



International Ragweed Society

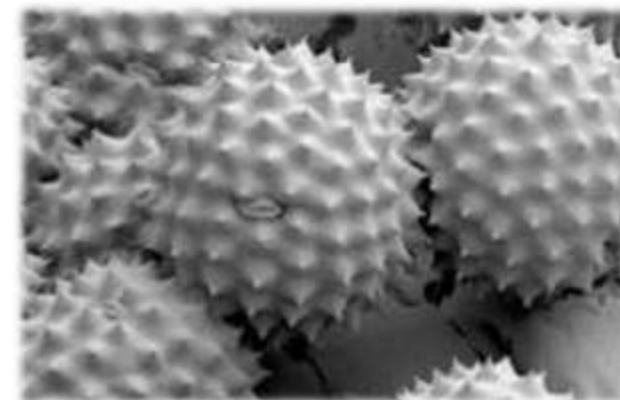


## INTERNATIONAL RAGWEED SYMPOSIUM

# *Can photoperiod parameter limit the northward expansion of Ragweed?*

Michel Thibaudon – Samuel Monnier – Fanny Vasseur

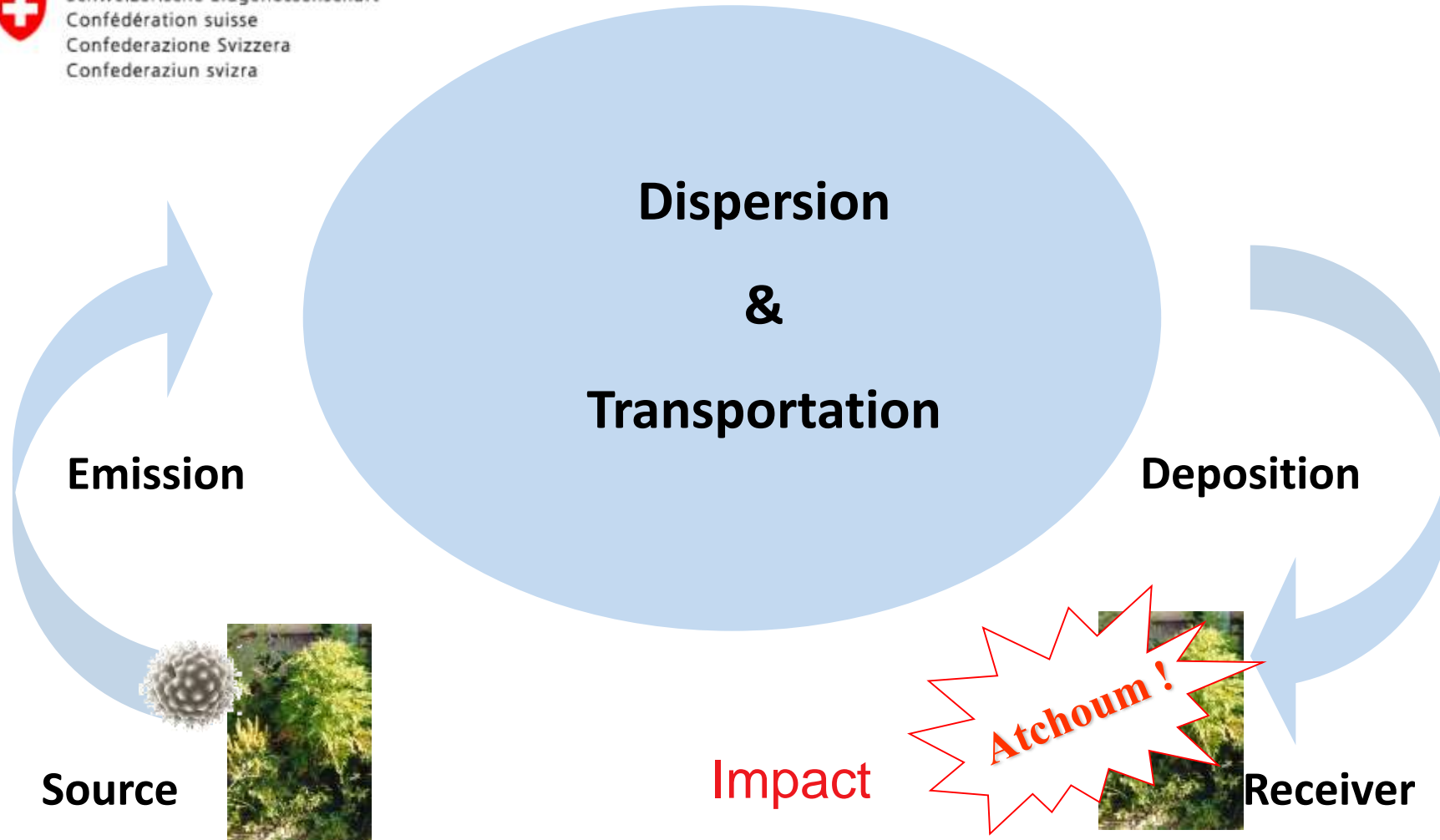
RNSA



# Aerobiology: a multidisciplinary approach



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra



# RNSA presentation

RNSA is the French aerobiology network responsible for analyzing biological particles in the air, and giving some information about their health impact.



The coordination center and training RNSA is located at Brussieu (69) in the heart of the Monts du Lyonnais, 40 km west of Lyon.

# ***Ambrosia artemisiifolia***

- Species of the **Asteraceae** family

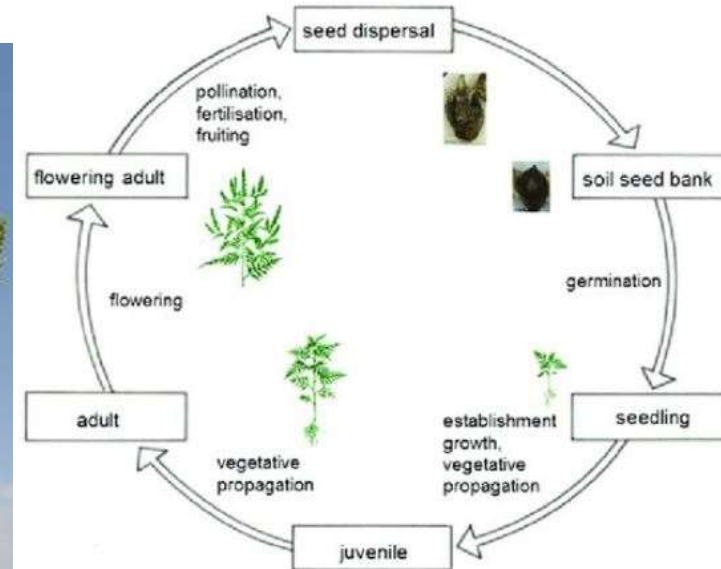
Daisy, Groundsel, Sunflower,  
wormwood

## **- Annual species**

maintenance of the species in an  
environment related to its  
reproductive success

## **- Invasive Exotic Species**

a species native to North America  
a species capable of breeding in  
our latitudes (45°N)  
a large production of mature  
seeds





