



GerminAR: análisis de la germinación

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Proceso de germinación

- En el proceso de germinación
 - la semilla es el de una unidad reproductiva
 - asegura la supervivencia de todas las especies de plantas
- Rol importante en la agricultura moderna
- Una comprensión fundamental de la germinación es esencial para lograr la máxima producción de cultivos



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Germinación

Definiciones

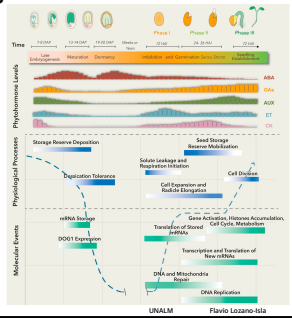
- Fisiólogos
 - Emergencia de la radícula a través de la cubierta de la semilla
- Analista de semillas
 - La emergencia y desarrollo a partir del embrión de la semilla
 - Estructuras esenciales
 - Capacidad de producir una planta normal

Samples	Germination Time, [Days]		
	0	2	4
Bean			
Lentil			
Lupine			
Chickpea			
Soybean			

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Proceso de germinación

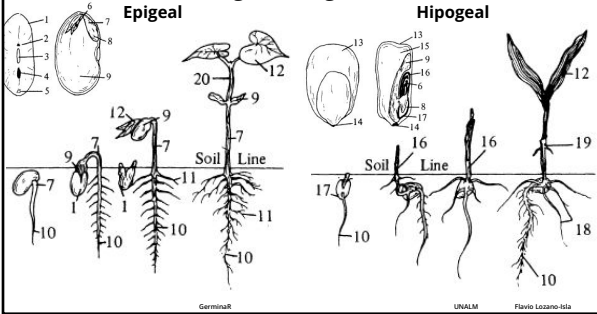
- Procesos en la germinación de semillas
 - Molecular
 - Bioquímico
 - Fisiológico
- Ácido abscísico (ABA):
 - maduración del embrión
 - Inducción y manutención de la dormancia
- Giberelinas (GAs):
 - Liberación de la dormancia
 - Germinación
- Etileno (ET):
 -



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Morfología de la germinación

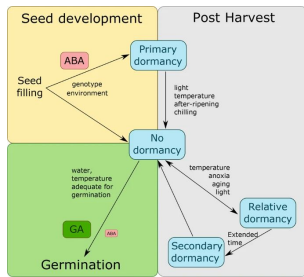


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Requerimientos para la germinación

- Madurez de la semilla
- Factores ambientales
 - Agua
 - Aire
 - Temperature
 - Luz
 - Intensidad
 - Calidad



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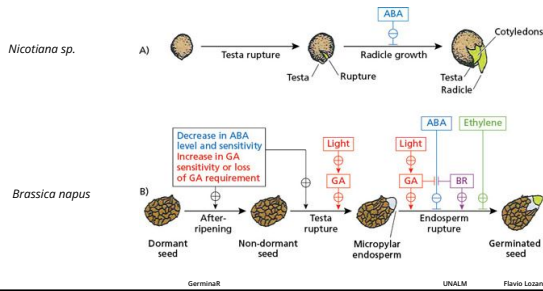
Factores que pueden afectar la germinación

- Presión osmótica
- Concentración de Ion-Hidrógeno (pH)
- Imbibición (presoaking)
- Bajas temperaturas
- Radiación
- Daño mecánico



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Germinación de semillas: regulación hormonal



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Importancia de las semillas



Seed&C, a global archive of primary seed germination data
 Eduardo Fernández-Pascual, Angélica Carra, Sergey Rudstam, Lydia Gáza, Shyam S. Phangul, Fernando O. Quere, SCORING Data Unit, Luciano Borge, Inmaculada Pérez

SEARCH | PDF | TOOLS | SHARE

The Svalbard Seed Vault and Crop Security
 Cary Fowler | Author Notes
 BioScience, Volume 58, Issue 3, March 2008, Pages 190–191,
<https://doi.org/10.1641/B580302>
 Published: 01 March 2008

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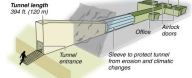
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Doomsday seed vault

A global archive vault that stores seeds from all known varieties of food crops

Why needed?
 Protect seeds against pest diseases and crop/infestations such as nuclear war, drought, strikes and climate change

Storage
 Storage facility situated 120 m, 1100 m below ground sea level, with 1200 tonnes and 1.5 million seeds and 1.5 million seeds due to global warming



Capacity
 Up to 4.5 million samples

Permanence
 Temperature will stabilize at 0°C (-18°C) by electrolytically powered heaters and in case of electrical breakdown, temperature will never exceed 2°C (+4°C)

Construction
 Began in March 2002, 100 m long, 10 m wide, 10 m high, near Longyearbyen

Source: Svalbard Norway © 2008 NCI

GerminaR

GerminaR

GerminaR is a platform base in open source R package to calculate and graphic the main germination indices. GerminaR include a web application called "GerminaQuant for R" for interactive analysis.

