BANANA BLACK SIGATOKA
To a better understanding of this disease control.

A presentation to the staff of
Thermal Lube and Gro Green
by Eduardo Martillo

Guayaquil, Julio 11 del 2014

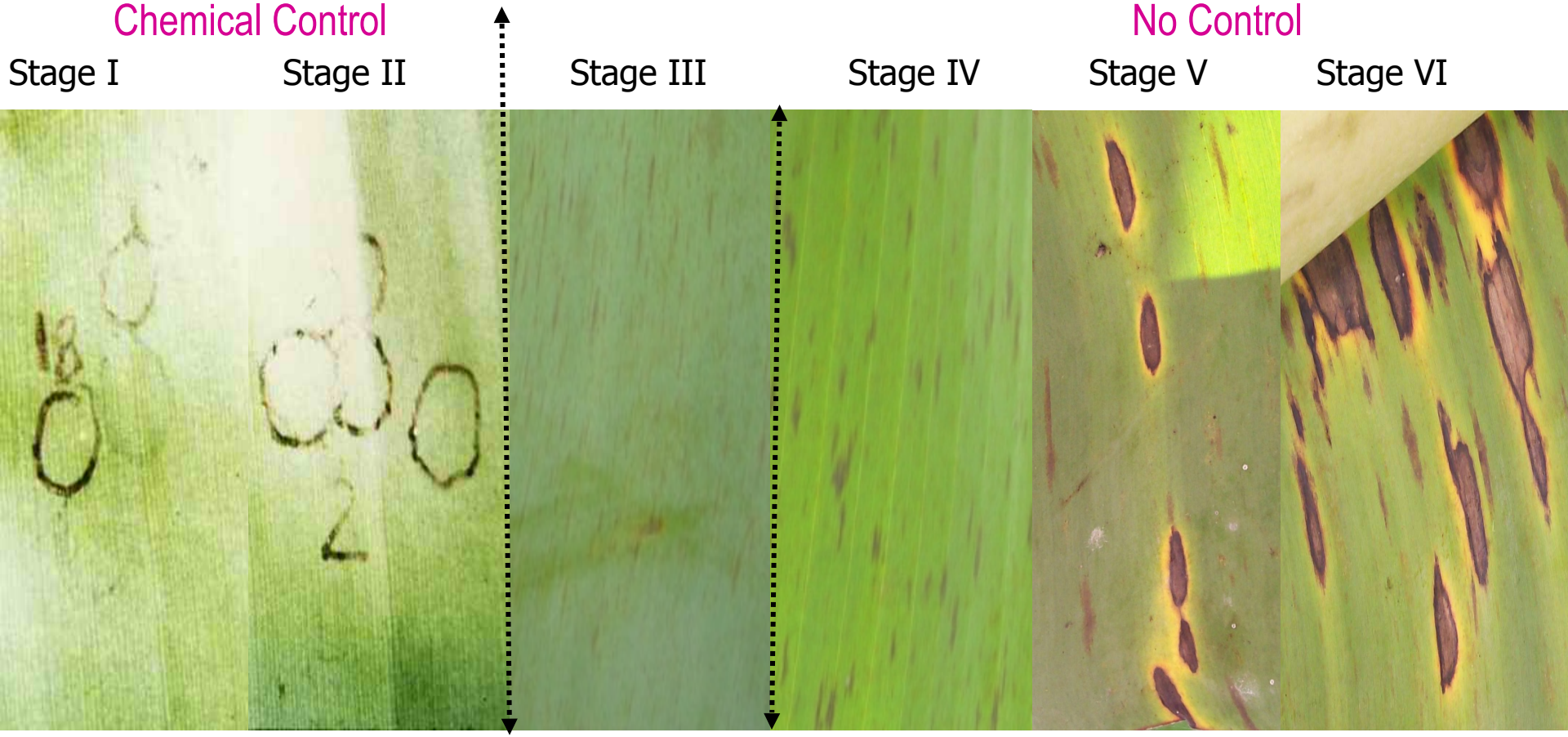
Welcome you all
To Ecuador !!!!!!

Agripac S.A.

Black Sigatoka

- This disease is caused by the fungus *Micosphaerella fijiensis* belonging to the ascomicete family.
- This disease can reduce until de 50 % of the banana production in the field.
- The challenge is to protect most of the banana plant leaves form this disease and keep them green.

Black Sigatoka: Stages of development



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History

- **1934.** Yellow Sigatoka (*Micosphaerella musicola*) arrived in the Caribbean and Central America.
- UFC met the challenge rapidly by application of Bordeaux mixture (25% of Cupper Sulphate + 75% of hydrated cal)
- Control was primarily by reducing conidial producction and toxifying conidia by redistribution of copper in dew and rainwater on the leaf surface.
- **1958.** Commercial applications of oil spray.
- Came the introduction of the protectant dithiocarbamate fungicide DITHANE M-22 applied in water.

History

- 1962. It was realized that this protectanct fungicide applied in an oil-in-water emulsion were much more effective than when applied in water alone.
- Oil is effective whether applied as an oil water emulsion or alone.
- Under heavy rainfall conditions oil alone gives superior disease control.

History

- **Rol of oil in controlling banana leaf spot:**
- It improves the spreading and sticking properties of all fungicides.
- It enhances the penetration of systemic fungicides
- It has profound effects on the patogen inside the leaf.
- Oil is a fungistatic greatly retarding patogen development inside the leaf following invasion

History

- **<u>Oil disadvantage:</u>**
- It causes phytotoxicity symptoms in the leaf such as leaf flecking and photosyntesis reduction.

History

- **First systemic fungicide.**
- **1972.** Benlate (produced by Dupont) was widely applied in oil alone and in oil-in-water emulsions and giving excellent control.
- This systemic fungicide was superior than protectant because they penetrated through the upper surface of the youngest unfurle leaves where tha patogen was still in the early satages of development.
- Therefore, it acts on the patogen inside the leaf long before it could sporulate

Fungicide uses

Year	Fungicide	a.i.	Chemical Group	Action type
1958	Dithane®	mancozeb	Bisdithiocarbamate	**Contact**
1972	Benlate ®	benomyl	Benzimydazol	Sistemic*
1978	Bravo 720 ®	Chlorothalonil	Ftalonitrilo	**Contact**
1982	Calixin 860 OE ®	Thridemorph	Amina	Translaminar
1987	Tilt 250 CE ®	Propiconazole	Triazole	Systemic*
1997	Bankit 250 CS ®	Azoxystrobin	Methoxiacrylate	Systemic*
2004	Siganex 500 CE ®	Pyrimethanil	Pyrimidin	Systemic
2006	Impulse 800 CE®	Spyroxamina	Amina	Systemic
2006	SERENADE ®	Bacillus subtilys	BIOLOGIC	**Contact**
2007	AGSOIL 23 CE®	M. alternifolia	ORGANIC	Systemic
2009	Cumora ®	Boscalid	Carboximide	Systemic

THE PETROLEUM OIL HAS BEEN USED TO CONTROL Y AND BS SINCE 1958 TILL NOW.

* Fungus resistances to these compounds.

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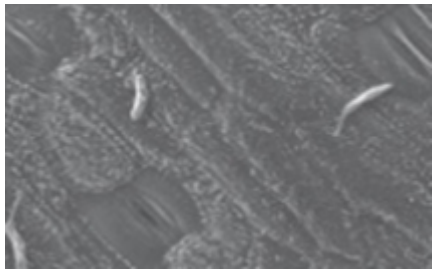
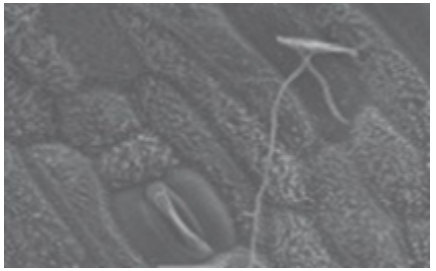
Ciclo de vida de la Sigatoka Negra

- La Sigatoka Negra tiene un ciclo sexual y asexual**.**
- En el ciclo sexual se producen **ascosporas** que son **diseminadas sobre distancias largas por el viento** y son consideradas las más importantes en el desarrollo de la enfermedad.
- Durante el **ciclo asexual** se producen los **conidios** que son diseminados sobre **distancias cortas** en la planta **por el agua**.
- Después de la germinación de las ascosporas o de las conidias el hongo puede crecer en la superficie de la hoja por cierto tiempo antes de **penetrar la hoja vía las estomas**.
- Bajo condiciones óptimas la Sigatoka Negra puede avanzar durante un ciclo vital completo en **21 días**.



