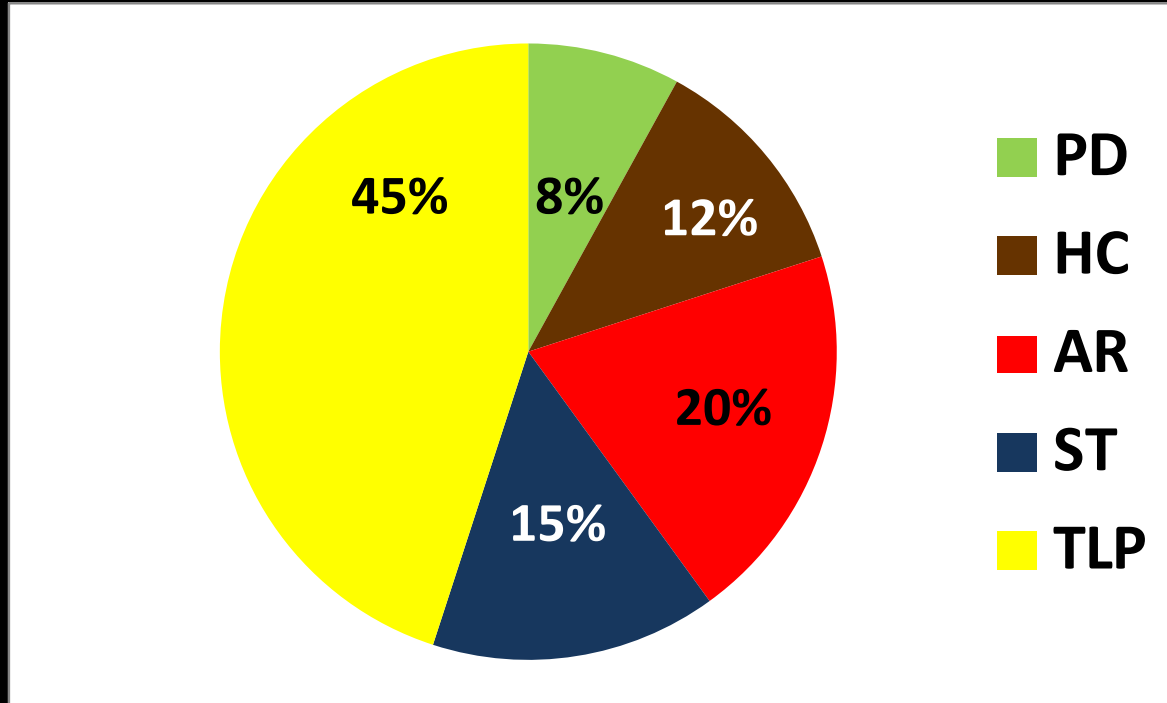
Spring (warm T, alpine and arctic)

Summer (hot T, mostly immigrants)

Amaranthaceae	7
Asteraceae	37
Fagaceae	8
Pinaceae	9
Poaceae	15
Polygonaceae	7
Salicaceae	16
	99
total number	155

5 Germination Characters

Estimate for the **MEDITERRANEAN**





ΠΟΛΛΑ ΣΠΙΤΑΚΑ
ΚΑΤΑΦΥΓΙΟ ΒΗΑΝΑΖΙΤΩΝ
MANY LITTLE HOUSES
HIDE FOR REBELS

Thank you!

2nd Mediterranean Plant Conservation Week
 "Conservation of Mediterranean Plant Diversity: Complementary Approaches and New Perspectives"
 14-16 June 2018, 10:30 - 16:00 2018



CIHEAM
MAI CHANIA



TRAINING TABLE