Installation

You can install the released version of GerminaR from [CRAN](#) with:

```
install.packages("GerminaR")
```

How to cite this article: Lozano-Isla F, Benites-Alfaro OE, Pompelli MF. GerminaR: An R package for germination analysis with the interactive web application "GerminaQuant for R." *Ecol Res.* 2019; 34:339-346. <https://doi.org/10.1111/11440-1703.1275>


TECHNICAL REPORT
GerminaR: An R package for germination analysis with the interactive web application "GerminaQuant for R"
 Flavio Lozano-Isla, Omar E. Benites-Alfaro, Marcelo F. Pompelli
 First published: 20 March 2019 | <https://doi.org/10.1111/11440-1703.1275> | Citations: 39

- Open source R package
- Calculate and graphic the main germination indices
- Include a web application called "GerminaQuant for R" for interactive analysis

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GerminaQuant para R

- Aplicación web interactiva
 - GerminaR
 - Shiny
- Calcula los índices de germinación
- Calculadora de NaCl y PEG 6000

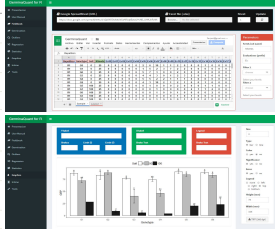


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GerminaQuant para R

Modulos

Module	Description
Presentation	Presentation of the package and the application with their principal characteristics and information
Fieldbook	Interface to upload the data from germination data and choose the parameter for the analysis. Allows to upload the data from google sheet or excel file
Germination	Table with the indices calculated from the germination data
Exploratory	Interface to explore your data and their distribution using boxplot graphics
Statistics	Interface to perform the statistical analysis according the experimental design. Allows to calculate the analysis of variance, summary statistics, mean comparison table and model diagnostic
Graphics	Plot the mean comparison table from the Statistics module. Allows to customized the results using bar or line plot
kTime	Plot the germination process in time selecting one of the factor from your experiment. Allows to customized the results using line plot
Tools	Tool for calculate the osmotic potential for any salt or PEG solution

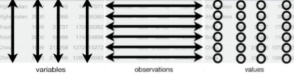


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Preparación de libro de campo

Organización de los datos

Repetition	Genotype	Salt	Weeks	Tr0	Tr1	Tr2	Tr3	Tr4	Tr5	Tr6	Tr7	Tr8	Tr9	Tr10
R11	G5	0	25	0	0	0	0	0	2	5	9	0	1	2
R11	G1	0	25	0	0	0	0	0	1	5	2	0	1	2
R11	G4	0	25	0	0	0	0	0	3	7	3	0	0	2
R11	G3	0	25	0	0	0	0	0	4	4	3	0	1	2
R11	G4	0	25	0	0	0	0	0	3	5	2	2	1	1
R11	G4	0	25	0	0	0	0	0	4	3	5	2	1	2
R11	G5	100	25	0	0	0	0	0	1	0	0	0	0	2
R11	G1	100	25	0	0	0	0	0	1	0	0	0	0	2



- Rojo: los factores (factores)
- Verde: N° semillas (numerico)
- Azul: evaluaciones (numerico)

Colección de datos

- Puede evaluarse en distintos lapsos de tiempos (i.e horas, días, semanas o meses)
- La base de datos debe iniciar en el tiempo cero
- La evaluación debe ser individual por cada periodo
 - NO debe ser acumulativa

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Prosopis: base de datos

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	rep	nacl	temp	seeds	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
2	1	0	25	50	0	39	8	3	0	0	0	0	0	0	0
3	2	0	25	50	0	40	9	1	0	0	0	0	0	0	0
4	3	0	25	50	0	34	16	0	0	0	0	0	0	0	0
5	4	0	25	50	0	43	7	0	0	0	0	0	0	0	0
6	1	0	30	50	0	48	2	0	0	0	0	0	0	0	0
7	2	0	30	50	0	47	3	0	0	0	0	0	0	0	0
8	3	0	30	50	0	50	0	0	0	0	0	0	0	0	0
9	4	0	30	50	0	46	1	0	0	0	0	0	0	0	0
10	1	0.5	25	50	0	10	37	1	2	0	0	0	0	0	0
11	2	0.5	25	50	0	18	30	1	1	0	0	0	0	0	0
12	3	0.5	25	50	0	6	44	0	0	0	0	0	0	0	0
13	4	0.5	25	50	0	8	42	0	0	0	0	0	0	0	0
14	1	0.5	30	50	0	45	5	0	0	0	0	0	0	0	0
15	2	0.5	30	50	0	42	8	0	0	0	0	0	0	0	0
16	3	0.5	30	50	0	46	4	0	0	0	0	0	0	0	0
17	4	0.5	30	50	0	47	3	0	0	0	0	0	0	0	0
18	1	1	25	50	0	0	22	20	6	0	0	0	0	0	0
19	2	1	25	50	0	0	27	8	13	0	0	0	0	0	0
20	3	1	25	50	0	3	27	6	11	0	0	0	0	0	0

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Indices de germinación

Variables	abbreviation	units	limits
Germinated seeds	grs	count	$0 \leq grs \leq n_i$
Germinability	grp	%	$0 \leq grp \leq 100$
Mean germination time	mgt	time	$0 \leq mgt \leq k$
Mean germination rate	mgr	$time^{-1}$	$0 < mgr \leq 1$
Germination speed	gsp	%	$0 < gsp \leq 100$
Uncertainty Index	unc	bit	$0 \leq unc \leq \log_2 n_i$
Synchronization Index	syn	-	$0 \leq syn \leq 1$
Germination variance	vgt	$time^2$	$0 < vgt \leq \infty$
Germination standard deviation	sdg	time	$0 < sdg \leq \infty$
Coefficient of variation	cvg	%	$0 < cvg \leq \infty$

According to Ranal and Santana (2006)

- n_i is the number of seeds germinated in i^{th} time
- K is the last day of the evaluation process for germination

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