Ascosporas



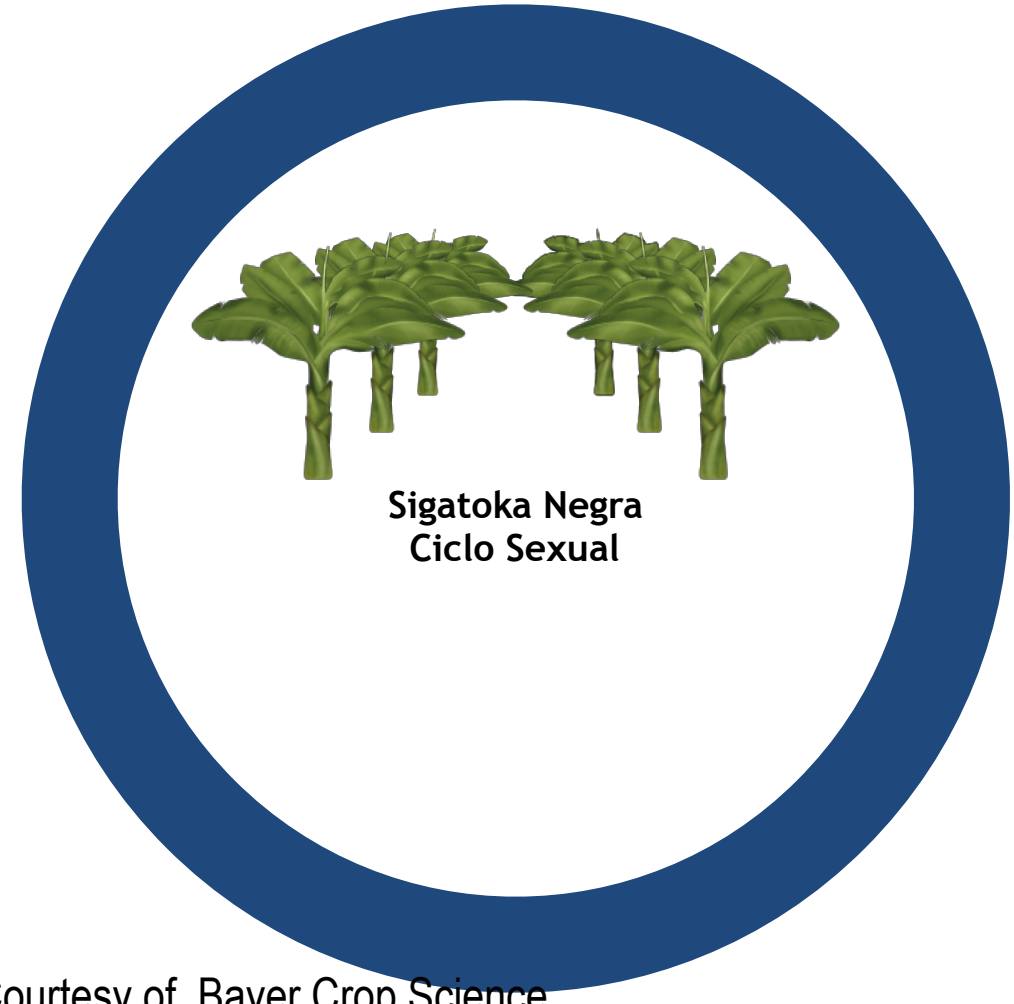
Desarrollo del tubo germinativo

Courtesy of Bayer Crop Science

Ciclo de vida de la Sigatoka Negra

Courtesy of Bayer Crop Science

Ciclo Sexual de la Sigatoka Negra



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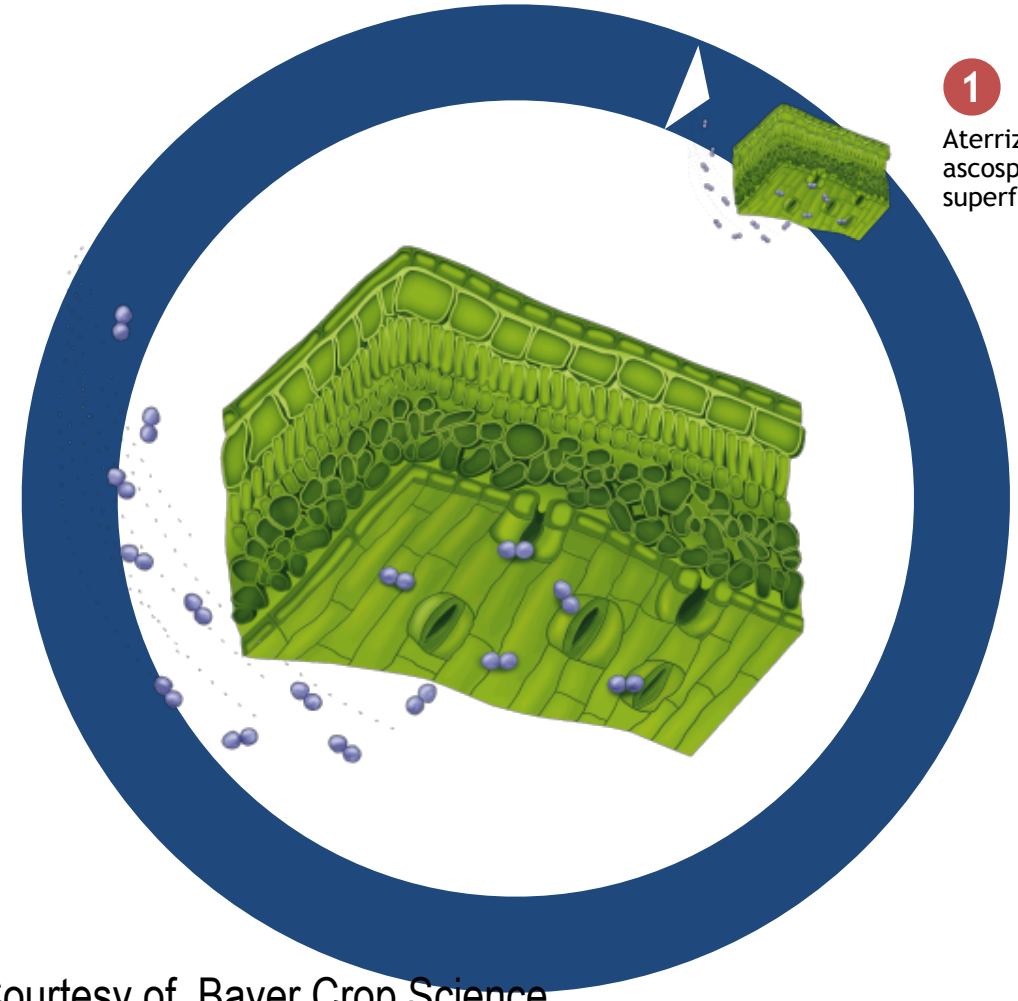
Ciclo Sexual de la Sigatoka Negra