# Ragweed Health Impact



# Pollen allergy

The **World Health Organization (WHO)** classifies allergic diseases as the **fourth** largest **disease** in the world and considers them to be "**a major public health problem in terms of quality of life, lost working days or teaching , drug costs, even mortality.** “

- Since the 2000s, pollen allergies affect **10 to 15%** of the world's population. According to a WHO estimate, they could reach **50%** of the world's population in less than ten years.
- In the **Rhône-Alpes region 13 to 21%** of the exposed population is allergic to ragweed (Rhône-Alpes ORS study)

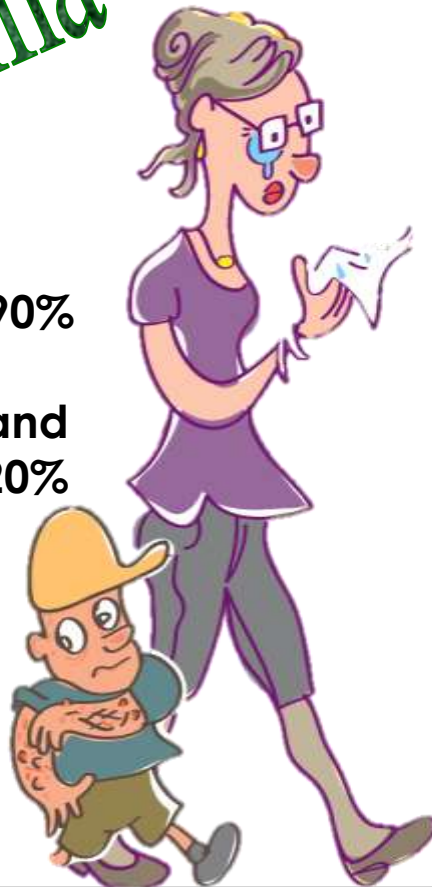
# Pollen allergy

*Asthma*

Rhinitis 90%

Urticaria and  
eczema 20%

*I am itchy*



*Conjunctivitis*

*I weep  
for  
its prick*

Conjunctivitis 75%

*I cough*

Tracheitis, asthma  
50%



# Photoperiod

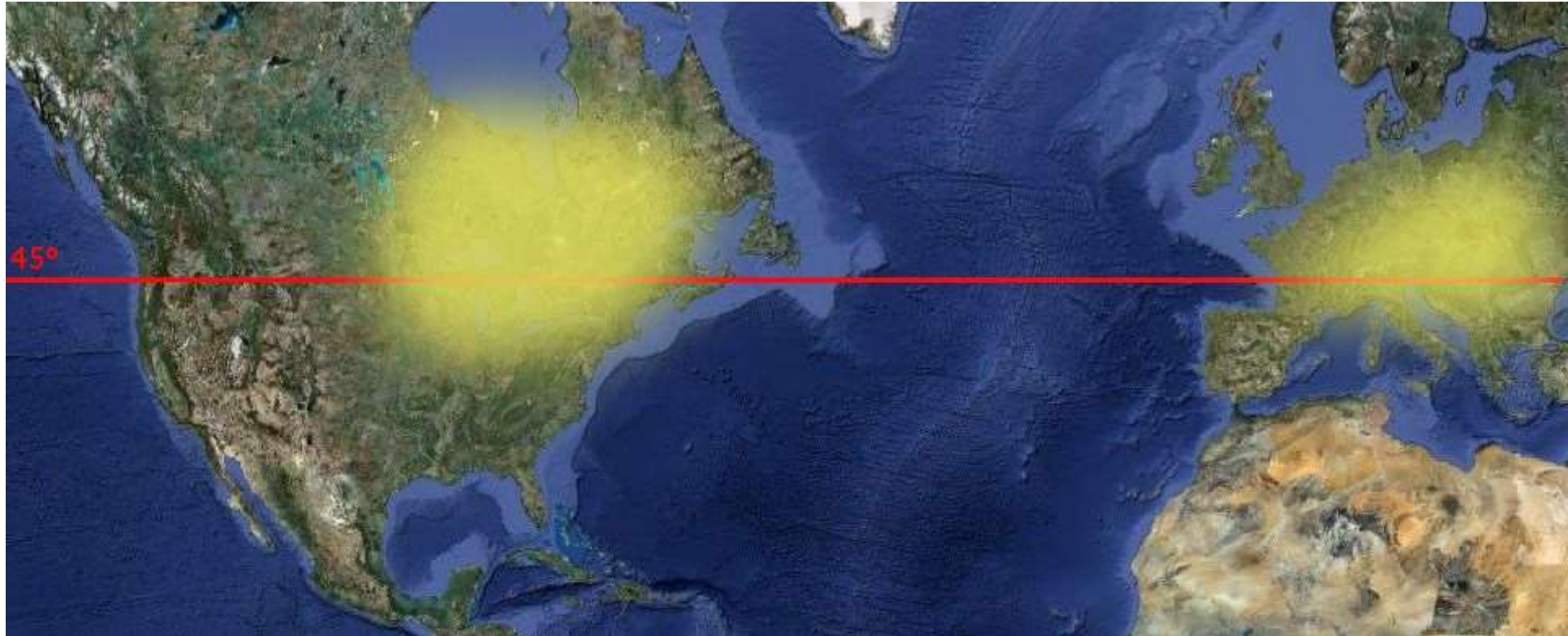
- **Definition:** the period of time each day during which an organism receives illumination; day length
- **Photoperiod** is **defined** as day length or 'the period of daily illumination received by an organism' and remains constant between years at any given geographic location.
- **Latitude** is the own parameter of photoperiod
- **Photoperiodism** refers to **the** response of plants and animals to **the** length of day or night. **Photoperiod** has an **important** role **in** agriculture as it determines fundamental physiological developments **in** some plants. ... This is crucial as plants are able to program themselves to develop **in** line with **the** right season



