Semana 10
Analisis Espacial

SP6350 Manejo de Enfermedades

Ciclo I-2025

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Figura 13.6. Patrones de distribución espacial de enfermedades. Los puntos representan plantas enfermas. En los tres casos la incidencia es la misma.

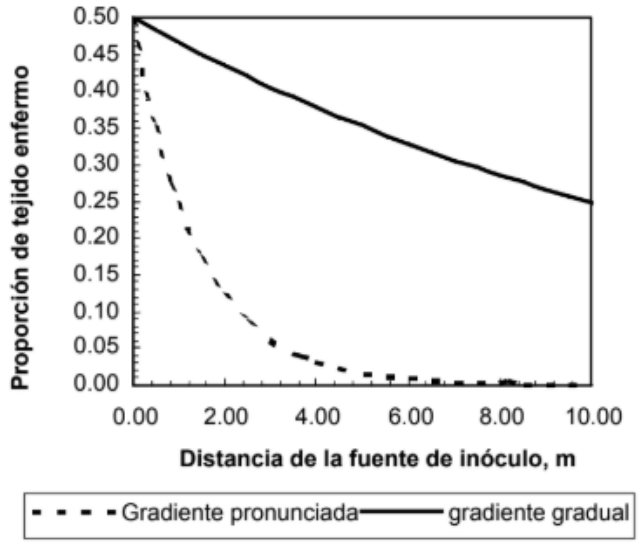


Figura 13.7. Ejemplos de gradientes de dispersión de enfermedades en plantas

- Los patrones de de distribución espacial están relacionados con los patrones de dispersión
- Gradiente de dispersión: Disminución de la cantidad de enfermedad en función de la distancia de la fuente de inóculo.
  - Gradiente gradual
  - Gradiente pronunciada
- Patógenos diseminados por viento o vectores se mueven distancias largas y tienen patrones espaciales al azar.
- Si el inóculo primario está dentro del terreno tenderá a tener distribuciones espacial agregada.
- Parches de mal drenaje también pueden producir distribuciones agregadas.