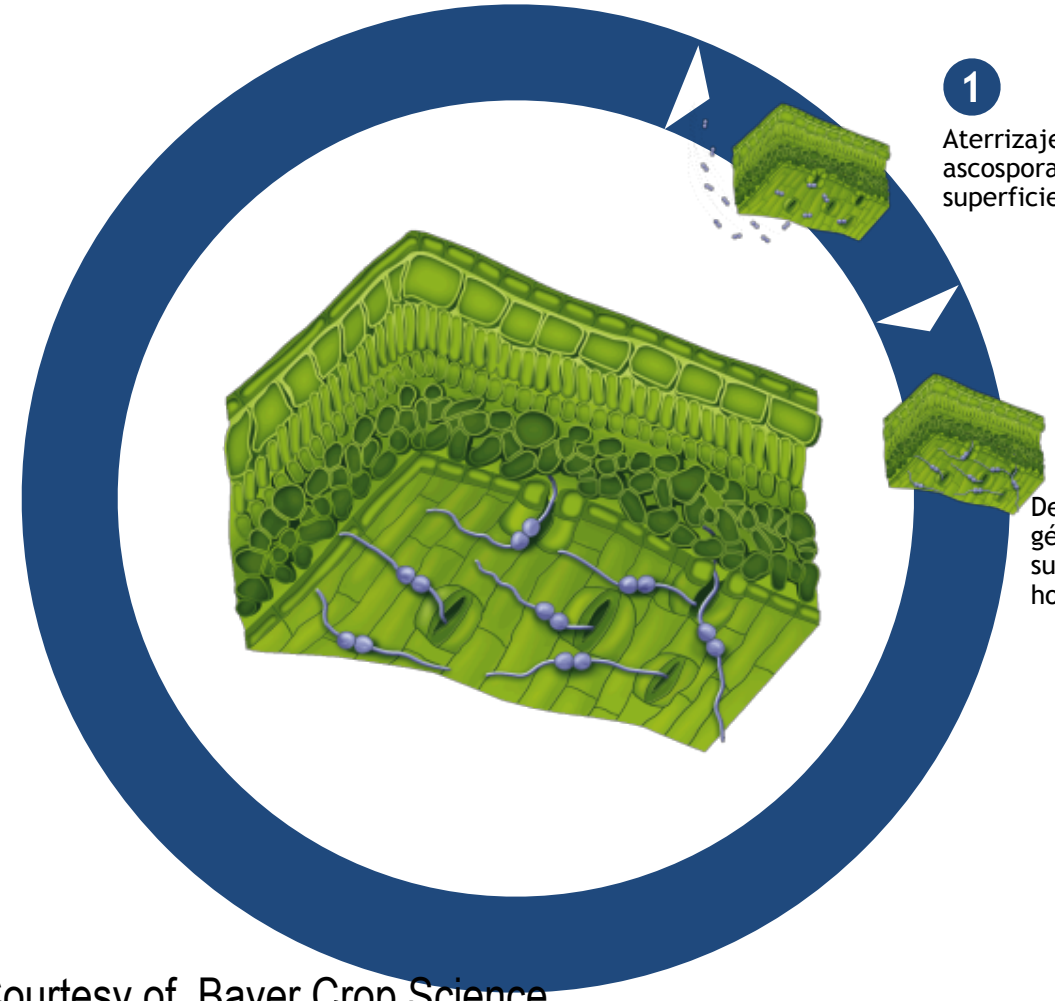
1

Aterrizaje de las ascosporas en la superficie de la hoja

Detalles Microscópicos

Courtesy of Bayer Crop Science

Ciclo Sexual de la Sigatoka Negra



1 Aterrizaje de las ascosporas en la superficie

2 Desarrollo del gérmen en la superficie de la hoja

Detalles Microscópicos

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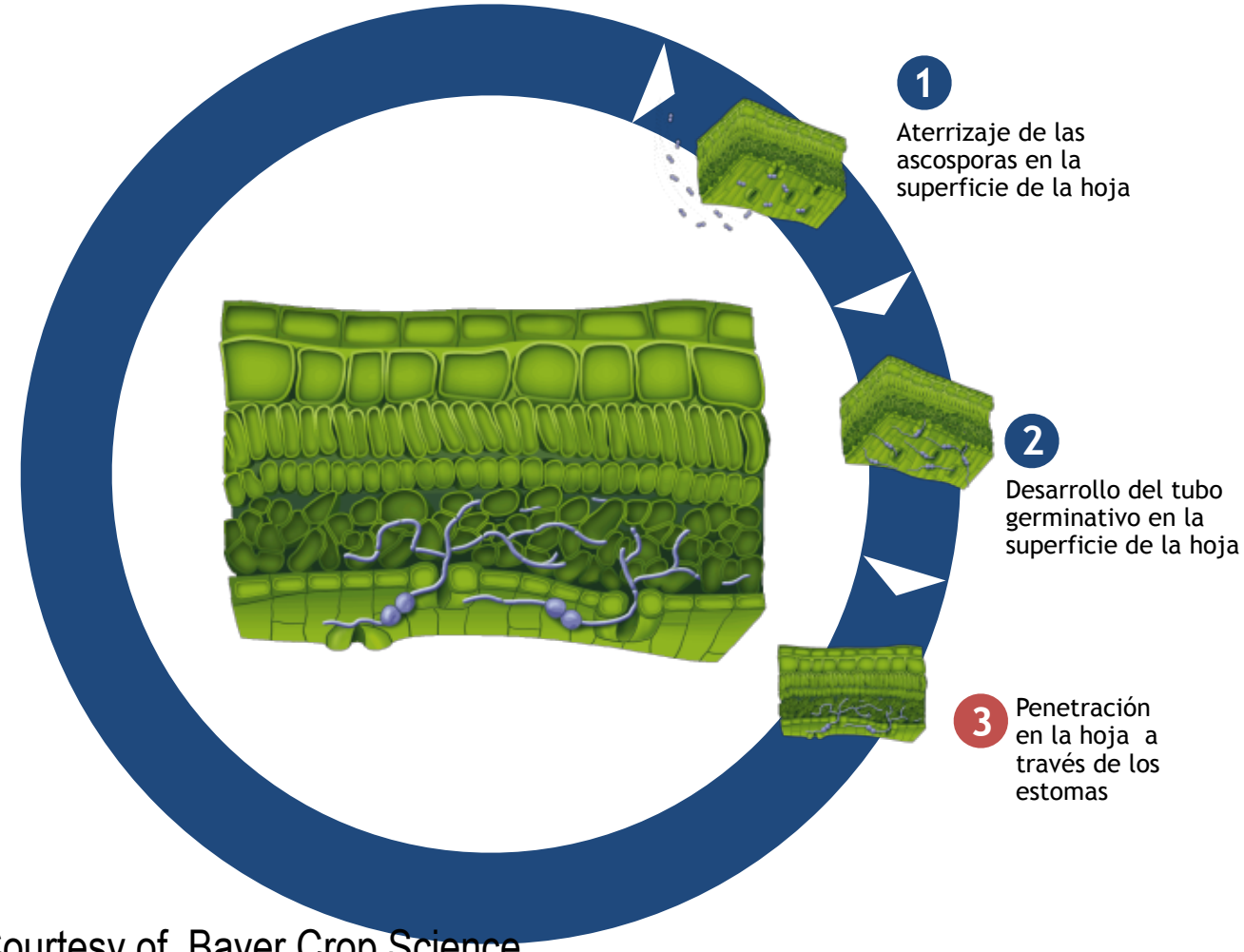

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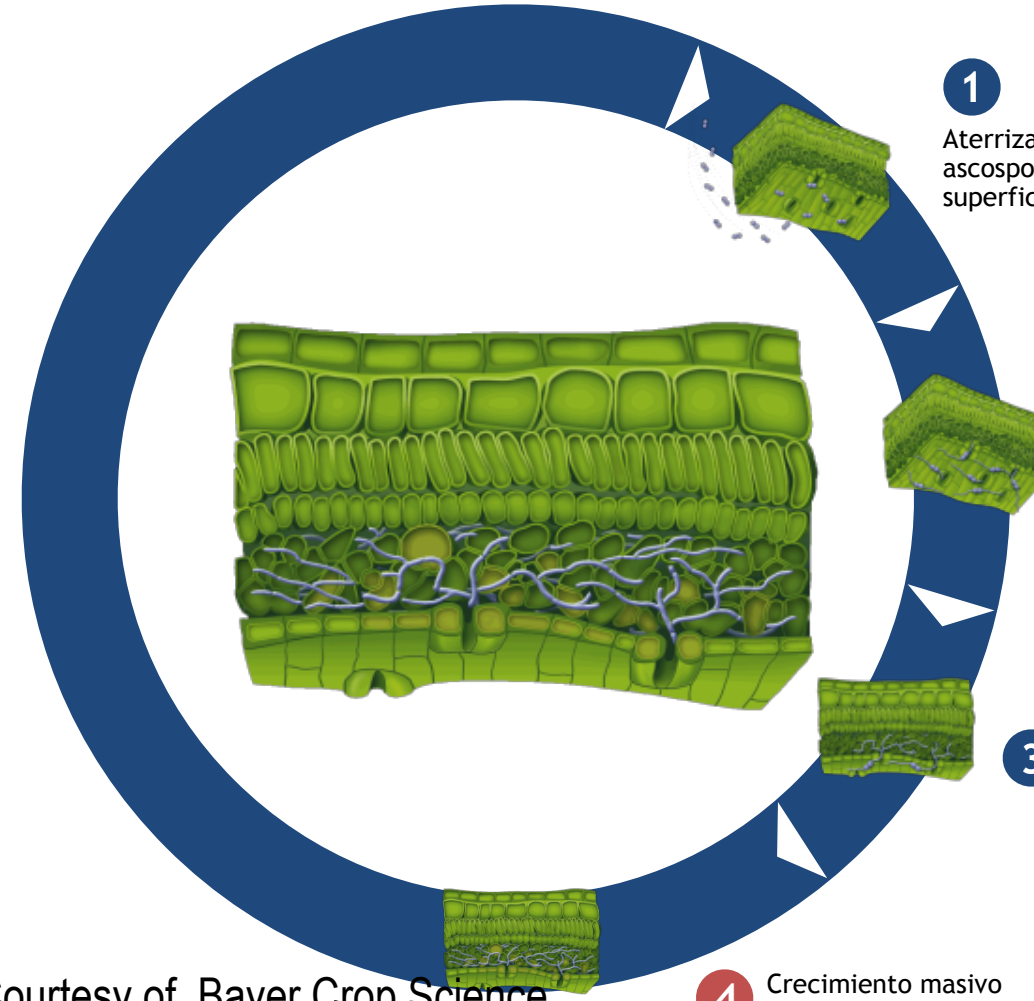
Ciclo Sexual de la Sigatoka Negra



1 Aterrizaje de las ascosporas en la superficie de la hoja

2 Desarrollo del gérmen en la superficie de la hoja

3 Penetración en la hoja a través de las estomas

4 Crecimiento masivo del mycelio

Síntomas de la hoja: estrias definidas

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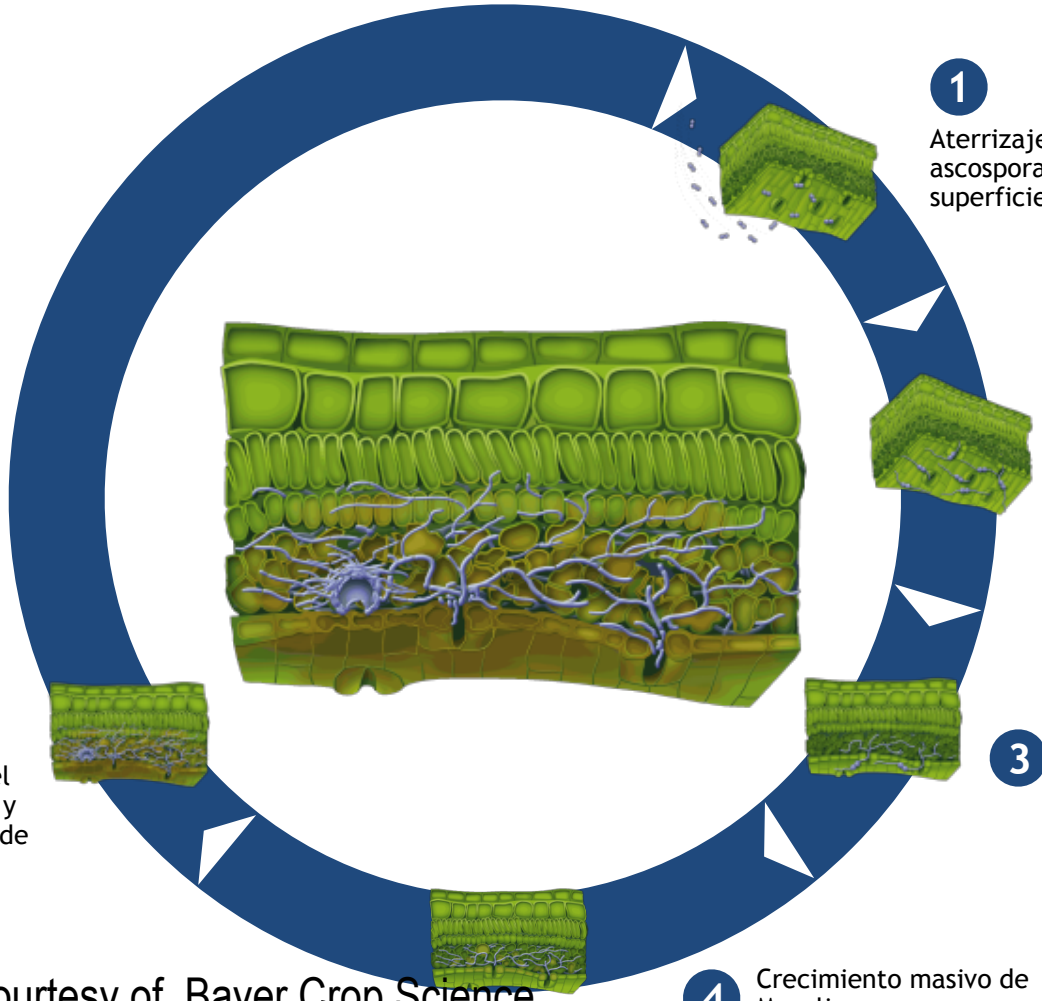
Ciclo Sexual de la Sigatoka Negra



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5 Desarrollo del spermogonia y lanzamiento de espermacia

