SUPPLEMENTARY MATERIAL (I)

Details of the climatic and soil conditions of the fields in which the emergences were recorded.
Note**:** This table complements Table 1 of the manuscript.

Location	Year	Latitude	Longitude	Texture	Annual precipitation	Annual temperature
Huelva1	2008					
Huelva2	2008					
Arganda	2005, 2006	40º19’ N	3º29’ W	Loam	461	13.5
Golega[+]	2006	39º20’ N	8º32’ W	Sandy loam	707	16.3
La Roca1	2006, 2007	41°34’ N	2°18’ E	Sandy loam	501	14.3
La Roca2	2008	41º34’ N	2º18’ E	Sandy loam	718	14.0
La Roca3	2009	41º34’ N	2º18’ E	Sandy loam	529	14.6
Miralcamp	2010	41°36' N	0°53' E	Sandy loam	427	13.2
Mollerussa	2010	41°37' N	0°54' E	Sandy loam	427	13.2
Albacete	2007, 2008	38º59’ N	1º51’ W	Sandy clay loam	353	14.3
Calaf	2006, 2007, 2008	41º45’ N	1º31’ E	Silt loam	273	11.8
El Encín	2008	40⁰28’ N	3º21’ W	Silt loam	291	14.7
Huelva	2006	37º17’ N	6º55’ W	Silt loam	233	18.2
Igualada	2006, 2007, 2008	41º34’ N	1º37’ E	Silt loam	331	13.8
Murillo	2008	42º23’ N	1º37’ W	Loam	82	12.6
Tajonar	2008	42º46’N	1º36’W	Loam	88	12.6

The number after the location indicates different field in the same location.

When a location has several years of datasets, the anual precipitation and temperature are the average of those years.

SUPPLEMENTARY MATERIAL (II)

Some examples of the calculations of the differential approach applied to the emergence of *Papaver rhoeas* at Igualada 2008.

A. Applying numerical filters to smooth the data of the emergence and the rate of increase (numerical derivative).

A1. Starting the iterations with the weekly emergences and the accumulated hydrothermal time in growing degree-days (GDD).

Week	Emergence[1] (pl/m2) (E_i)	Hydrothermal time (GDD) (^0C)	Smoothed emergence[2] (pl/m^2) ($\bar{E}_i$)	Derivative of smoothed emergence[3] (pl/m^2.GDD) ($d\bar{E}_i$)	Smoothed derivative (pl/m^2.GDD) ($\overline{dE_i}$)	Specific emergence rate (GDD)$^{-1}$ (ER)	Ln $\bar{E}_i$ (pl/m^2)
			First iteration				
0	0.0	0					
1	1.8	32	17.45				
2	50.5	60	51.12	1.782			
3	101.0	75	93.05	2.293	1.788	0.019	4.533
4	127.6	92	125.50	1.290			
5	147.8	119	149.99				
6	174.5	142					
			Second iteration				
0	0.0	0					
1	1.8	32	17.45				
2	50.5	60	51.12	1.782			
3	101.0	75	93.05	2.293	1.788	0.019	4.533
4	127.6	92	125.50	1.290	1.494	0.012	4.832
5	147.8	119	149.99	0.898			
6	174.5	142	170.19				
7	188.2	189					
			Third iteration				
0	0.0	0					
1	1.8	32	17.45				
2	50.5	60	51.12	1.782			
3	101.0	75	93.05	2.293	1.788	0.019	4.533
4	127.6	92	125.50	1.290	1.494	0.012	4.832
5	147.8	119	149.99	0.898	0.891	0.006	5.011
6	174.5	142	170.19	0.485			
7	188.2	189	184.27				
8	190.1	227					

[1] Emergence at week *i*: E_i

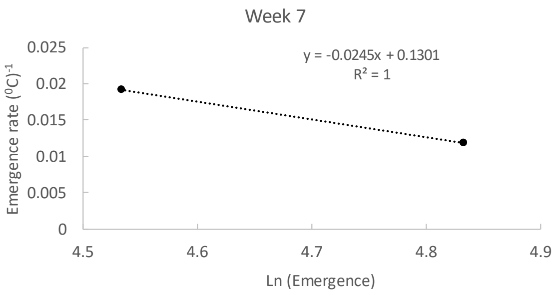
[2] Smoothed emergence at week *i*: $\bar{E}_i = \frac{E_{i-1}+E_i+E_{i+1}}{3}$