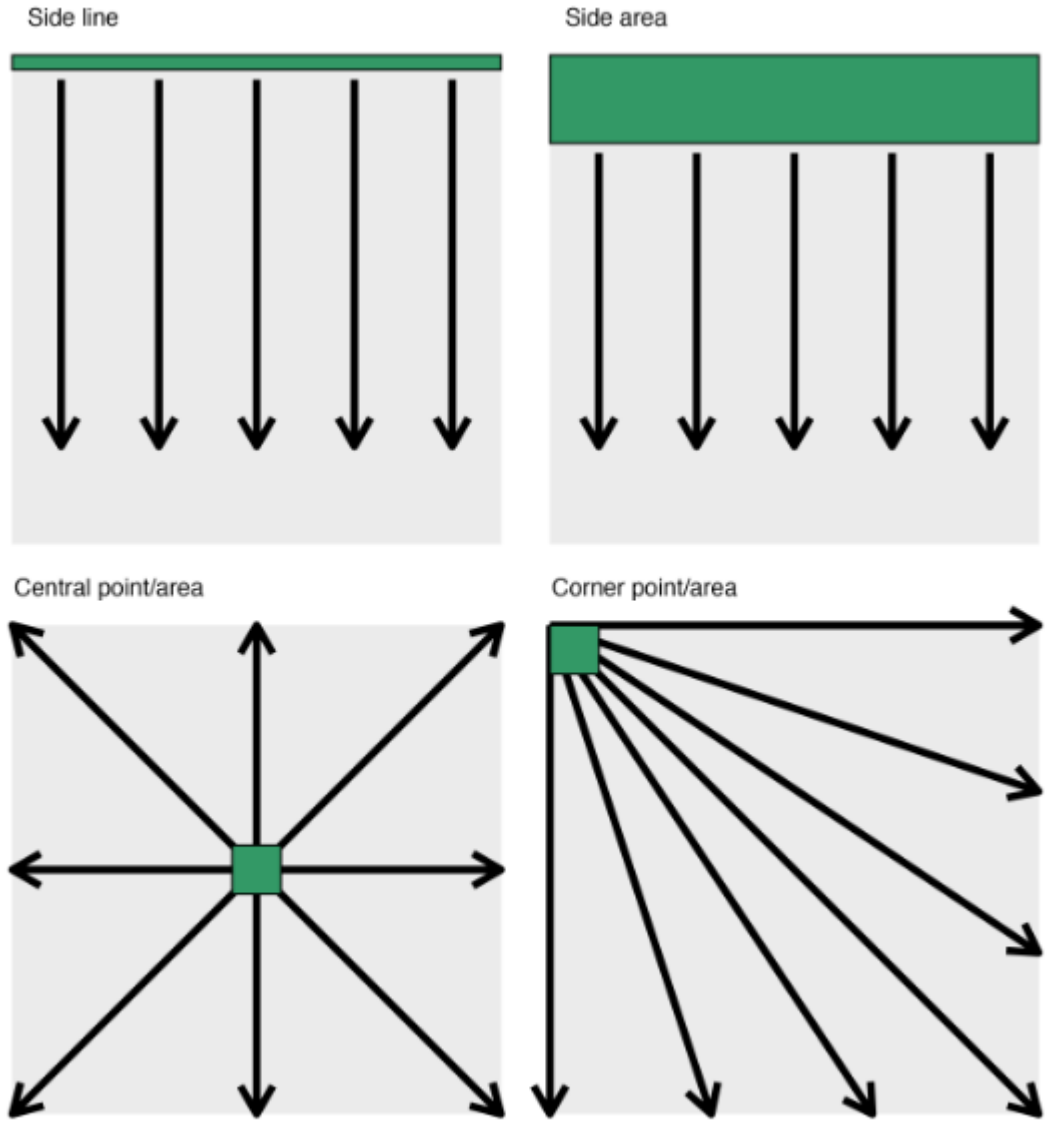


Figure 12.4: Example of location and size of inoculum sources for the study of disease gradie

Fig. 1. (**A**) Bean leaf beetle feeding on soybean leaf, and (**B**) early feeding on young soybean plants at VE-VC growth stage. (**C**) Oval holes, characteristic of bean leaf beetle feeding, and (**D**) symptoms of BPMV on soybean leaf.

- *Cerotoma trifurcata* se alimenta de las hojas de soya
- El virus BPMV (bean pod mottle virus) sobrevive y se desemina por medio de éste escarabajo y de forma mecánica.