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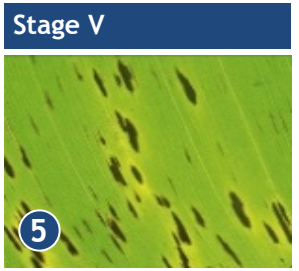
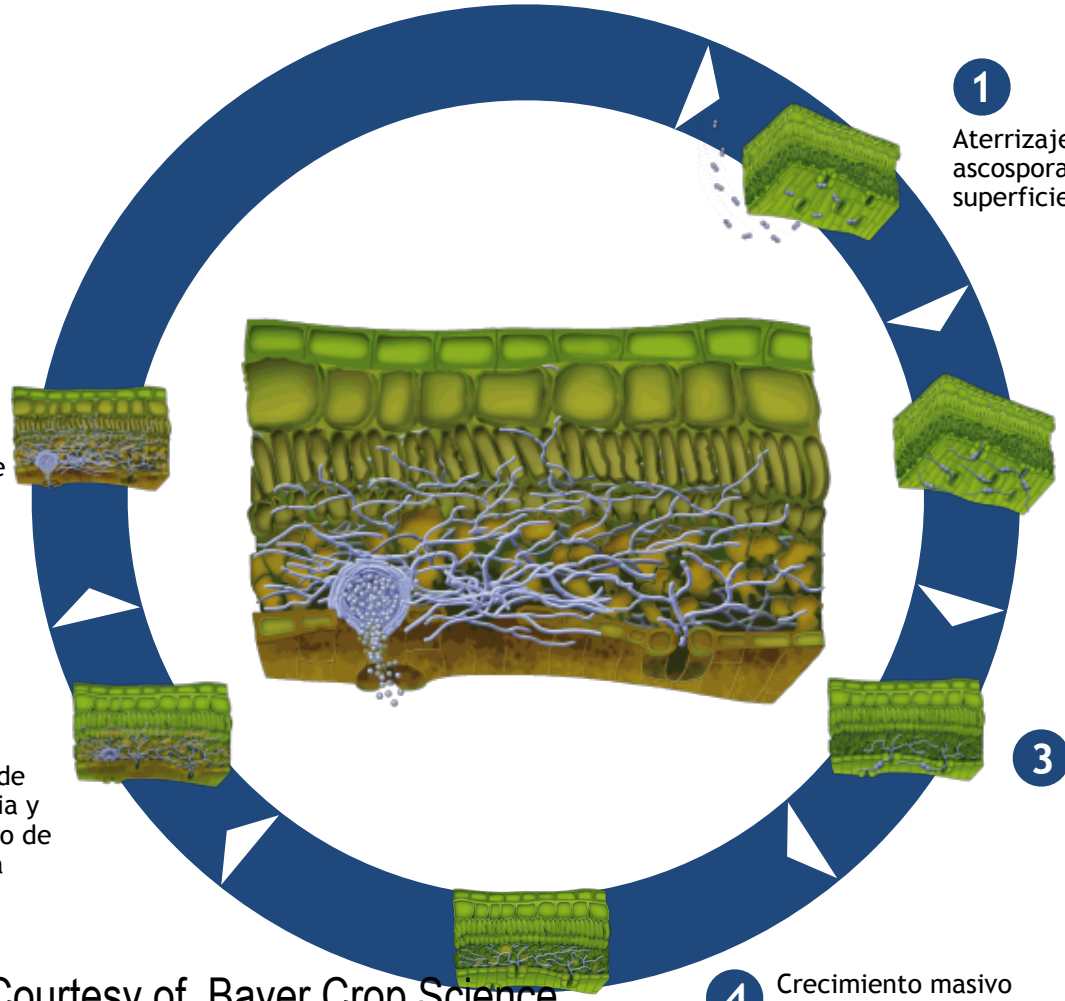


Síntomas de la hoja: aparición del halo amarillo

Ciclo Sexual de la Sigatoka Negra



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6 Fertilización de hyphe (♀) por spermacia (♂)

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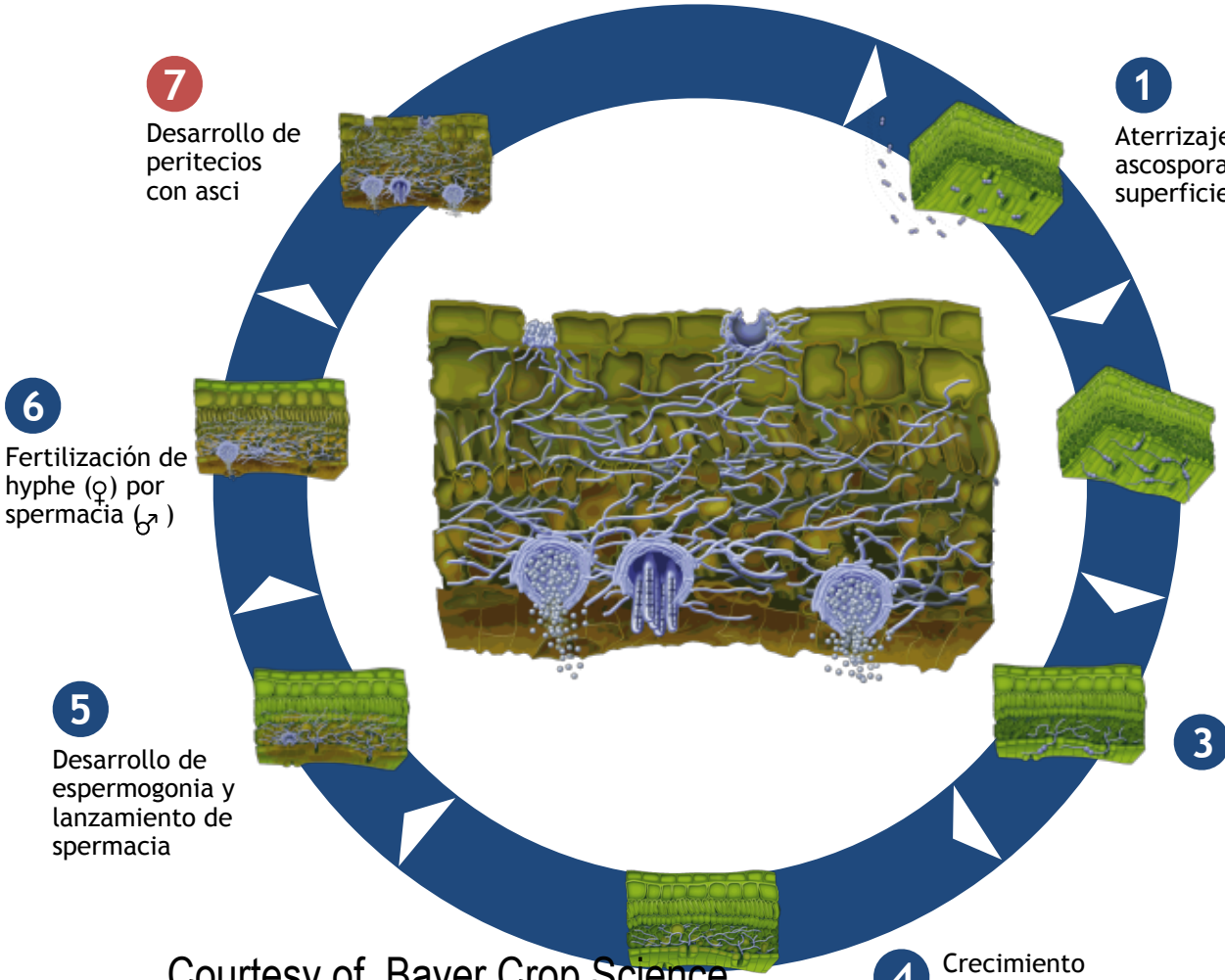
Ciclo Sexual de la Sigatoka Negra



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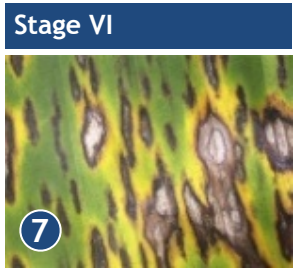
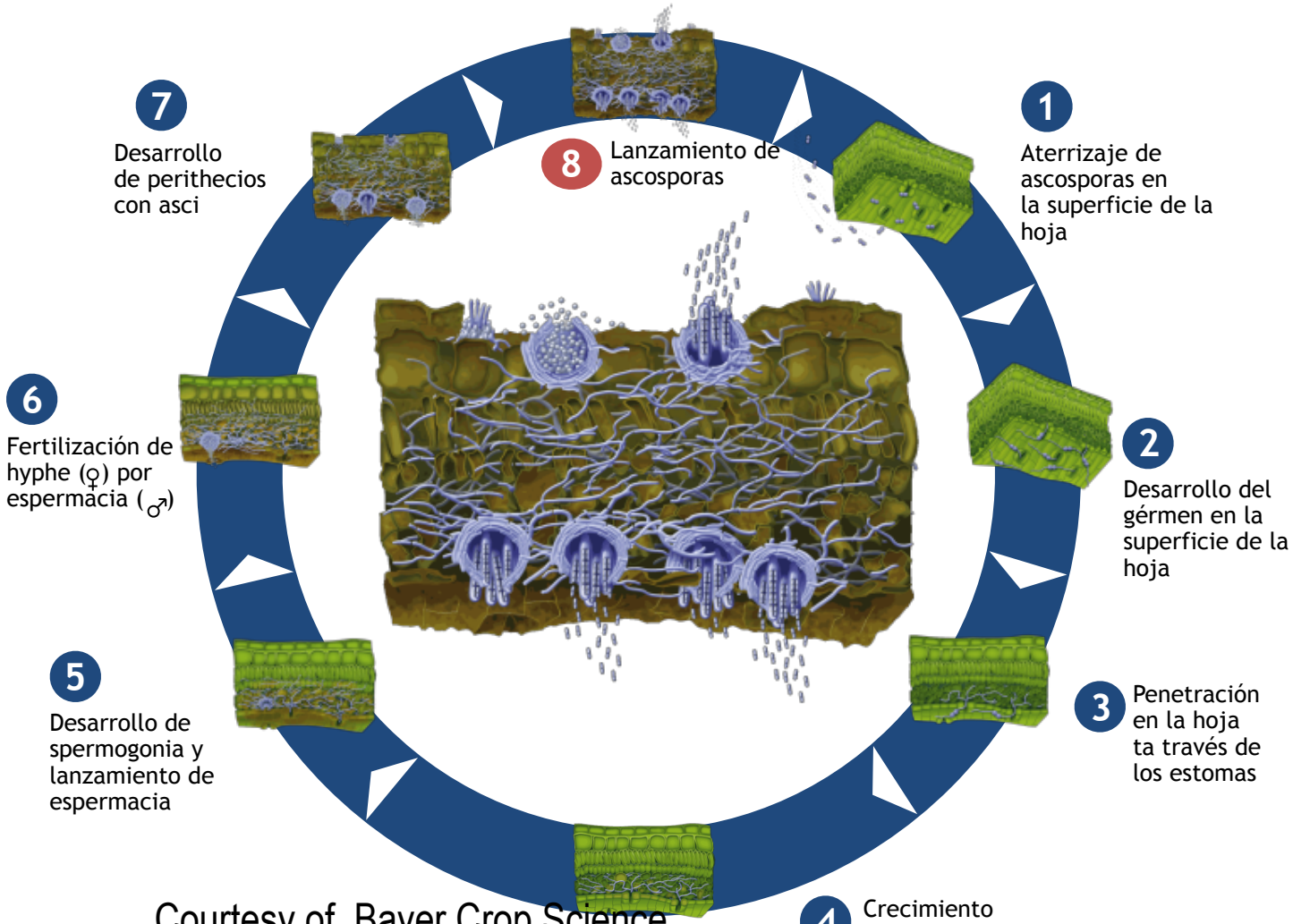