# Photoperiod

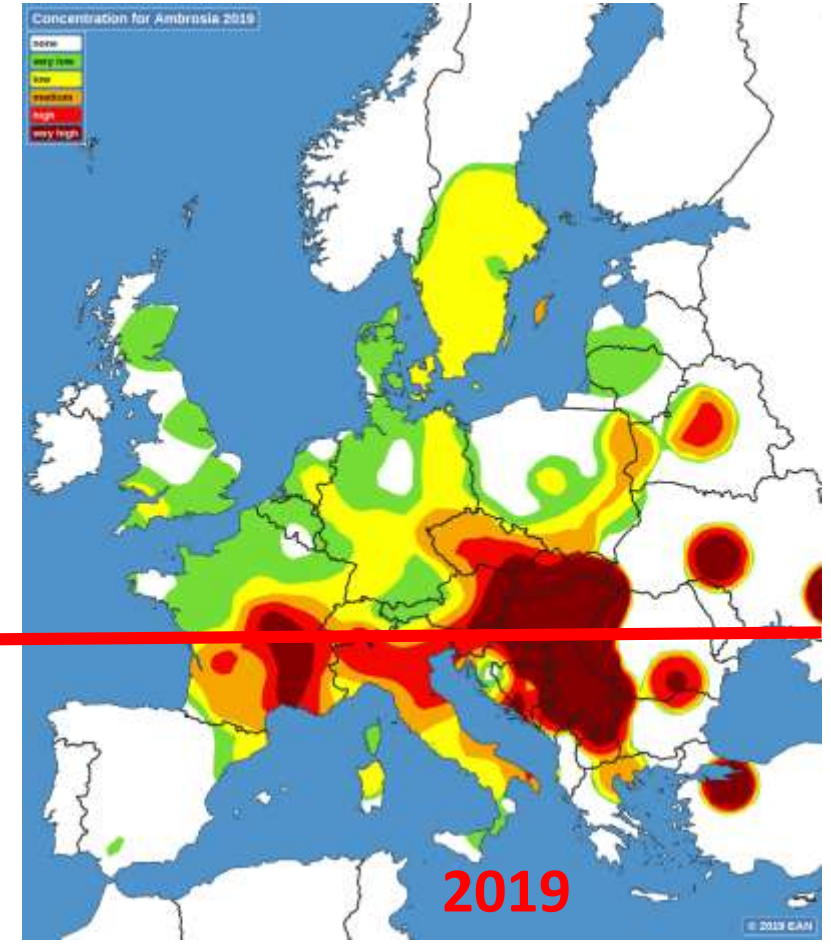
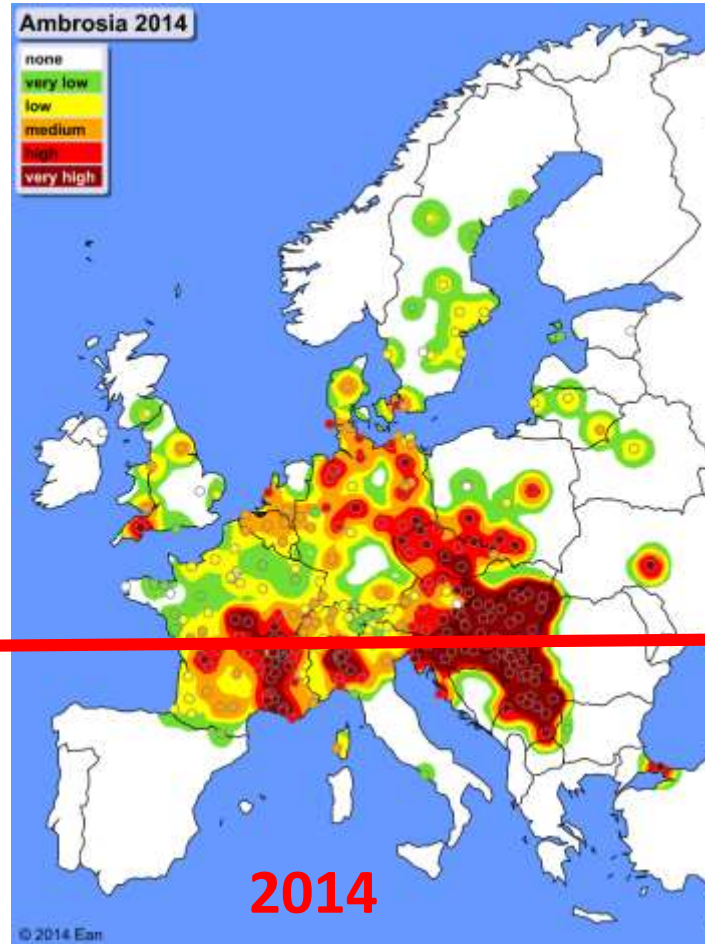
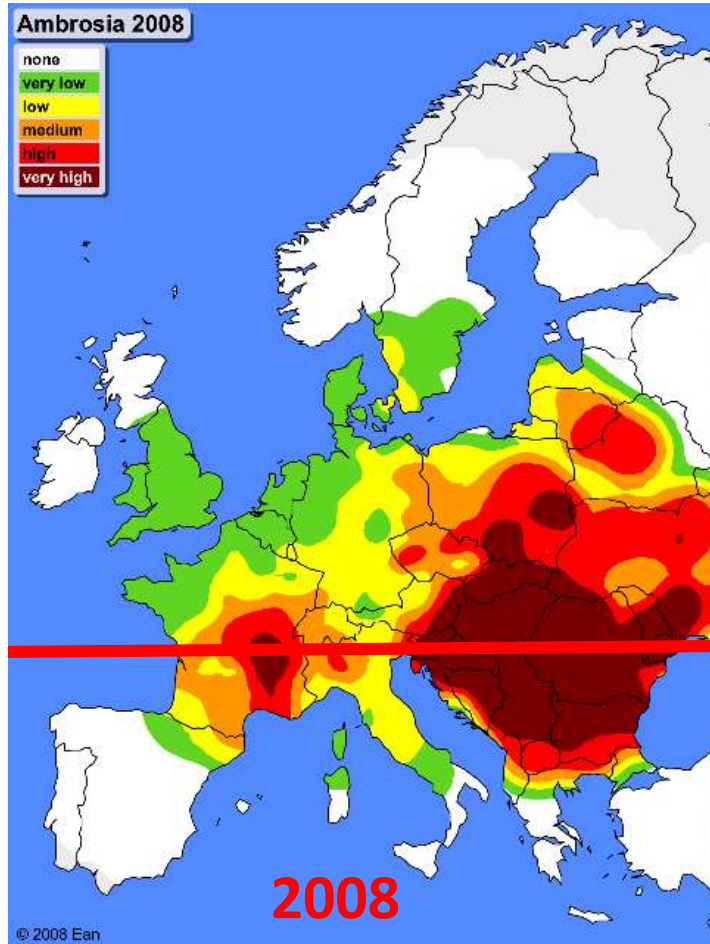
- A lot of studies try to show the possible expansion of Ragweed on Northern countries
- If we consider some of them as Bullock report (1990), Scalone (1996) et Deen (1998a and 1998b) we can summarize that :
- **Temperature** may increase the **vegetative parameter of production of the plant** and the possibility of Northern production
- **Photoperiod** cannot increase or decrease **vegetative production** but is an **essential parameter for reproductive**.
- For these reasons, if with **Climate change** (temperature) the plant can grow at northern latitude, photoperiod doesn't permit it to produce **productive grains**.