Fig. 2. (**A**) Demarcation of soybean quadrats using 12-inch stakes (25 quadrats per row, six rows per plot). (**B**) Thinning of soybean plants, each quadrat had 4 soybean plants. (**C**) ELISA plate showing positive wells (yellow) and negative wells (clear). ELISA was used to detect BPMV.

Byamukama et al 2010

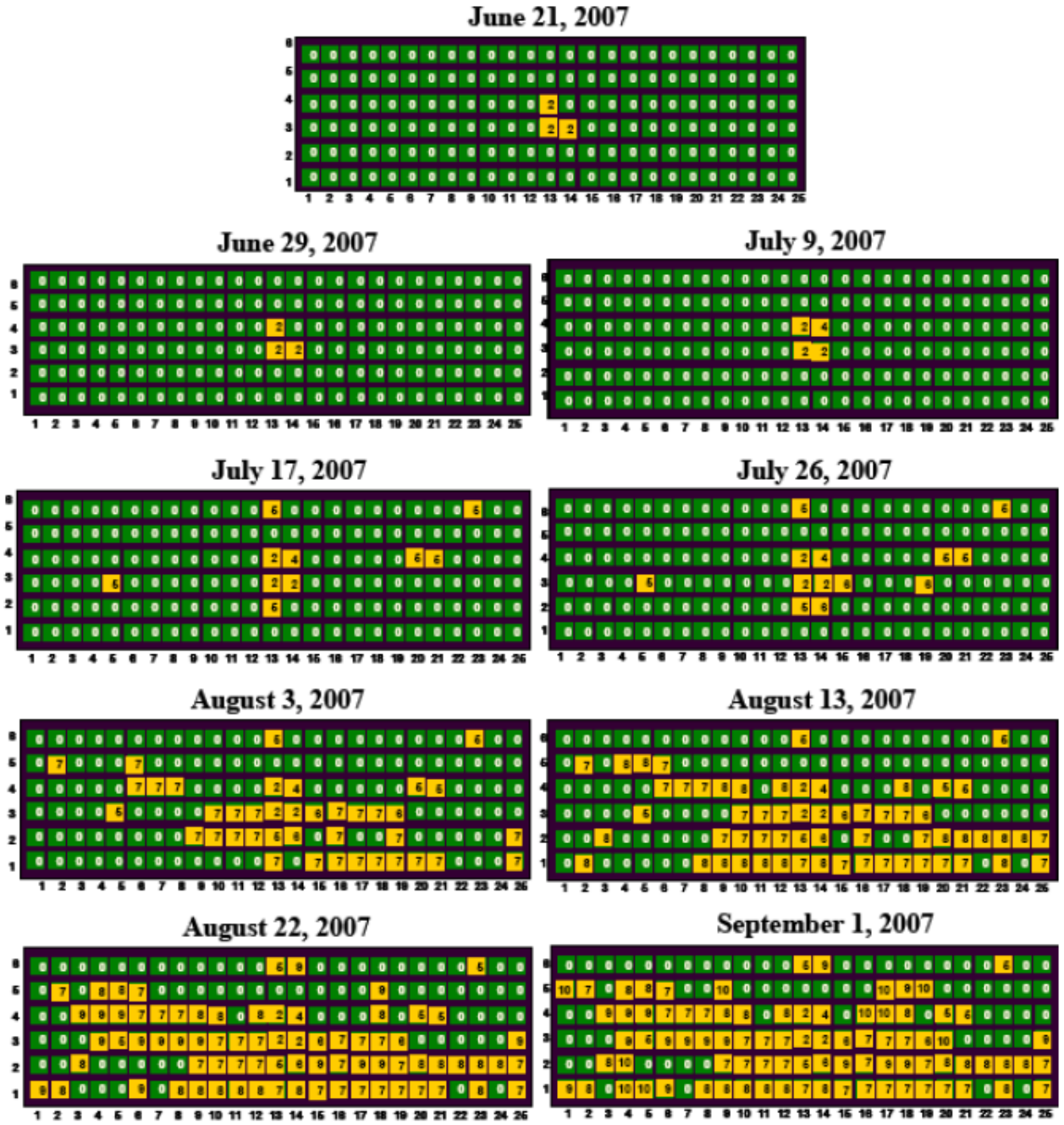
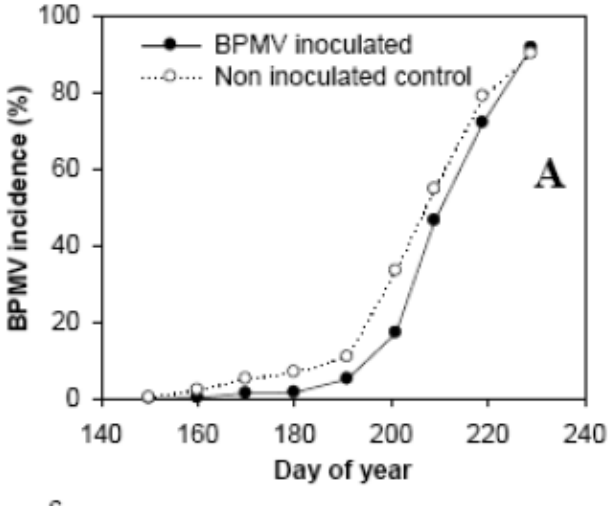
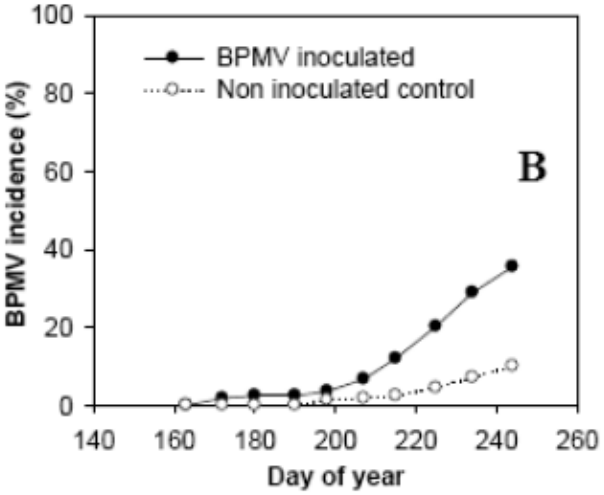