Síntomas de la hoja: area gris con perithecios

Ciclo Sexual de la Sigatoka Negra



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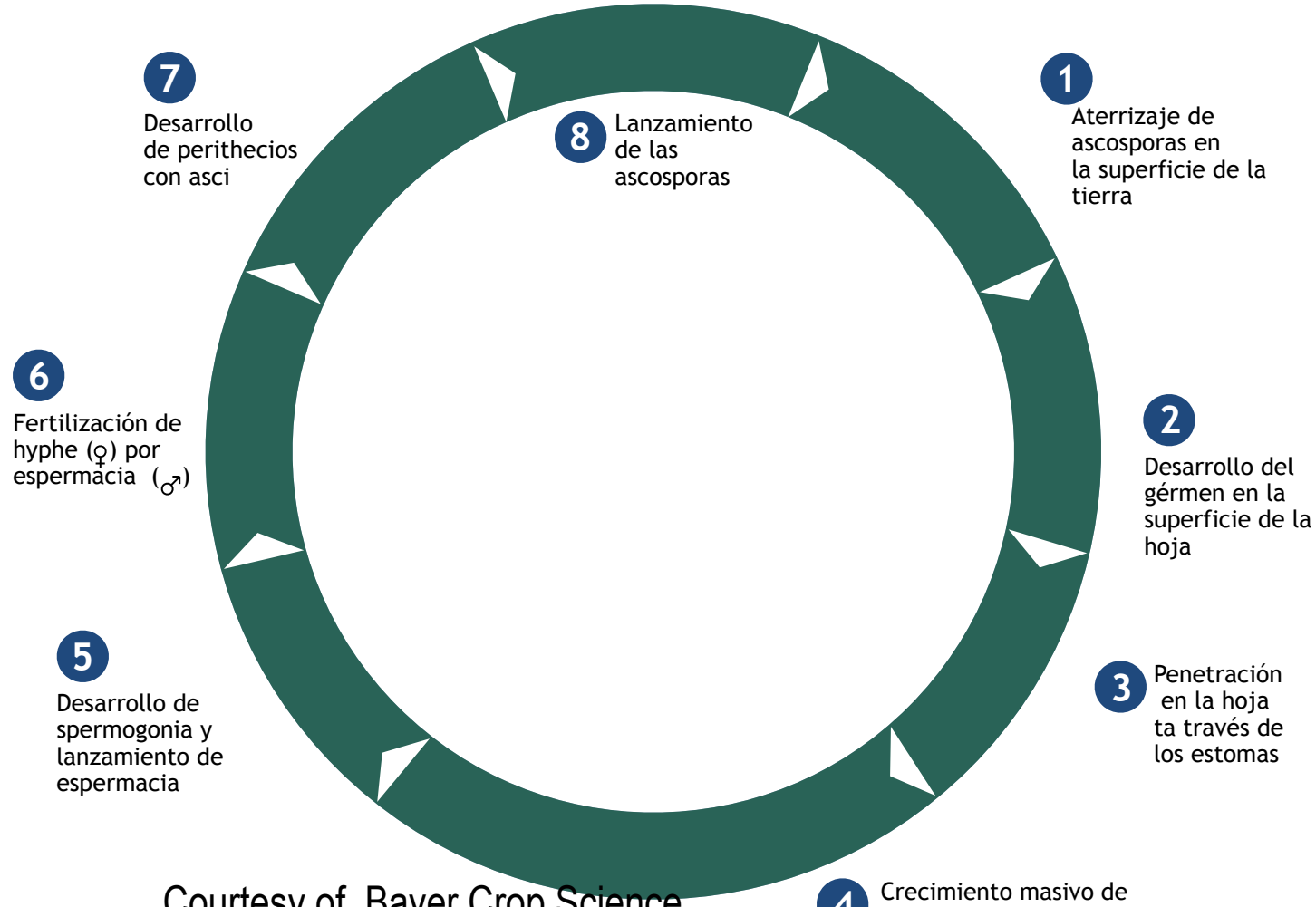

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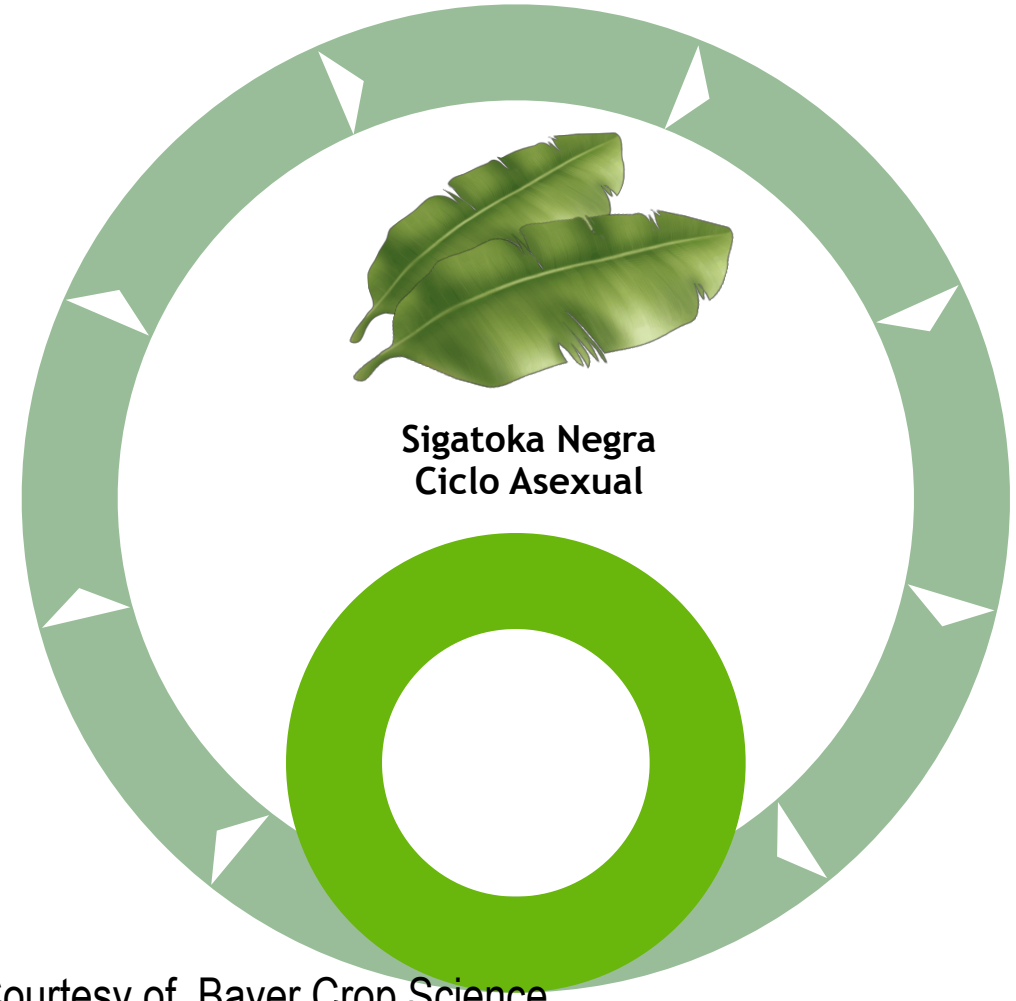
Ciclo Asexual de la Sigatoka Negra