# Ragweed in the world (North)



**Around the 45th parallel**

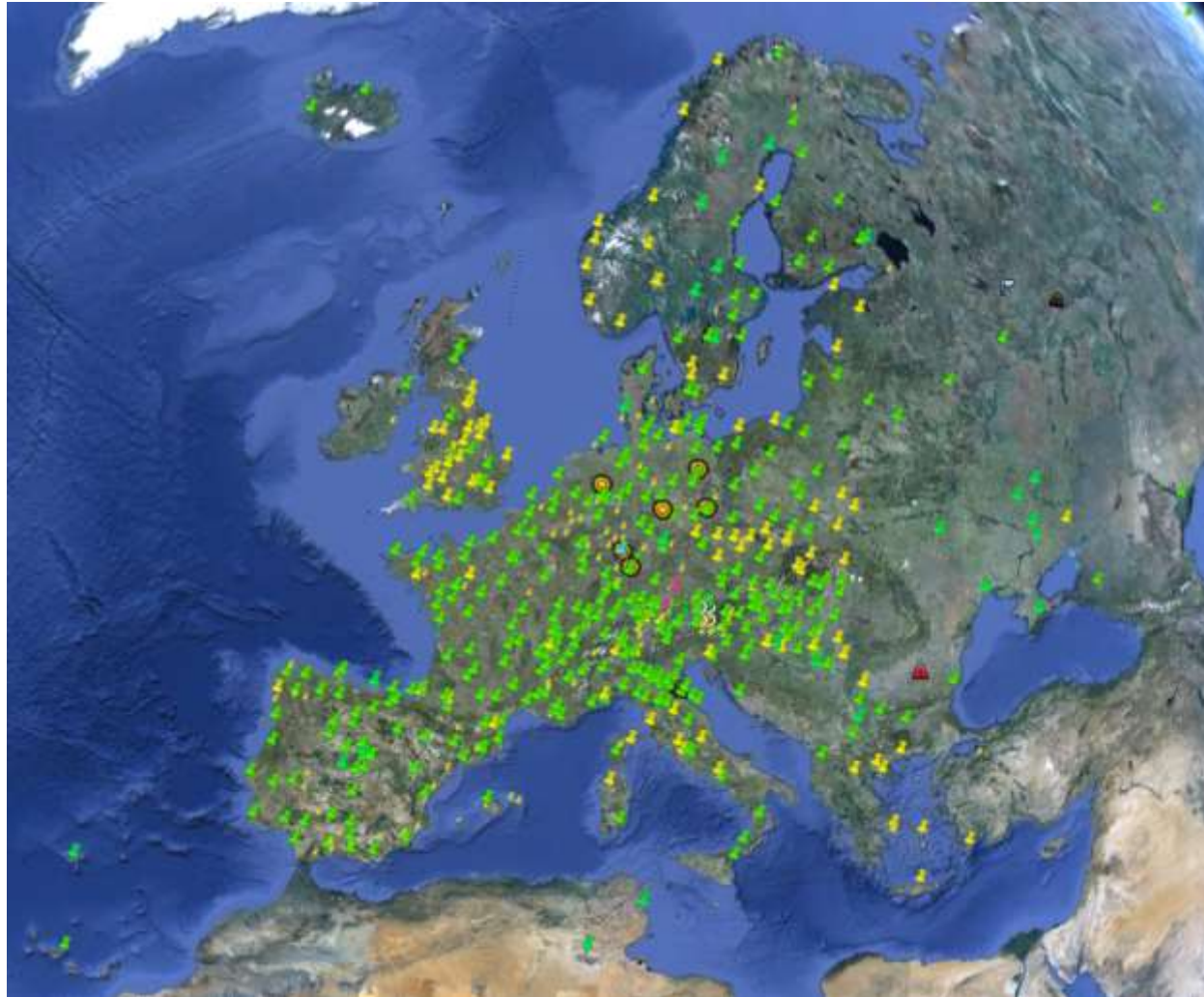
# Ragweed in Europe



**Around the 45th parallel**



# Pollens stations in Europe





# Pollen exposure measurement : pollen trap

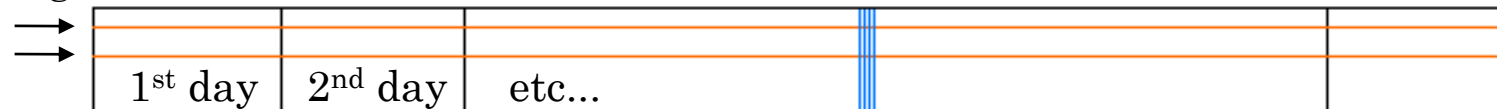
Current standard method in Europe

Breathing orifice  
(10 L air/min)



Horizontal  
reading

Adhesive band on the drum



1h = 2mm

Measurements were made  
with Hirst-type pollen traps.

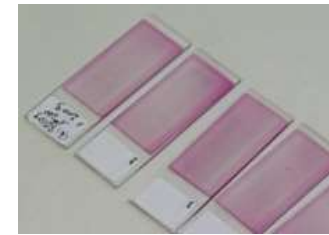
# *Pollen exposure measurement : analysis*