Fig. 6. Spatial maps depicting the spatial spread of *Bean pod mottle virus* (BPMV) at various sampling times within 'NE3001' soybeans in 2007 in BPMV-inoculated plot. Yellow quadrats depict the detection of BPMV and the green quadrats depict the non-detection of BPMV. Spread of BPMV within plots is depicted over successive sampling times by numbers within boxes that indicate the sampling period in which BPMV was first detected in a soybean quadrat.



2006



2007

Byamukama et al 2010

- Experimentos evaluando la dispersión del patógeno desde un punto de inóculo.
- La gradiente de dispersión puede variar:
  - en diferentes años,
  - según el ambiente:
    - lluvia
    - dirección del viento
  - diferentes épocas del año
  - tratamientos

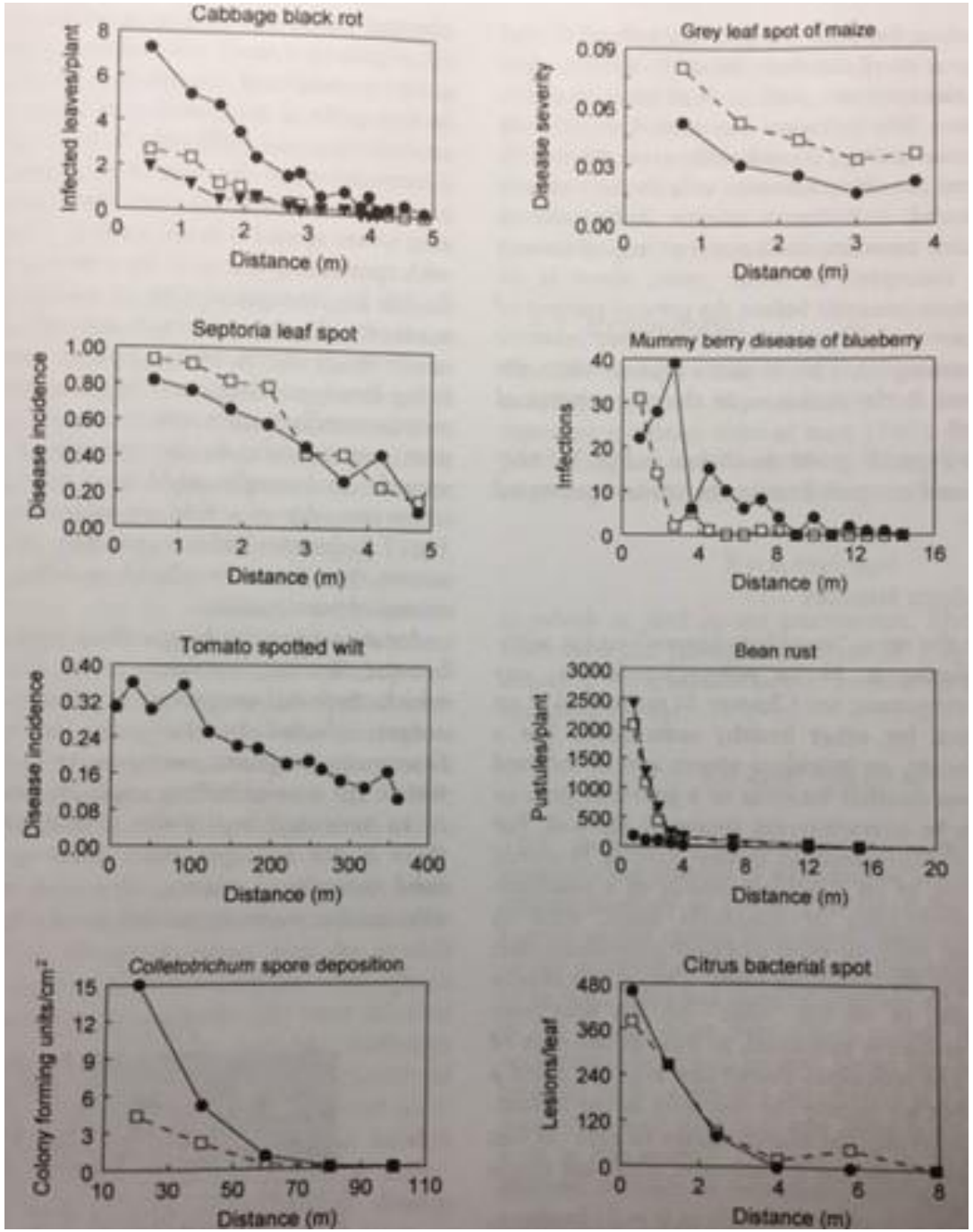


FIG. 7.1. Exampled dispersal and disease gradients. *Left-hand column*: Number of cabbage leaves infected by *Xanthomonas campestris* pv. *campestris*, cause of black rot, from a point source (Kocks and Ruissen, 1996). Incidence of Septoria leaf spot of tomato, caused by *Septoria lycopersici*, in relation to distance from a point source (Parker et al., 1997). Lines are for two different years. Incidence of tomato spotted wilt of peppers, caused by tomato spotted wilt virus, from an area source in Georgia (Gitaitis et al., 1998). Number of spores of *Colletotrichum acutatum* deposited over 1 min at 5 and 15 min into a generated rain over a plastic mulch surface (Yang et al., 1991). *Right-hand column*: Severity of grey leaf spot of maize, caused by *Cercospora zeae-maydis*, in relationship to an area source (Asea et al., 2002). Lines are for two different seasons. Number of shoots of blueberry infected by *Monilinia vaccinii-corymbosi*, cause of mummy berry disease, from a point source (Cox and Scherm, 2001). Lines are for up- and down-wind from the source. Number of bean rust pustules, caused by *Uromyces appendiculatus*, in relation to distance from a line source (Aylor and Ferrandino, 1989). Lines are for different times. Number of lesions/leaf of citrus bacterial spot, caused by *Xanthomonas axonopodis* pv. *citrumelo*. Lines are for two treatments at one assessment time (Gottwald et al., 1997).

(Madden et al, 2007)

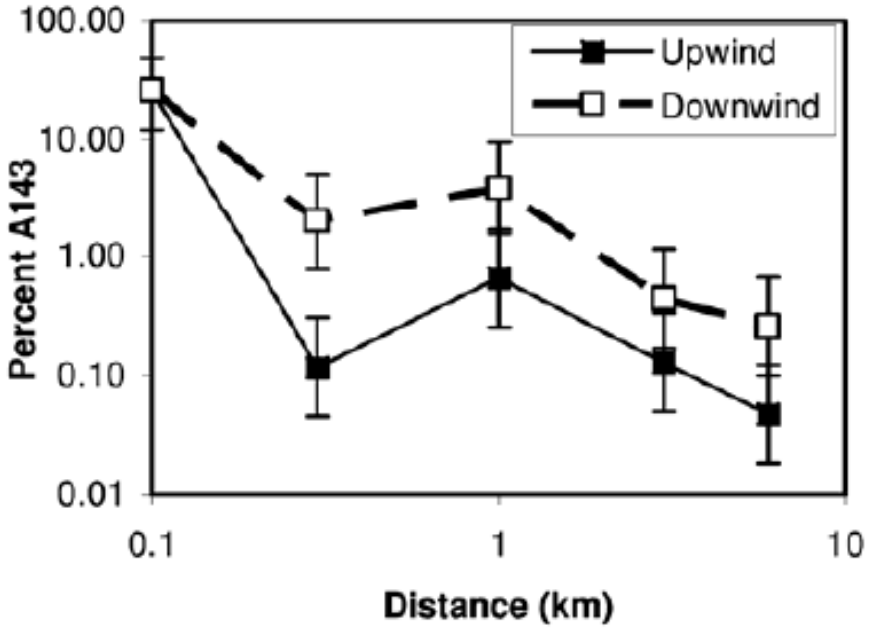


Fig. 1. Percent frequency of G143A in *Mycosphaerella fijiensis* on trap plants at various distances from a source farm along transects aligned with or opposed to the prevailing wind. Transect to the southwest, downwind, □; and to the northeast, upwind, ■. Frequency in the source is that at the start of the experiment. By the time of sampling in the transects, the frequency had risen to ≈78%.