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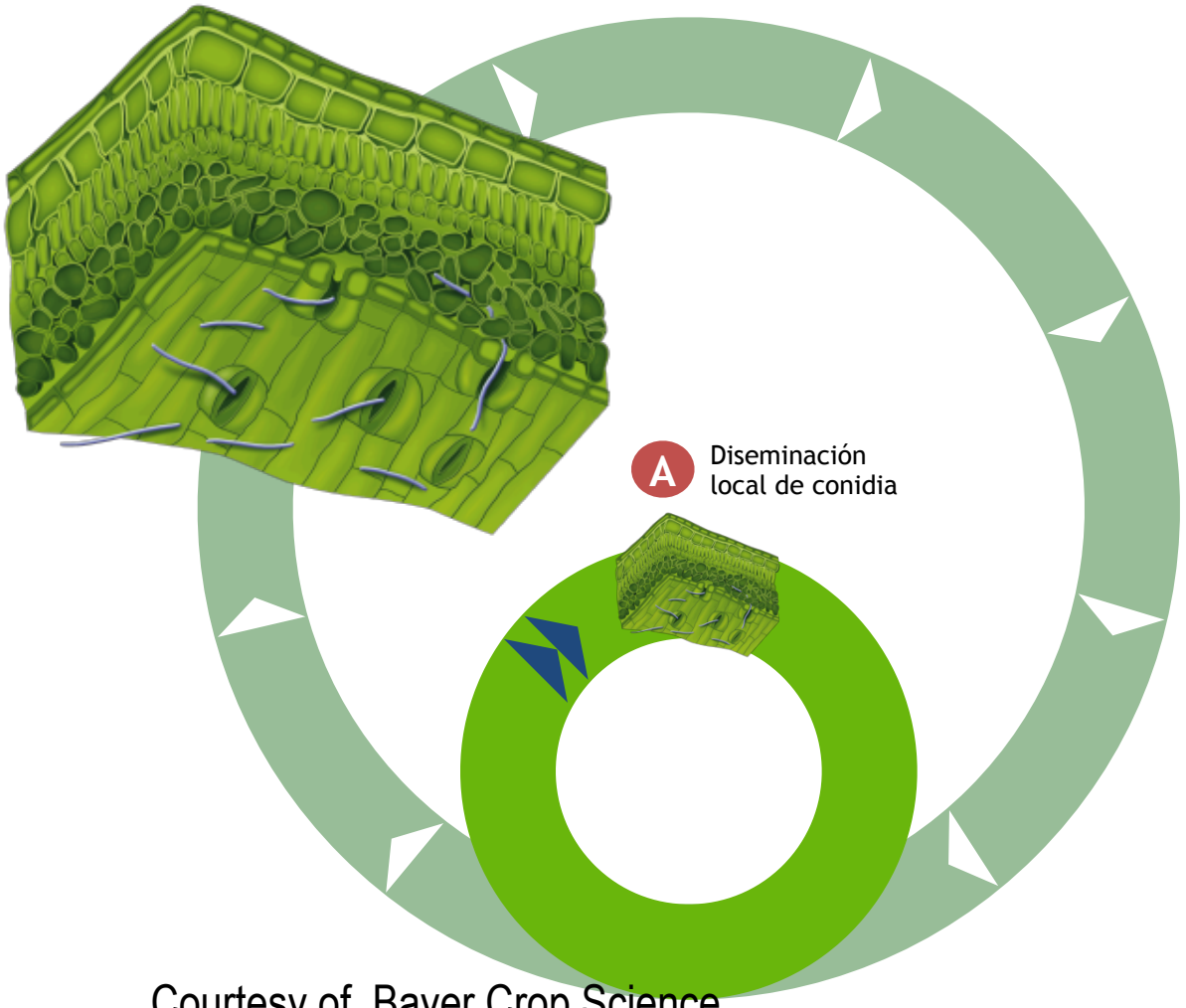
Black Sigatoka Asexual Cycle



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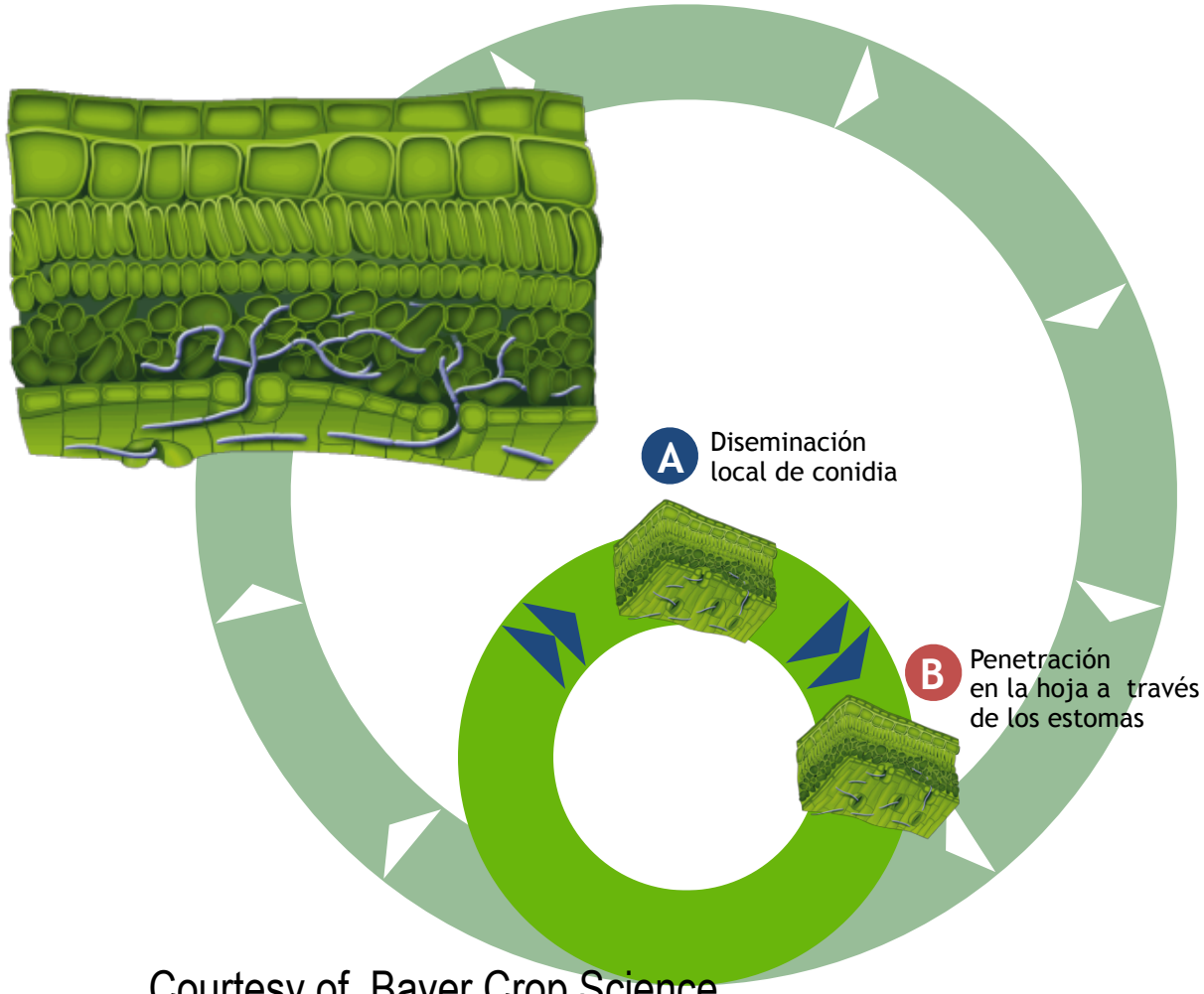
Ciclo Asexual Sigatoka Negra



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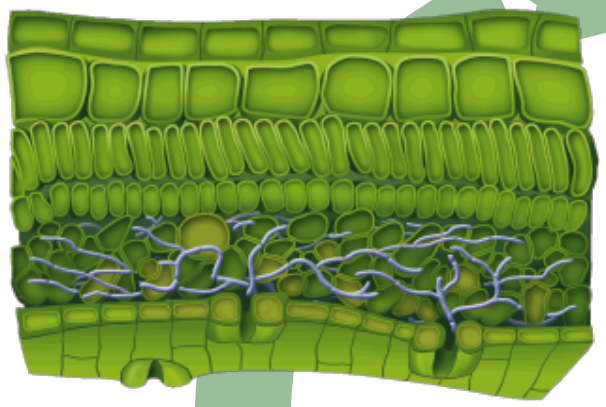

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Síntomas de la hoja: estrias definidas

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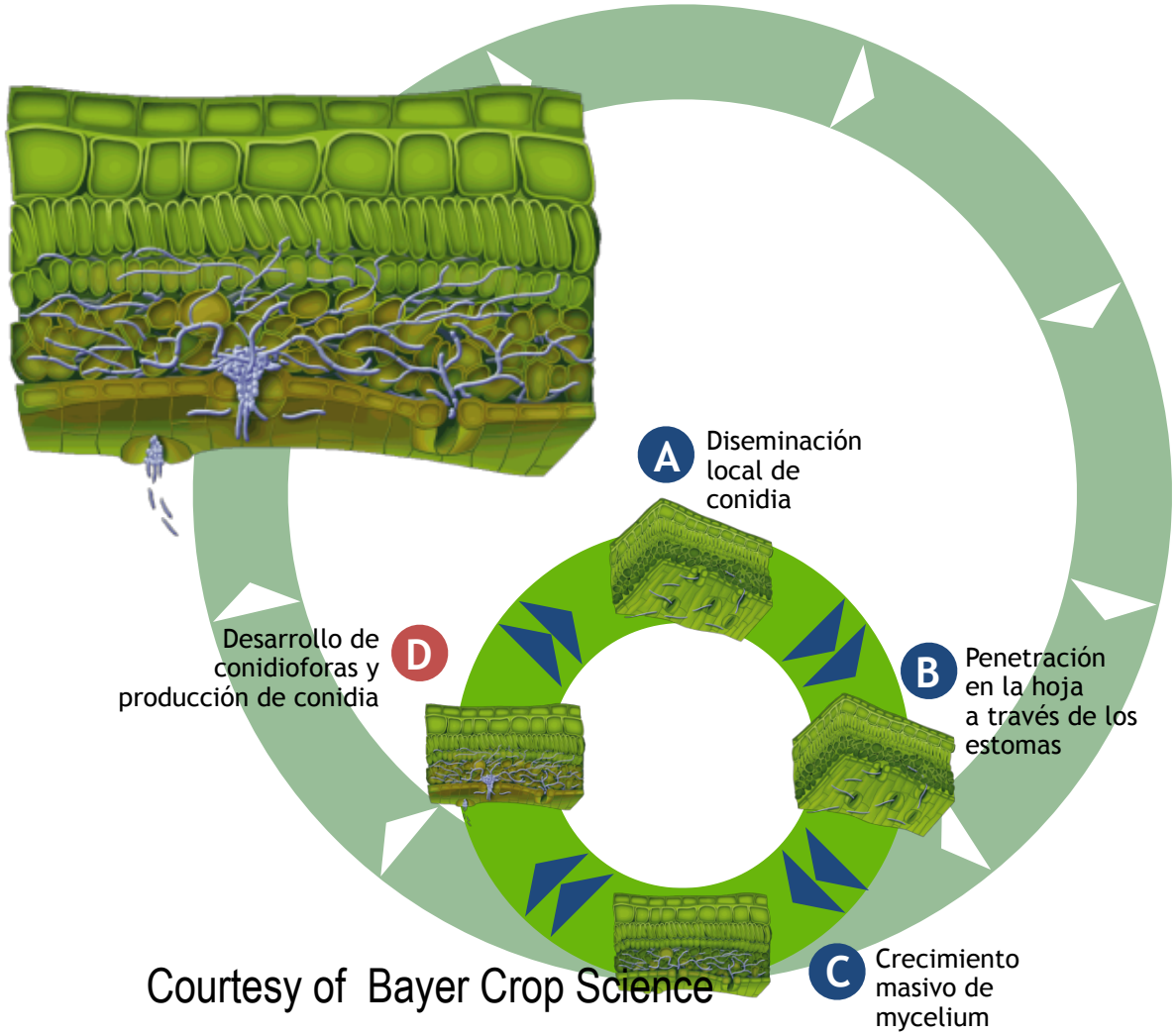