Collection of the  
drum band



Dividing the  
band  
into daily  
sections



1 slide by day

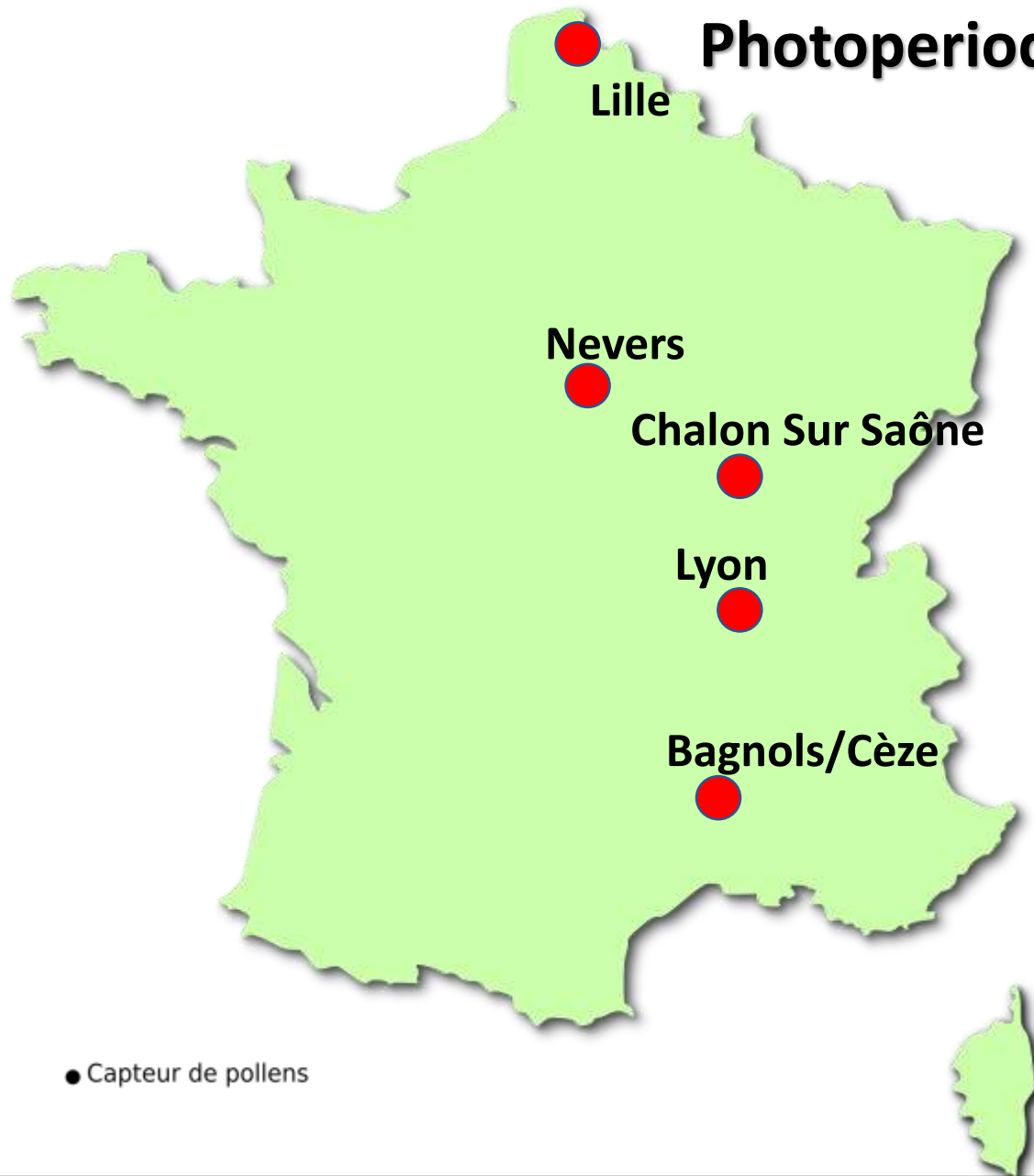


Counting with a  
vocal recognition system



Daily amounts (grains/m<sup>3</sup>)

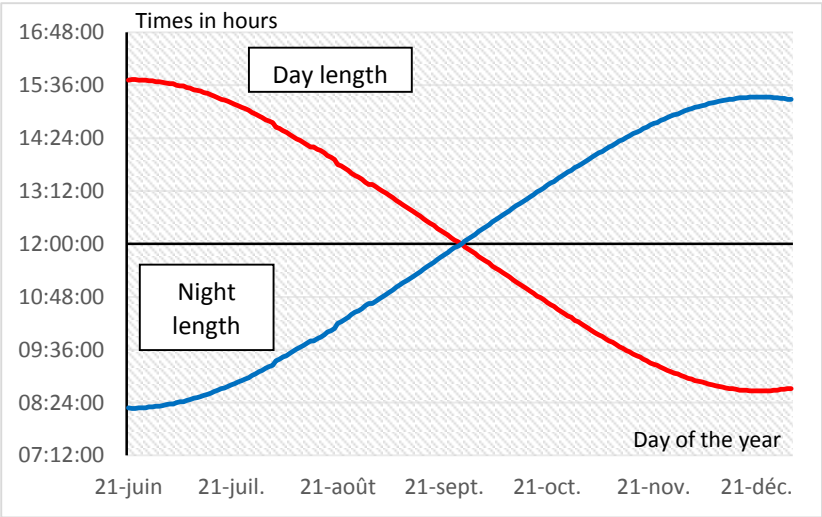
# Photoperiod study site



Lille	3°03'48" est	50°38'14" nord
Nevers	3°09'42" est	46°59'34" nord
Chalon-sur-Saône	4°51'10" est	46°46'50" nord
Lyon	4°50'32" est	45°45'35" nord
Bagnols-sur-Cèze	4°37'13" est	44°09'45" nord

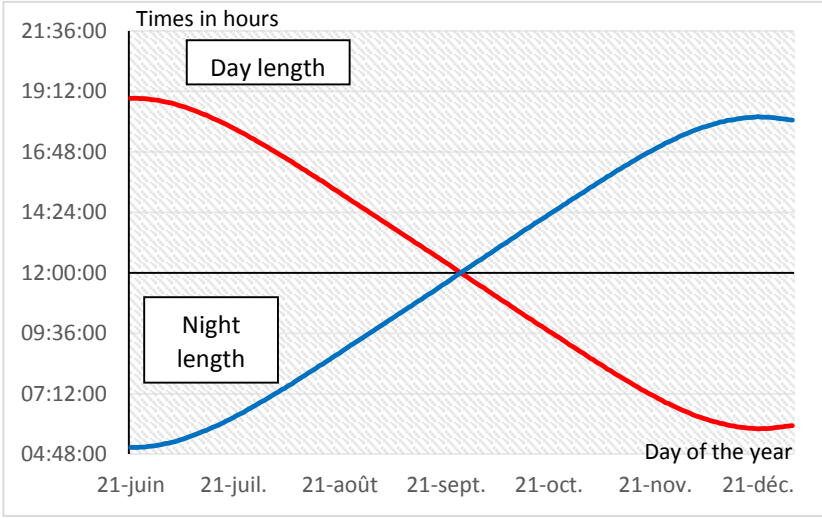
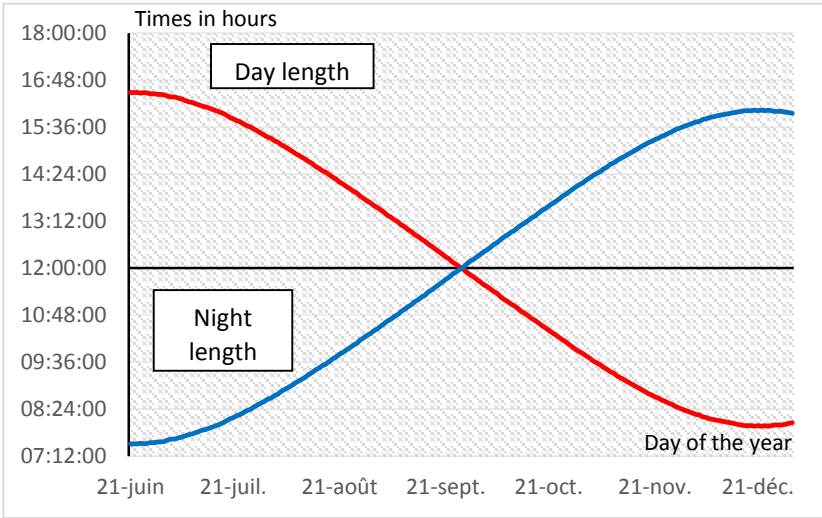
● Capteur de pollens

**Photoperiod** : The daily duration of light and dark to which an organism is exposed, considered especially with regard to its effect on growth and development.