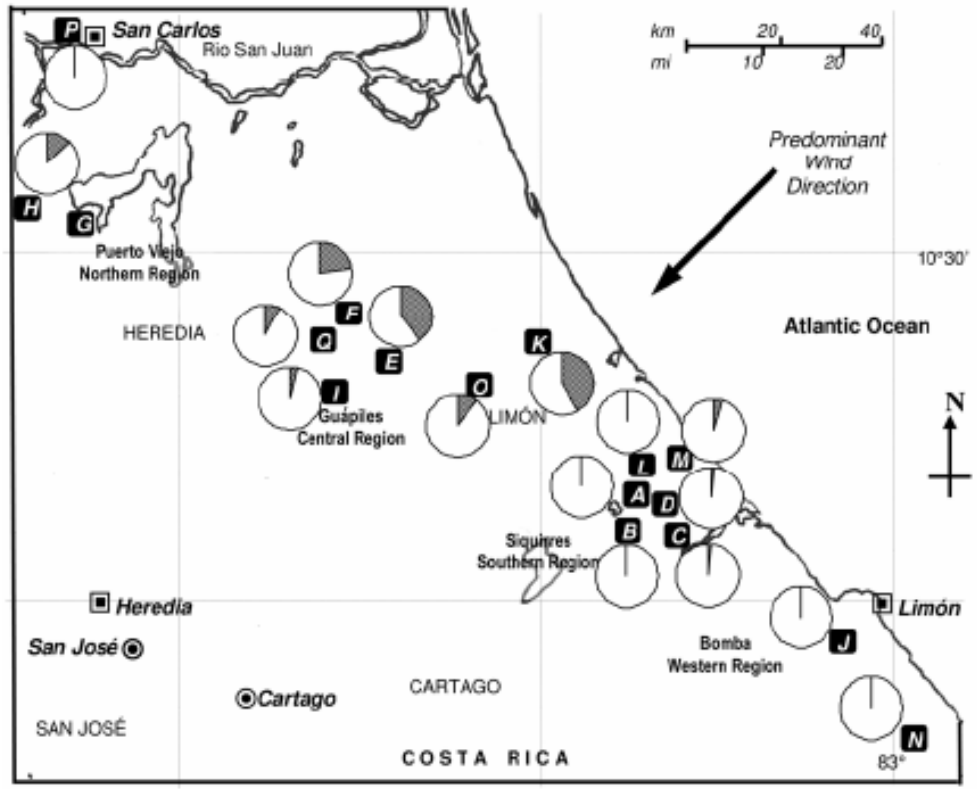


Fig. 3. Frequency of G143A allele in *Mycosphaerella fijiensis* (gray) in August 2000 across Costa Rica.