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Commercial applications in Ecuador

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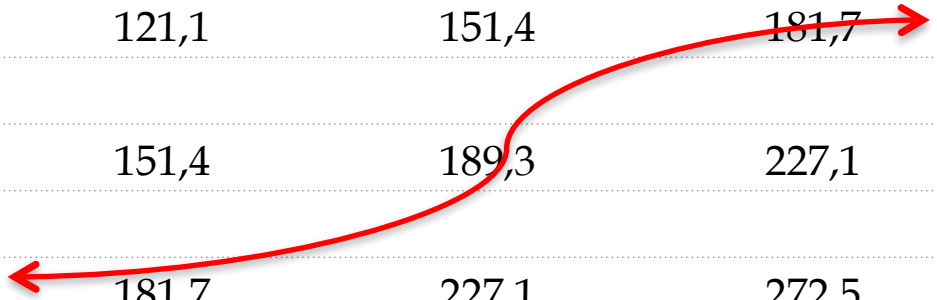
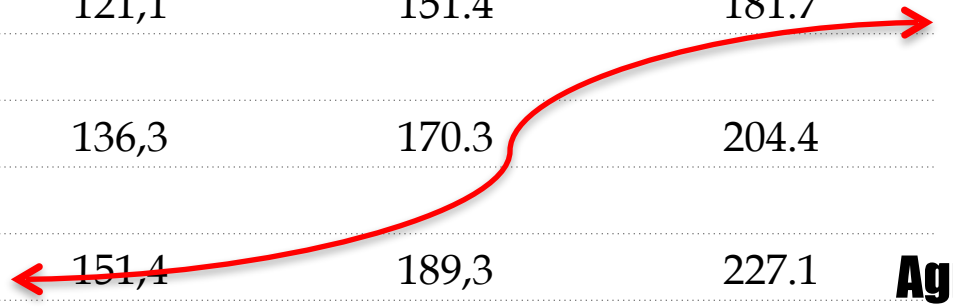
Liters of oil /ha/year

	gal/ha/ciclo		
Ciclos/año	**2,0**	**2,5**	**3,0**
16	121,1	151,4	181,7
20	151,4	189,3	227,1
24	181,7	227,1	272,5
28	212,0	265,0	317,9
32	242,2	302,8	363,4
36	272,5	340,7	408,8
40	302,8	378,5	454,2



Reduction of 50% oil/ha/year

Ciclos/año	gal/ha/ciclo		
	2,0	**2,5**	**3,0**
16	60,6	75,5	90.8
20	75,5	94,6	113.6
24	90,8	113.6	136.3
28	106,0	132.5	159.0
32	121,1	151.4	181.7
36	136,3	170.3	204.4
40	151,4	189,3	227.1



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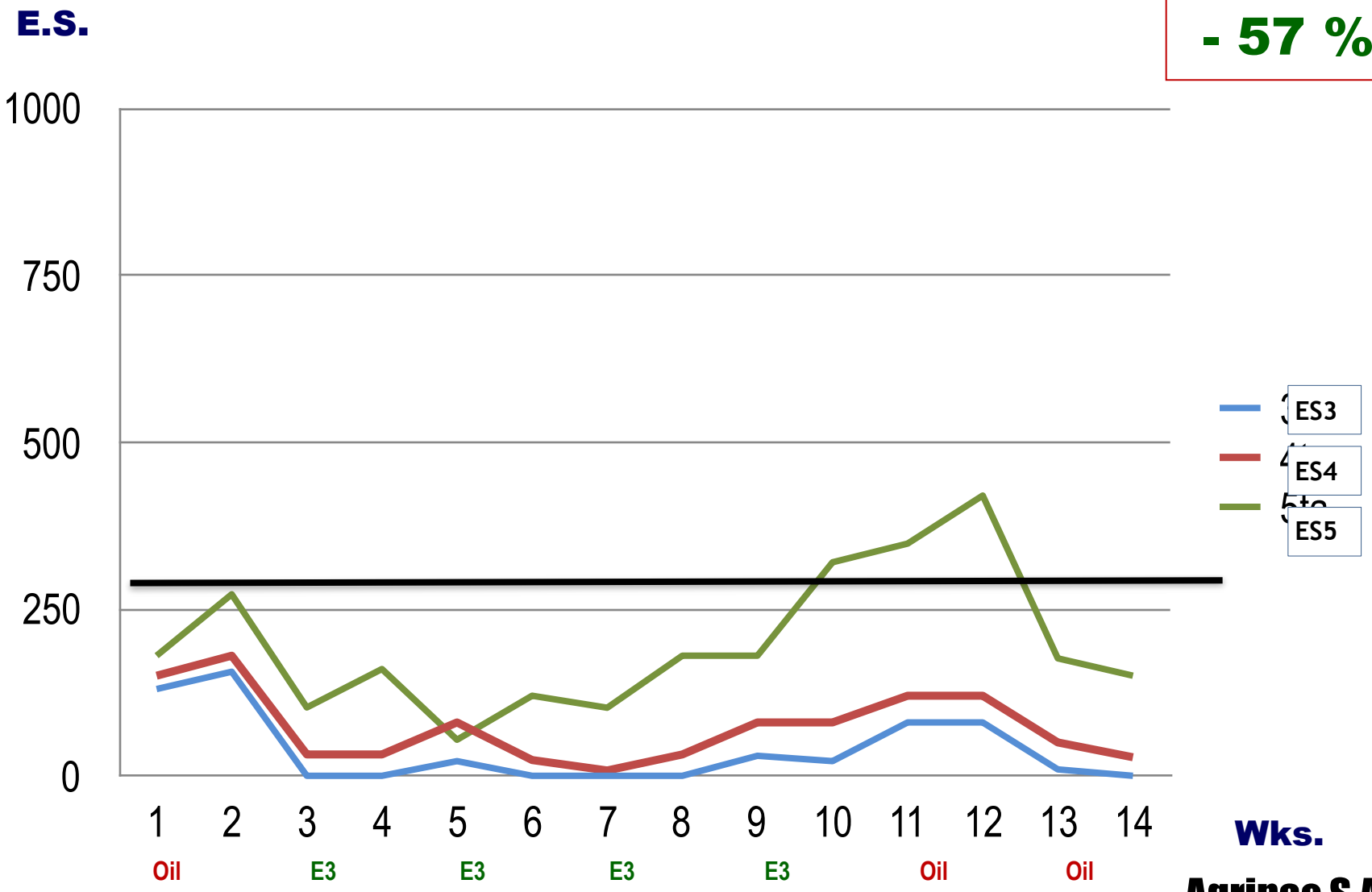
Mix Order per hectare

- 50 % of the total volume of water to be used (18,9 or 22,7 liters).
- 0,4 liters of E3
- Fungide 1 (Systemic)
- Fungicide 2 (Systemic o Protectan)
- 50 % of water
- TOTAL AGITATION TIME: 10 -12 MINUTES