**Lyon** day length and night length curve

**Lille** day length and night length curve

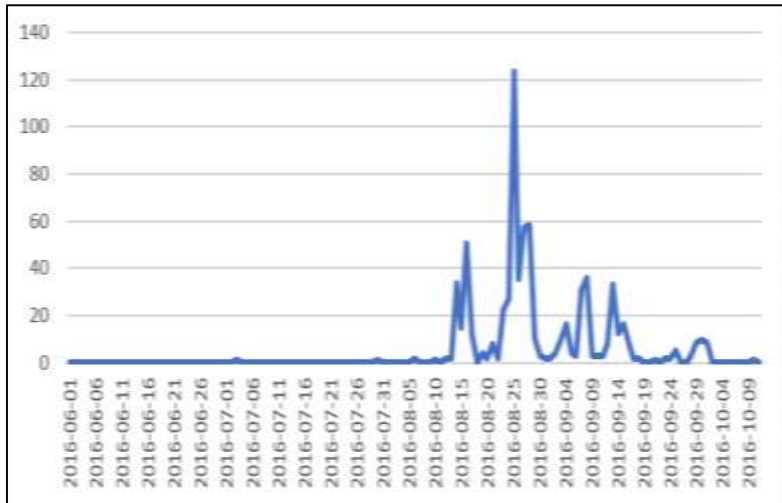


**Helsinki** day length and night length curve



# The photoperiod

LYON	AMBROSIA	Sommes cumulées	32	2016-07-01	0	0	63	2016-08-01	0	1,94	93	2016-08-31	1,94	474,22	118	2016-09-25	4,95	679,86	
2	2016-06-01	0	33	2016-07-02	0	0	64	2016-08-02	0	1,94	94	2016-09-01	1,94	476,16	119	2016-09-26	0	679,86	
3	2016-06-02	0	34	2016-07-03	0,97	0,97	65	2016-08-03	0	1,94	95	2016-09-02	3,88	480,04	120	2016-09-27	0	679,86	
4	2016-06-03	0	35	2016-07-04	0	0,97	66	2016-08-04	0	1,94	96	2016-09-03	5,82	485,96	121	2016-09-28	2,91	682,77	
5	2016-06-04	0	36	2016-07-05	0	0,97	67	2016-08-05	0	1,94	97	2016-09-04	7,76	489,74	122	2016-09-29	8,73	691,5	
6	2016-06-05	0	37	2016-07-06	0	0,97	68	2016-08-06	1,94	3,88	98	2016-09-05	9,70	506,23	123	2016-09-30	0,70	701,2	
7	2016-06-06	0	38	2016-07-07	0	0,97	69	2016-08-07	0	3,88	99	2016-09-06	11,64	510,11	124	2016-10-01	8,73	709,93	
8	2016-06-07	0	39	2016-07-08	0	0,97	70	2016-08-08	0	3,88	100	2016-09-07	13,58	513,02	125	2016-10-02	0	709,93	
9	2016-06-08	0	40	2016-07-09	0	0,97	71	2016-08-09	0	3,88	101	2016-09-08	15,52	514,06	126	2016-10-03	0	709,93	
10	2016-06-09	0	41	2016-07-10	0	0,97	72	2016-08-10	0,97	4,85	102	2016-09-09	17,46	519,95	127	2016-10-04	0	709,93	
11	2016-06-10	0	42	2016-07-11	0	0,97	73	2016-08-11	0	4,85	101	2016-09-08	19,40	529,85	128	2016-10-05	0	709,93	
12	2016-06-11	0	43	2016-07-12	0	0,97	74	2016-08-12	1,94	6,79	102	2016-09-09	21,34	532,66	129	2016-10-06	0	709,93	
13	2016-06-12	0	44	2016-07-13	0	0,97	75	2016-08-13	1,94	8,73	103	2016-09-10	23,28	535,77	130	2016-10-07	0	709,93	
14	2016-06-13	0	45	2016-07-14	0	0,97	76	2016-08-14	33,95	42,68	104	2016-09-11	25,22	538,66	131	2016-10-08	0	709,93	
15	2016-06-14	0	46	2016-07-15	0	0,97	77	2016-08-15	14,25	57,22	105	2016-09-12	27,16	539,44	132	2016-10-09	0	709,93	
16	2016-06-15	0	47	2016-07-16	0	0,97	78	2016-08-16	50,44	107,67	106	2016-09-13	29,10	542,42	133	2016-10-10	0,97	710,9	17,7725
17	2016-06-16	0	48	2016-07-17	0	0,97	79	2016-08-17	11,64	119,31	107	2016-09-14	31,04	544,06	134	2016-10-11	0	710,9	693,1275
18	2016-06-17	0	49	2016-07-18	0	0,97	80	2016-08-18	0	119,31	108	2016-09-15	32,98	548,86					
19	2016-06-18	0	50	2016-07-19	0	0,97	81	2016-08-19	3,88	123,19	109	2016-09-16	34,92	552,77					
20	2016-06-19	0	51	2016-07-20	0	0,97	82	2016-08-20	1,94	125,13	110	2016-09-17	36,86	556,66					
21	2016-06-20	0	52	2016-07-21	0	0,97	83	2016-08-21	7,76	132,89	111	2016-09-18	38,80	560,23					
22	2016-06-21	0	53	2016-07-22	0	0,97	84	2016-08-22	1,94	134,83	112	2016-09-19	40,74	563,02					
23	2016-06-22	0	54	2016-07-23	0	0,97	85	2016-08-23	22,70	157,53	113	2016-09-20	42,68	566,28					
24	2016-06-23	0	55	2016-07-24	0	0,97	86	2016-08-24	26,73	184,26	114	2016-09-21	44,62	568,22					
25	2016-06-24	0	56	2016-07-25	0	0,97	87	2016-08-25	123,71	307,97	115	2016-09-22	46,56	570,16					
26	2016-06-25	0	57	2016-07-26	0	0,97	88	2016-08-26	35,64	343,61	116	2016-09-23	48,50	570,16					
27	2016-06-26	0	58	2016-07-27	0	0,97	89	2016-08-27	57,41	401,02	117	2016-09-24	50,44	571,13					
28	2016-06-27	0	59	2016-07-28	0	0,97	90	2016-08-28	58,39	459,41	118	2016-09-25	52,38	571,13					
29	2016-06-28	0	60	2016-07-29	0	0,97	91	2016-08-29	9,90	469,31	119	2016-09-26	54,32	573,07					
30	2016-06-29	0	61	2016-07-30	0,97	1,94	92	2016-08-30	2,97	472,28	120	2016-09-27	56,26	575,01					
31	2016-06-30	0	62	2016-07-31	0	1,94	93	2016-08-31	1,94	474,22	121	2016-09-28	58,20						



## Ambrosia data for 2016 from the Lyon site.

The **purple column** represents the dates for which there was ragweed in Lyon in 2016.

The **green column** represents ragweed data collected day by day.

The **blue column** represents the cumulative sums of ragweed data.

The **green rectangle** is the sum of the ragweed rate in 2016 in Lyon.

The **red number** represents 2.5% of the total ragweed rate for 2016 in Lyon. The **red rectangle** takes the value of at least 17.7725 (**2.5% total ragweed**) and gives the date when ragweed pollination **begins**.

The **orange number** represents 97.5% of the total ragweed rate for 2016 in Lyon. The **orange rectangle** takes the value that is at least 693.1275 (**97.5% total ragweed**) and gives the date when ragweed pollination **ends**.