Amil et al 2007

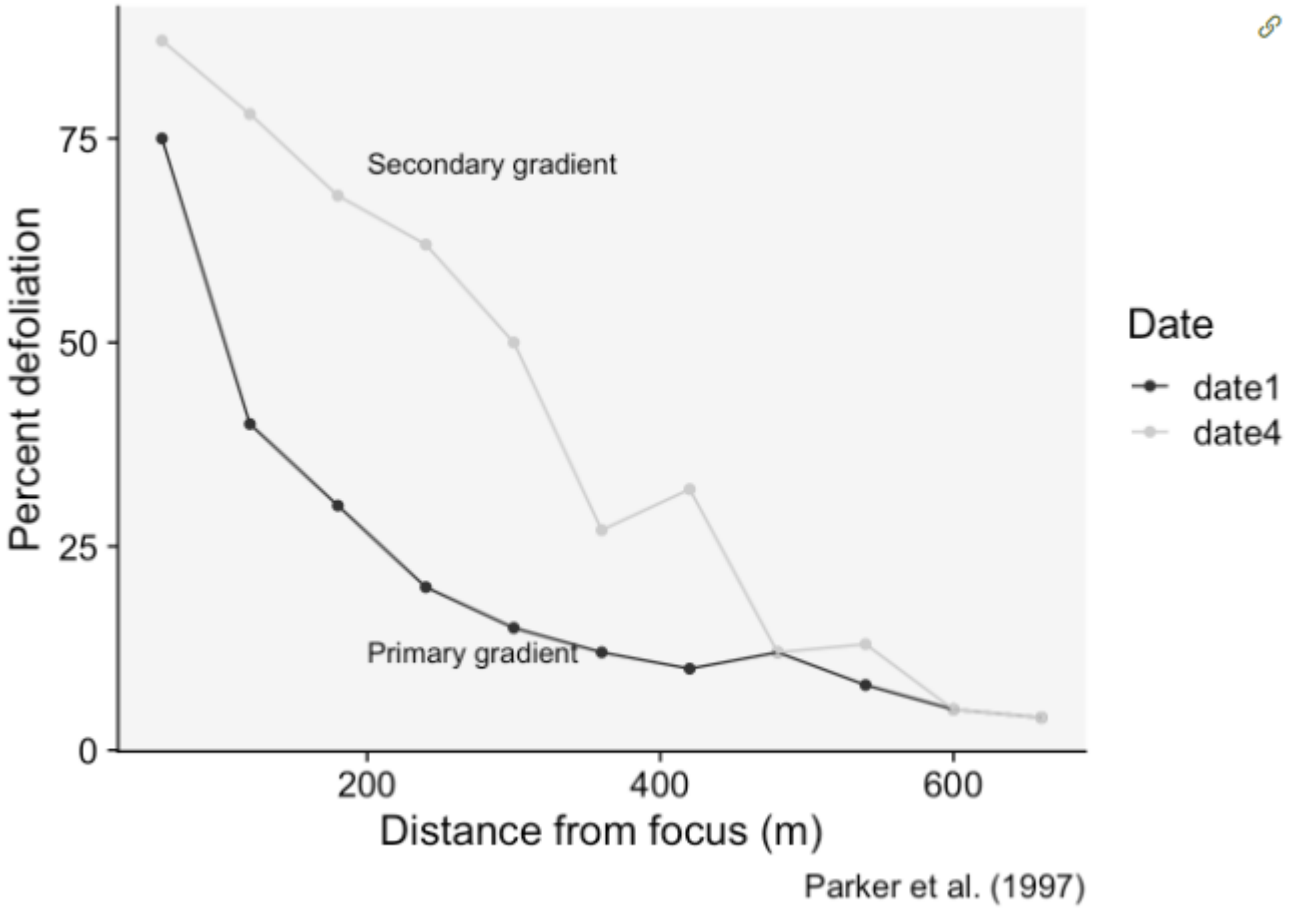


Figure 12.3: Primary and secondary gradients of defoliation due to Septoria leaf spot on tomato

- Gradiente primaria: únicamente generada por la fuente de inóculo inicial
- Gradiente secundaria: toma en cuenta movimiento de inóculo previamente infectadas por el inóculo primario