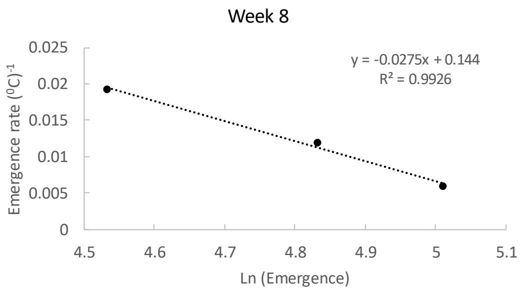
[3] Derivative of smoothed emergence at week *i*: $d\bar{E}_i = \frac{\bar{E}_{i+1}-\bar{E}_{i-1}}{t_{H,i+1}-t_{H,i-1}}$

[4] Smoothed derivative at week *i*: $\overline{dE_i} = \frac{d\bar{E}_{i-1}+d\bar{E}_i+d\bar{E}_{i+1}}{3}$

[5] Specific emergence rate at week *i*: $ER = \frac{\overline{dE_i}}{\bar{E}_i}$

A2. Obtaining the first two linear regressions ($A = -mB + n$) between the specific emergence rate (ER= A) and the natural logarithm of the smoothed emergence (Ln $\overline{E_\iota}$=B) for the two available data points at the end of week 7 and the three available data points at the end of week 8.





A3. Obtaining the maximum expected seedling emergence (*K*) in the field.

Week 7: $m = 0.0245 \quad n = m\,Ln(K) \quad 0.1301 = 0.0245\,Ln(K) \quad K = 204.15\ \text{pl/m}^2$

Week 8: $m = 0.0275 \quad n = m\,Ln(K) \quad 0.1440 = 0.0275\,Ln(K) \quad K = 189.01\ \text{pl/m}^2$

These steps are repeated for every new week of counts, obtaining new values of the expected maximum seedling emergence *K*.

A4. The iterations stopped when the numerical derivative of the smoothed emergence dropped below the threshold of 0.03 (in week 11 in this case and after six iterations).

Week	Emergence[1] (pl/m²) (E_i)	Hydrothermal time (GDD) (⁰C)	Smoothed emergence[2] (pl/m²) ($\overline{E_\iota}$)	Derivative of smoothed emergence[3] (pl/m².GDD) ($d\overline{E_\iota}$)	Smoothed derivative (pl/m².GDD) ($\overline{d\overline{E}_\iota}$)	Specific emergence rate (GDD)⁻¹ (*ER*)	Ln $\overline{E_\iota}$ (pl/m²)
			Sixth iteration				
0	0.0	0					
1	1.8	32	17.45				
2	50.5	60	51.12	1.782			
3	101.0	75	93.05	2.293	1.788	0.019	4.533
4	127.6	92	125.50	1.290	1.494	0.012	4.832
5	147.8	119	149.99	0.898	0.891	0.006	5.011
6	174.5	142	170.19	0.485	0.538	0.003	5.137
7	188.2	189	184.27	0.230	0.262	0.001	5.216
8	190.1	227	189.78	0.070	0.103	0.001	5.246
9	191.0	281	190.69	0.010			
10	191.0	346	191.00				
11	191.0	404					

[1] Emergence at week *i*: E_i

[2] Smoothed emergence at week *i*: $\overline{E_\iota} = \frac{E_{i-1}+E_i+E_{i+1}}{3}$

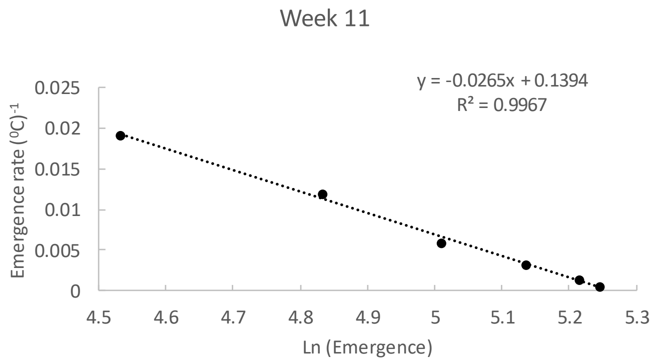
[3] Derivative of smoothed emergence at week *i*: $d\overline{E_\iota} = \frac{\bar{E}_{i+1}-\bar{E}_{i-1}}{t_{H,i+1}-t_{H,i-1}}$

[4] Smoothed derivative at week *i*: $\overline{dE_i} = \frac{d\bar{E}_{i-1}+d\bar{E}_i+d\bar{E}_{i+1}}{3}$

[5] Specific emergence rate at week *i*: $ER = \frac{\overline{dE_i}}{\overline{E_\iota}}$

After counting the emergence at the end of week eleven we observe that the derivative of the smoothed emergence drops to 0.01, which is below the threshold of 0.03 and even the threshold of 0.05. Consequently, we consider that the maximum emergence is already reached (191 pl/m^2) and we stop the counts. Note that the field had no emergences since week 9.