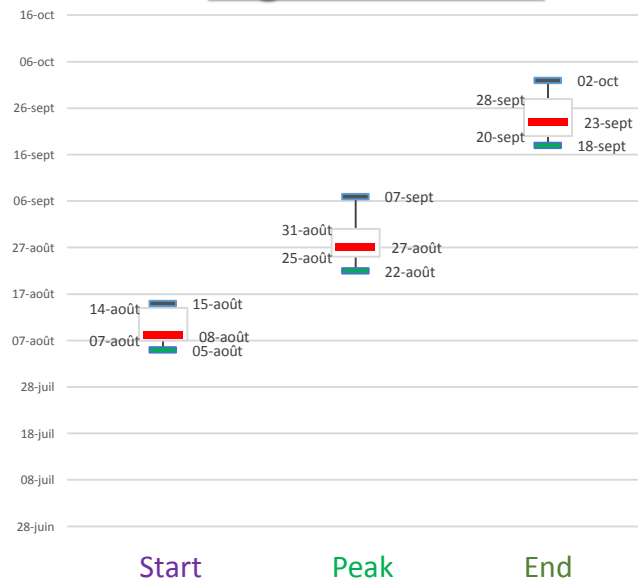
The **graph** represents the curve of the ambrosia rate in 2016 in Lyon, depending on the date. The date of the first major **peak** is in dark blue rectangle , **08/25/2016**.

# Ragweed data

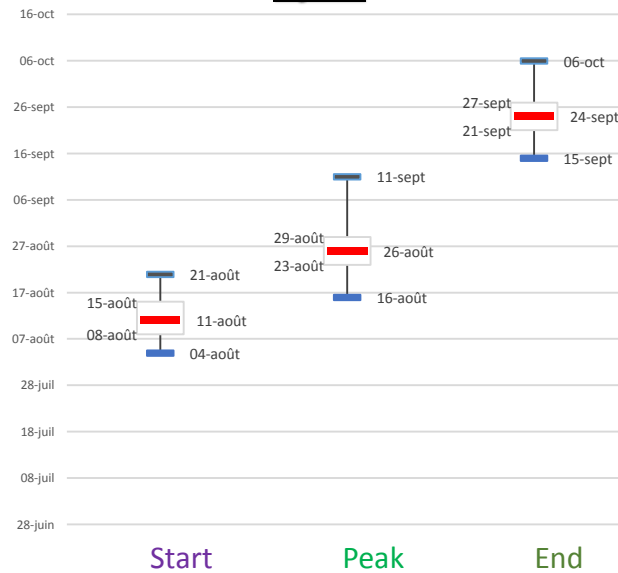
Sites	Bagnols-sur-Cèze	Lyon	Chalon-sur-Saône	Nevers	Lille
Analysis period	2008 - 2019	1987 - 2019	1994 - 2019	2004 - 2019	/

**For Lille** : It was not possible to make the box plots of Lille because the ragweed data are too weak to be able to define start, peak or end dates for ragweed pollination.