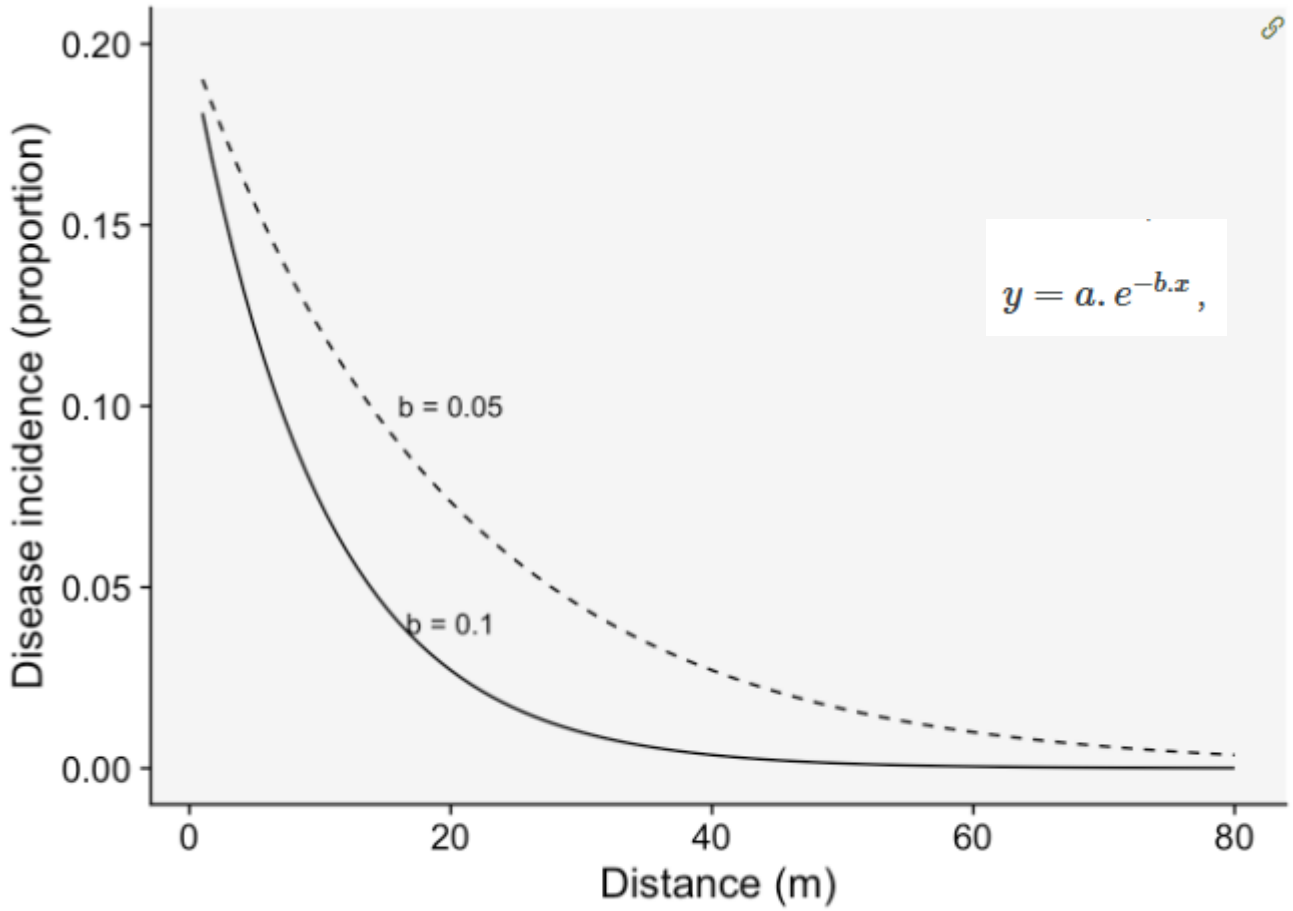


Figure 13.1: Exponential curves describing plant disease gradients

- Modelo exponencial para gradiente de dispersión

a es la intensidad a la distancia cero

B es la tasa de cambio

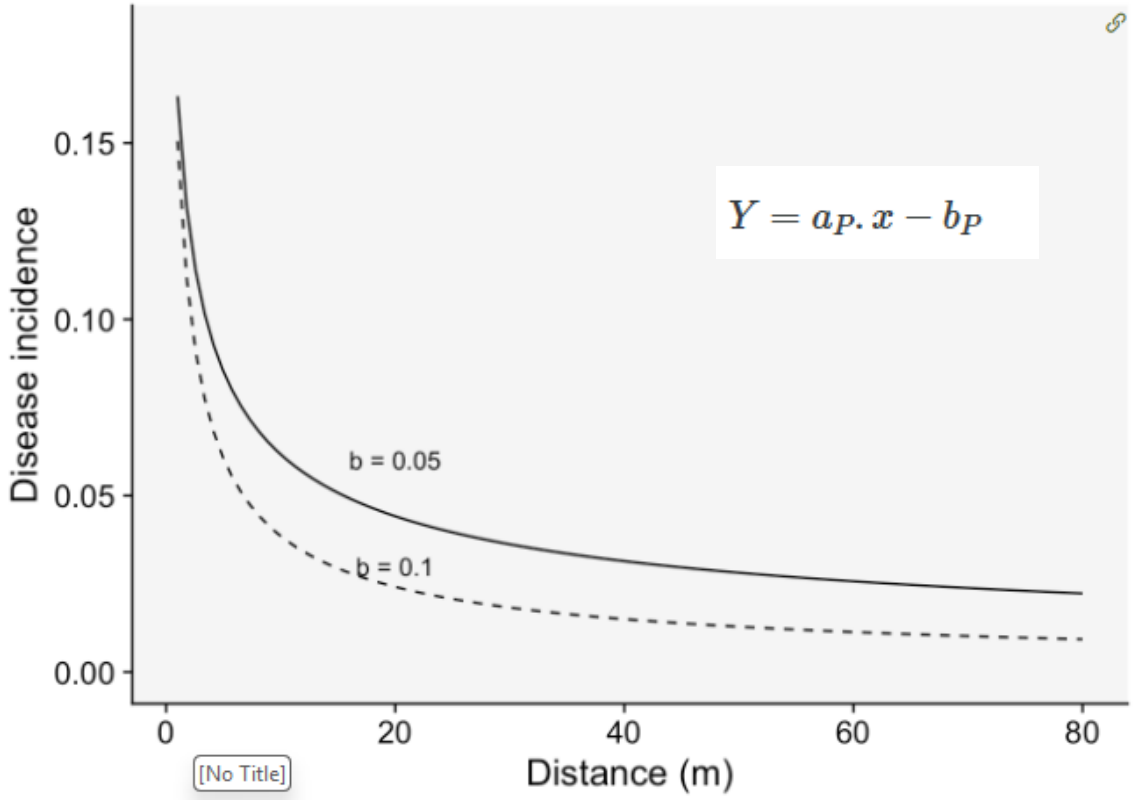


Figure 13.2: Power law (modified) curves describing plant disease gradients

- Modelo potencial para gradiente de dispersión

a_p y b_p son parámetros del modelo.