A5. Obtaining the last linear regression ($A = -mB + n$) between the specific emergence rate (ER $= A$) and the natural logarithm of the smoothed emergence ($\ln \overline{E_\iota} = B$) for the six data points available at the end of week 11.



A6. Obtaining the maximum expected seedling emergence (*K*) in the field at week 11.

$$m = 0.0265$$

$$n = m\ Ln(K) \qquad 0.1394 = 0.0265\ Ln(K) \qquad K = 192.7\ pl/m^2$$

According to the differential model, the expected number of emergences were 192.7 pl/m^2. The seedling population in the field was 191 pl/m^2 at this moment. The prediction was considered accurate because the difference between the predicted and the actual value was less than 10%.

B. Applying numerical filters to smooth the rate of increase of the emergences (numerical derivative).

B1. Summary of all iterations with the weekly emergences and the accumulated hydrothermal time in growing degree-days (GDD). Iterations are ceased when the derivative of emergence reached the threshold of 0.03.

Week	Emergence[1] (pl/m2) (E_i)	Hydrothermal time (GDD) (^{0}C)	Derivative of emergence[3] (pl/m^2.GDD) ($d\overline{E}_i$)	Smoothed derivative (pl/m^2.GDD) ($\overline{dE_i}$)	Specific emergence rate (GDD)$^{-1}$ (*ER*)	Ln $\overline{E}_i$ (pl/m^2)
0	0.0	0				
1	1.8	32	0.85			
2	50.5	60	2.34	1.85	0.036	3.922
3	101.0	75	2.38	1.93	0.019	4.615
4	127.6	92	1.06	1.46	0.011	4.849
5	147.8	119	0.94	0.86	0.006	4.996
6	174.5	142	0.57	0.57	0.003	5.162
7	188.2	189	0.18	0.26	0.001	5.238
8	190.1	227	0.03			
9	191.0	281				

[1] Emergence at week *i*: E_i

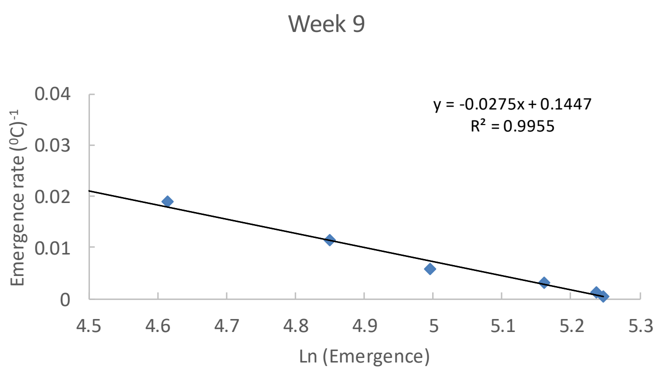
[2] Smoothed emergence at week *i*: $\overline{E}_i = \frac{E_{i-1}+E_i+E_{i+1}}{3}$

[3] Derivative of smoothed emergence at week *i*: $d\overline{E}_i = \frac{\overline{E}_{i+1}-\overline{E}_{i-1}}{t_{H,i+1}-t_{H,i-1}}$

[4] Smoothed derivative at week *i*: $\overline{dE_i} = \frac{d\overline{E}_{i-1}+d\overline{E}_i+d\overline{E}_{i+1}}{3}$

[5] Specific emergence rate at week *i*: $ER = \frac{\overline{dE_i}}{\overline{E}_i}$

B2. Linear regression ($A = -mB + n$) between the specific emergence rate (ER) and the natural logarithm of the emergence (ln $\overline{E}_i$) for the six data points available at the end of week 9.



B3. Obtaining the maximum expected seedling emergence (*K*) in the field at week 11.

$$m = 0.0265$$

$$n = m\,Ln(K) \qquad 0.1394 = 0.0265\,Ln(K) \qquad K = 192.7\ pl/m^2$$

According to the differential model, the expected number of emergences were 192.7 pl/m^2. The seedling population in the field was 191 pl/m^2 at this moment. The prediction was considered accurate because the difference between the predicted and the actual value was less than 10%.