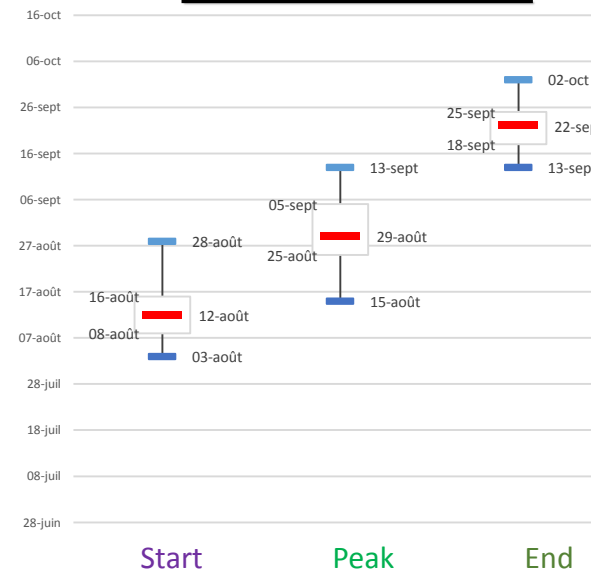
## Bagnols-sur-Cèze



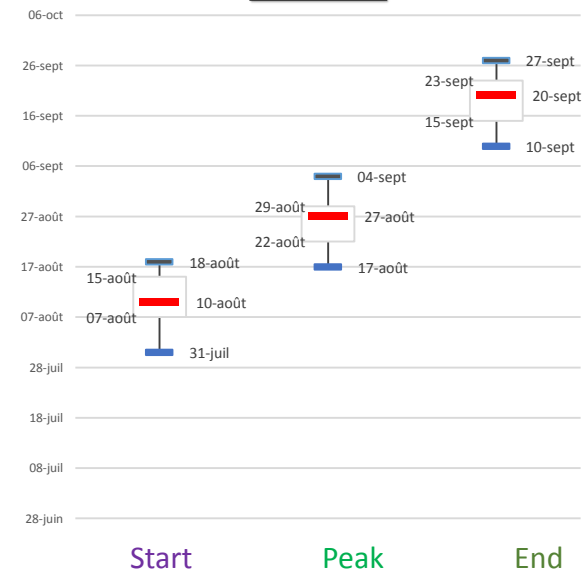
## Lyon

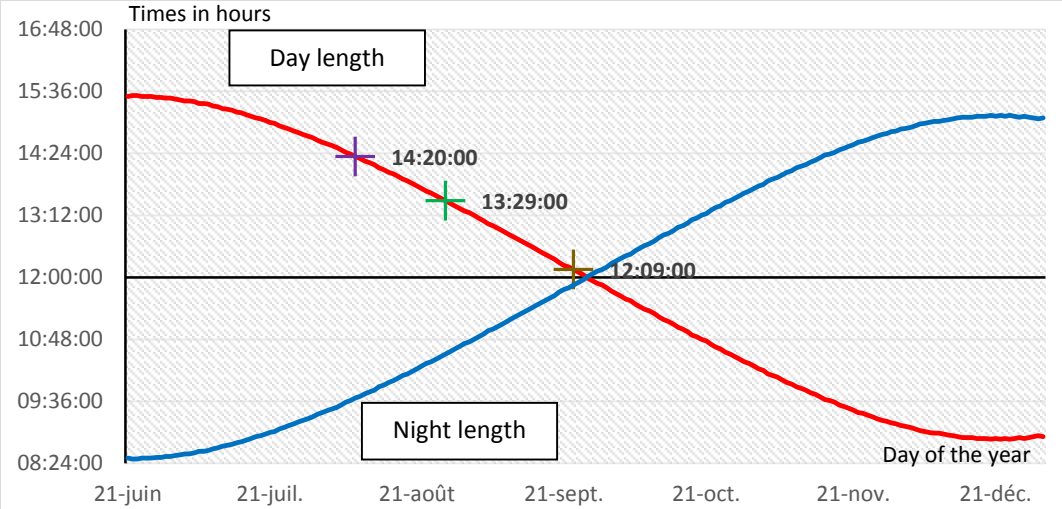


## Chalon-sur-Saône



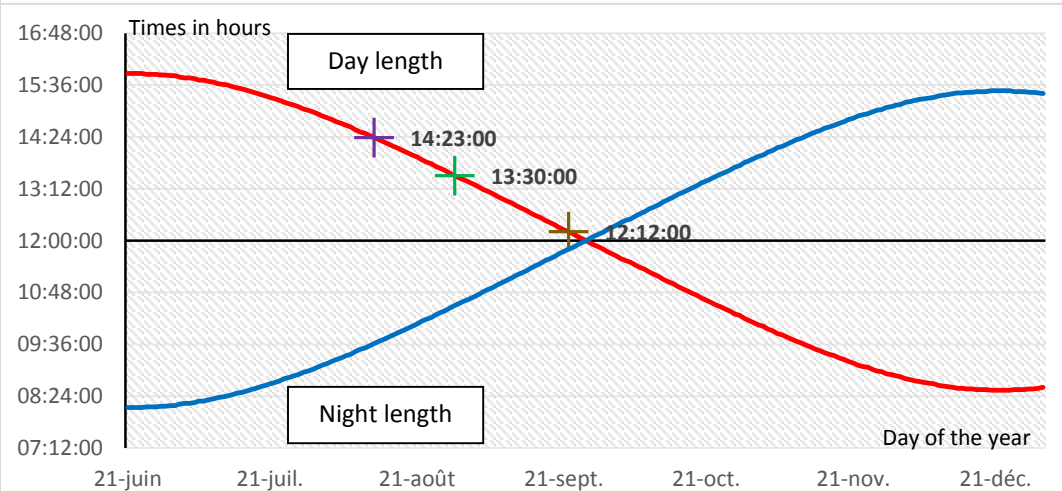
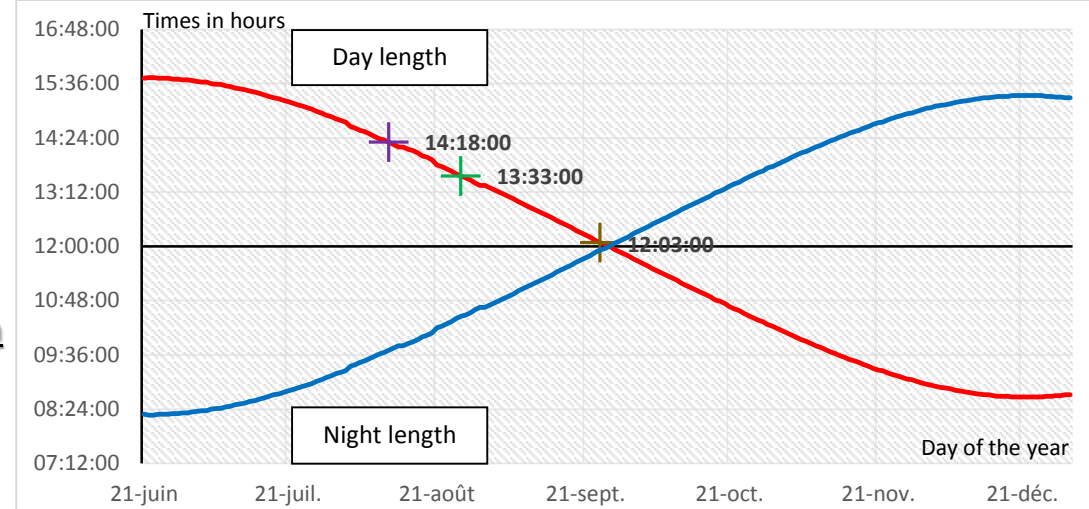
## Nevers





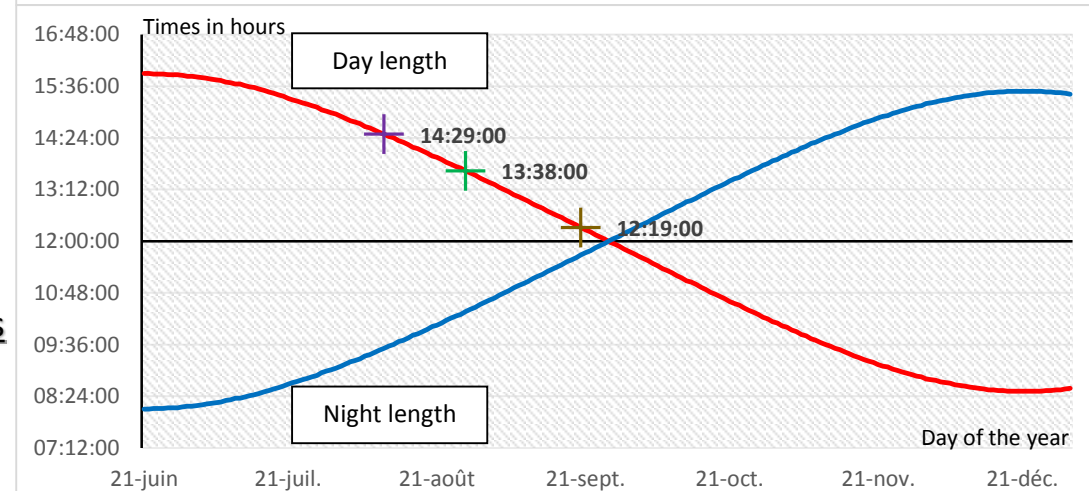
Bagnols-sur-Cèze

Lyon



Chalon-sur-Saône

Nevers



Site	Start date	Peak date	End date
Bagnols-sur-Cèze	14:20 / August 8	13:29 / August 27	12:09 / September 23
Lyon	14:18 / August 11	13:33 / August 26	12:03 / September 25
Chalon-sur-Saône	14:23 / August 12	13:30 / August 29	12:12 / September 22
Nevers	14:29 / August 10	13:38 / August 27	12:19 / September 20
Lille *	14:19 / August 19	13:29 / September 2	12:09 / September 23

It is experimentally and hypothetically observed that the pollination of ragweed **begins** from the moment when for the day length there is only **14.20 hours**., the **peak** of pollination occurs at a day length of about **13:30 hours**., the **end** of pollination takes place at a day length of approximately **12:10 hours**.

***\*For Lille, if we take the theoretical day lengths, we find respectively for the start, peak and end dates, August 19, September 2 and September 23.***



# Discussion



A lot of studies try to show the possible expansion of Ragweed on Northern countries

If we consider some of them as Bullock report (2010) Scalone (2016) et Deen (1998a, 1998b, 2001) we can summarize that :

- Temperature may increase the **vegetative parameter of production** of the plant and the possibility of Northern production
- **Photoperiod cannot increase or decrease vegetative production** but is an essential **parameter for reproductive**.

For these reasons, if with Climate change (temperature) the plant can grow at northern latitude, **photoperiod doesn't permit it to produce productive grains**





# Conclusion

- Photoperiodic response are the most important factors limiting the European distribution of invasive plants such as *Ambrosia artemisiifolia*.
- Attempts to predict the northward range shift of ragweed have led to the conclusion that the extension of the range limit is to a large extent constrained by the photoperiod requirement for induction of **flowering then seed production**.
- The positioning of the dates of the start of pollination, the main peak and of the end of pollination on each of the curves makes it possible to understand that the day accumulation delays the dates as the site is further north.
- At the latitude of Lille there is not enough pollen in the air, therefore **not enough seeds for plant reproduction**. This is why *ambrosia* does not develop very well at this latitude.
- This study is a feasibility study which should be continued using sites over a larger North-South area.



# Thank you for your attention



[www.pollens.fr](http://www.pollens.fr)  
<http://internationalragweedsociety.org/>