Tiene valores altos cuando x se aproxima a cero

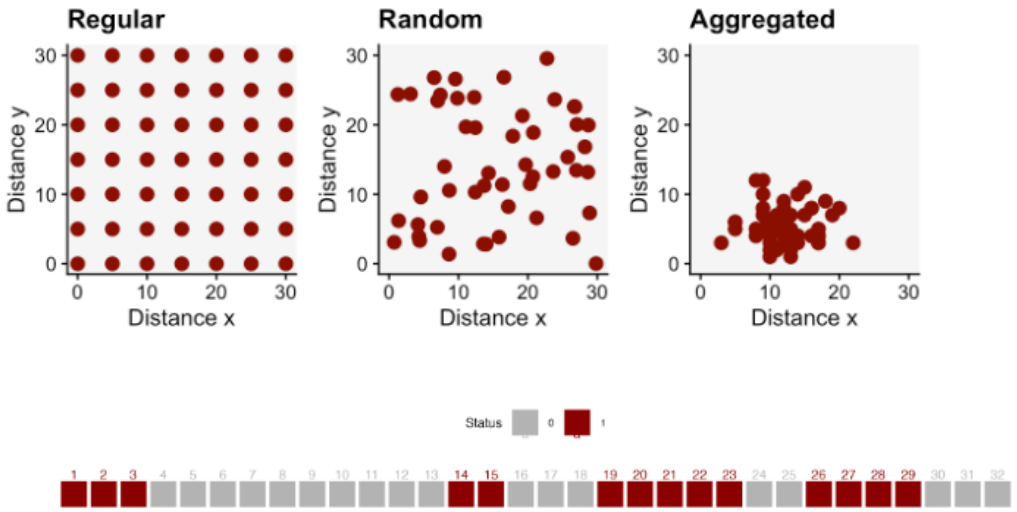


Figure 16.2: Sequence of diseased (dark red) or non-diseased (gray) units (plants). The numbers represent the position of the unit

We can obtain the number of runs and related statistics using the `oruns_test()` function of the {r4pde}.

```
library(r4pde)
oruns_test(row1$y1)
```

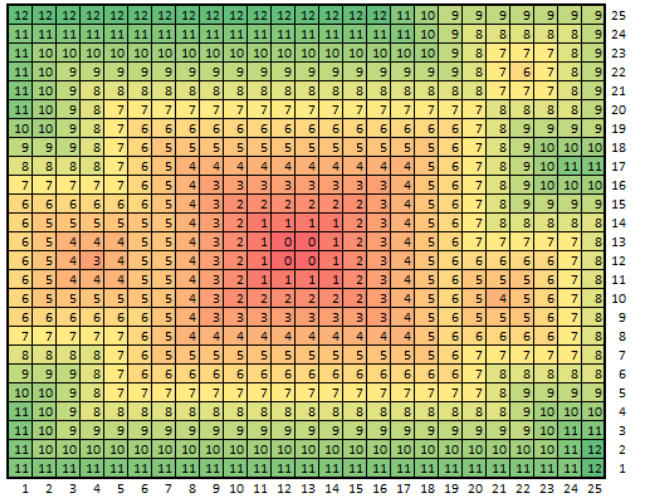
```
Ordinary Runs Test of Data Sequence:
 -----------------------------------
 Total Number of Runs (U): 8
 Expected Number of Runs (EU): 16.75
 Standard Deviation of Runs (sU): 2.74
 Z-score: -3.20
 P-value: 0.0007

 Interpretation:
 Based on the Z-score, the sequence exhibits 'aggregation or clustering'.
```

- Ordinary run análisis:
  - Permite detectar si existe agregación en el patrón de distribución espacial.

Table 13.1. Random numbers giving the positions of infections occurring by "jumps"

E	N	E	N	E	N	E	N	E	N
4	12	6	11	3	14	10	3	4	2
21	10	4	25	3	25	21	4	4	5
22	22	18	25	3	12	2	16	4	3
1	13	23	9	23	15	14	8	25	7
20	5	2	3	14	12	2	13	2	12
18	14	10	19	21	14	4	18	10	1
24	10	2	18	18	21	1	8	15	9
22	5	22	14	20	22	20	19	5	8
18	23	8	18	17	25	19	2	21	5
20	8	14	10	16	1	11	12	15	5
20	13	11	9	18	1	11	23	11	20
22	7	7	24	8	24	11	25	11	10
13	21	10	20	16	10	14	19	14	21
13	8	12	19	14	4	1	15	18	8
16	8	6	2	13	2	5	23	1	2
15	1	4	24	8	21	6	16	13	9
3	18	20	12	25	14	23	12	4	10
13	18	19	21	9	10	8	6	9	9
22	3	24	2	15	7	13	1	23	4

- Practica análisis espacial
- Epidemiology simulation Games McRoberts y Gughes 2015
- Asignación 4



t	newly infected	total (accumulated)
0	4	4
1	12	16
2	20	36
3	29	65
4	45	110
5	39	149
6	74	223
7	77	300
8	85	385
9	79	464
10	61	525
11	54	579
12	18	597
13		
14		
15		
16		
17		
18		

***Long-range dispersal every 50 infected plants

#	E	N	success? (Y=1/N=0)	
1	4	12	1	
2	21	10	1	
3	22	22	1	
4	1	13	0	
5	20	5	0	
6	18	14	0	
7	24	10	0	
8	22	5	0	
9	18	23	0	
10	20	8	0	
			3	Total successful jumps