Farm A: Evolutive Stage of the Disease

Oil Reduction
- 57 %



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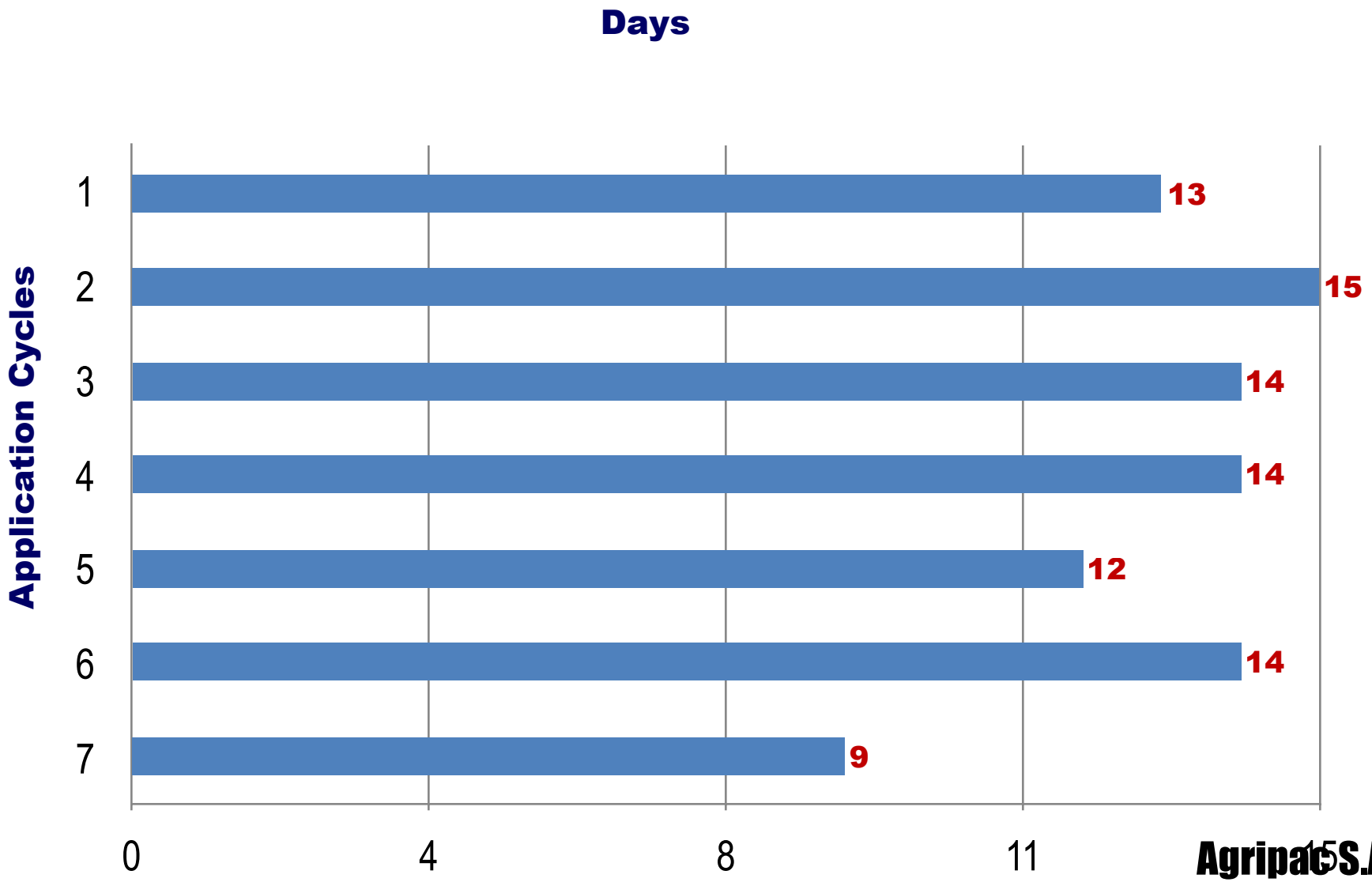
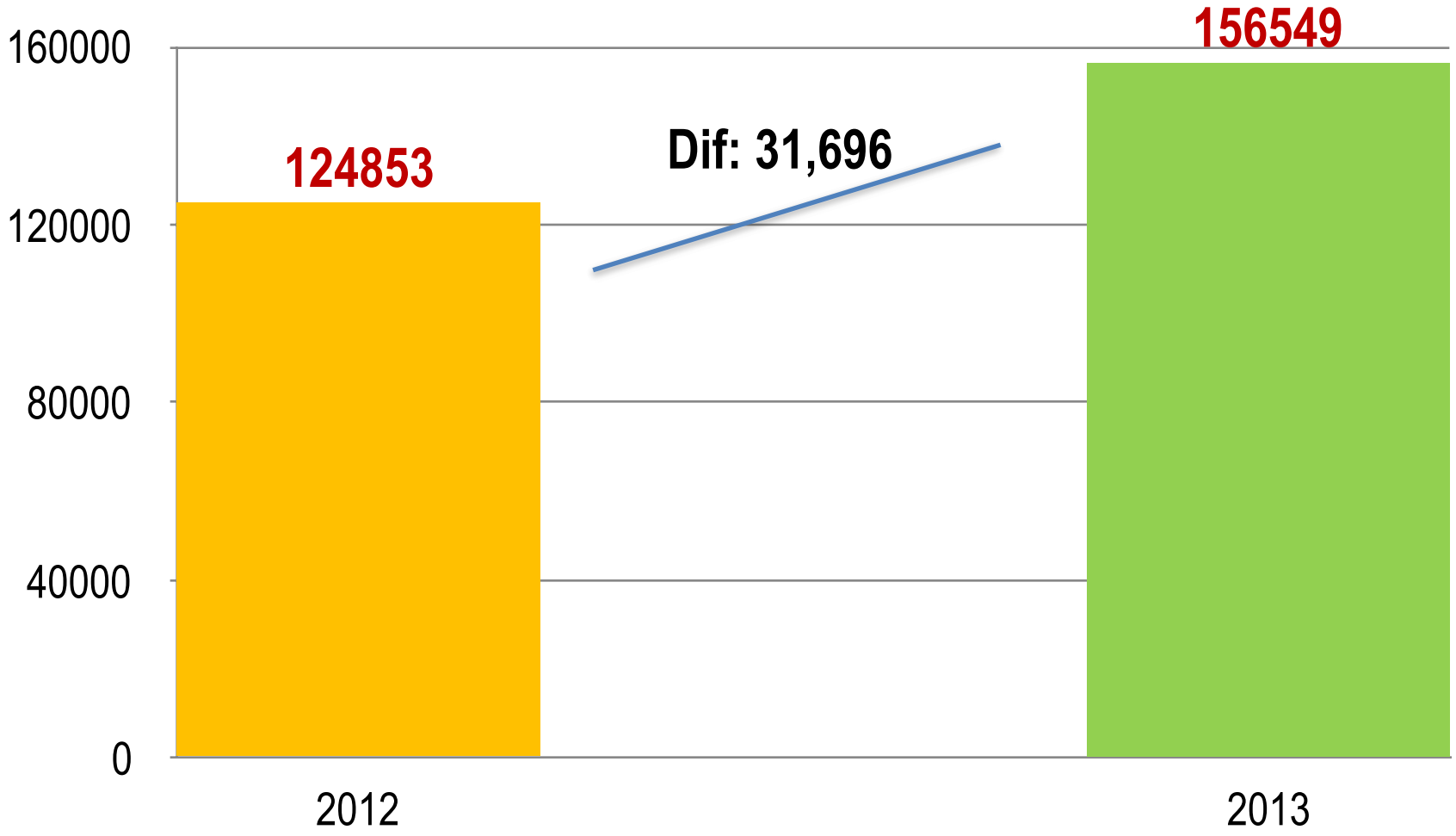
Farm A: Application Frecuency



Farm A: Boxes/week production to week 10



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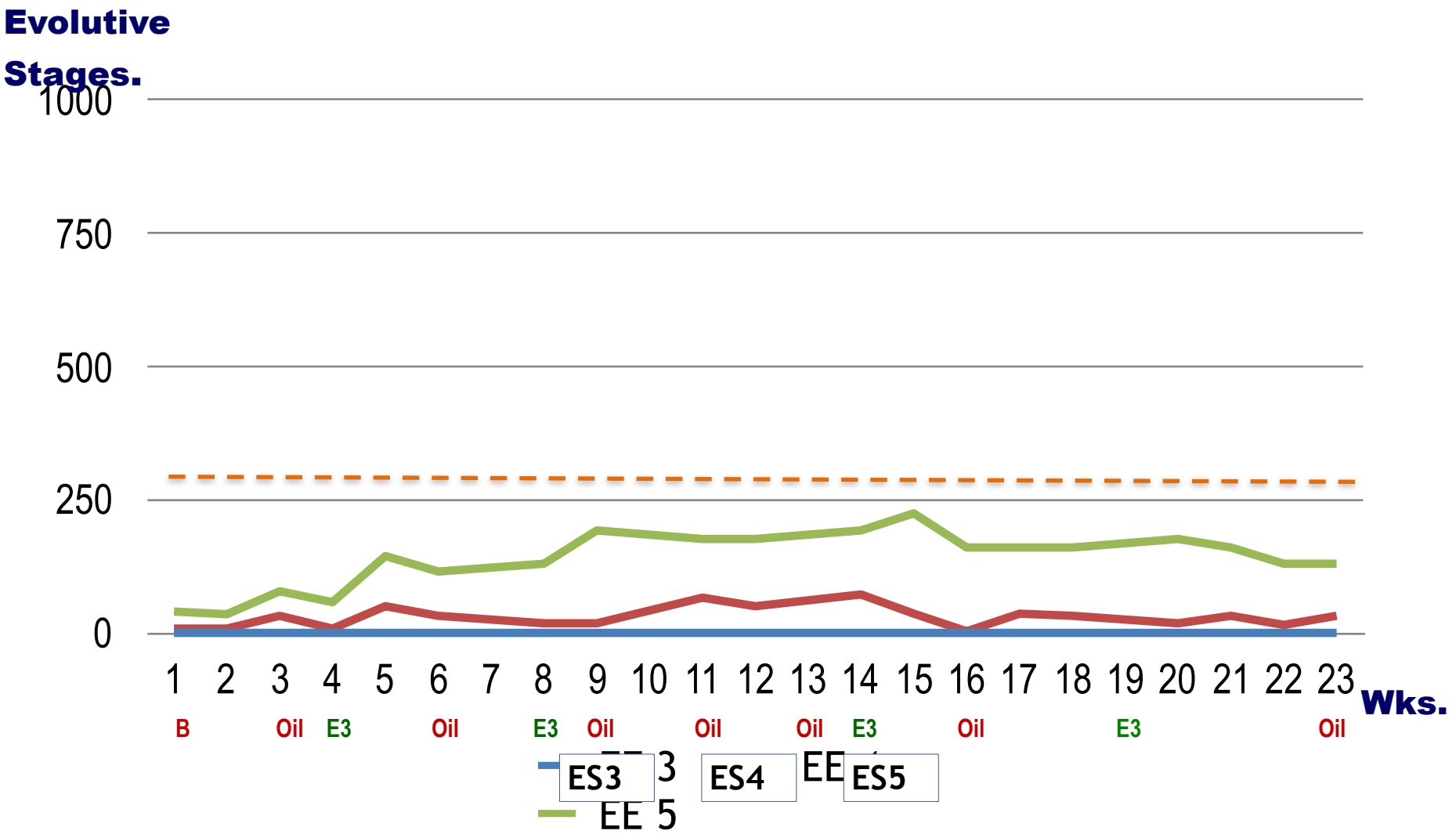
Valdivia Farm – Evolutive Stages



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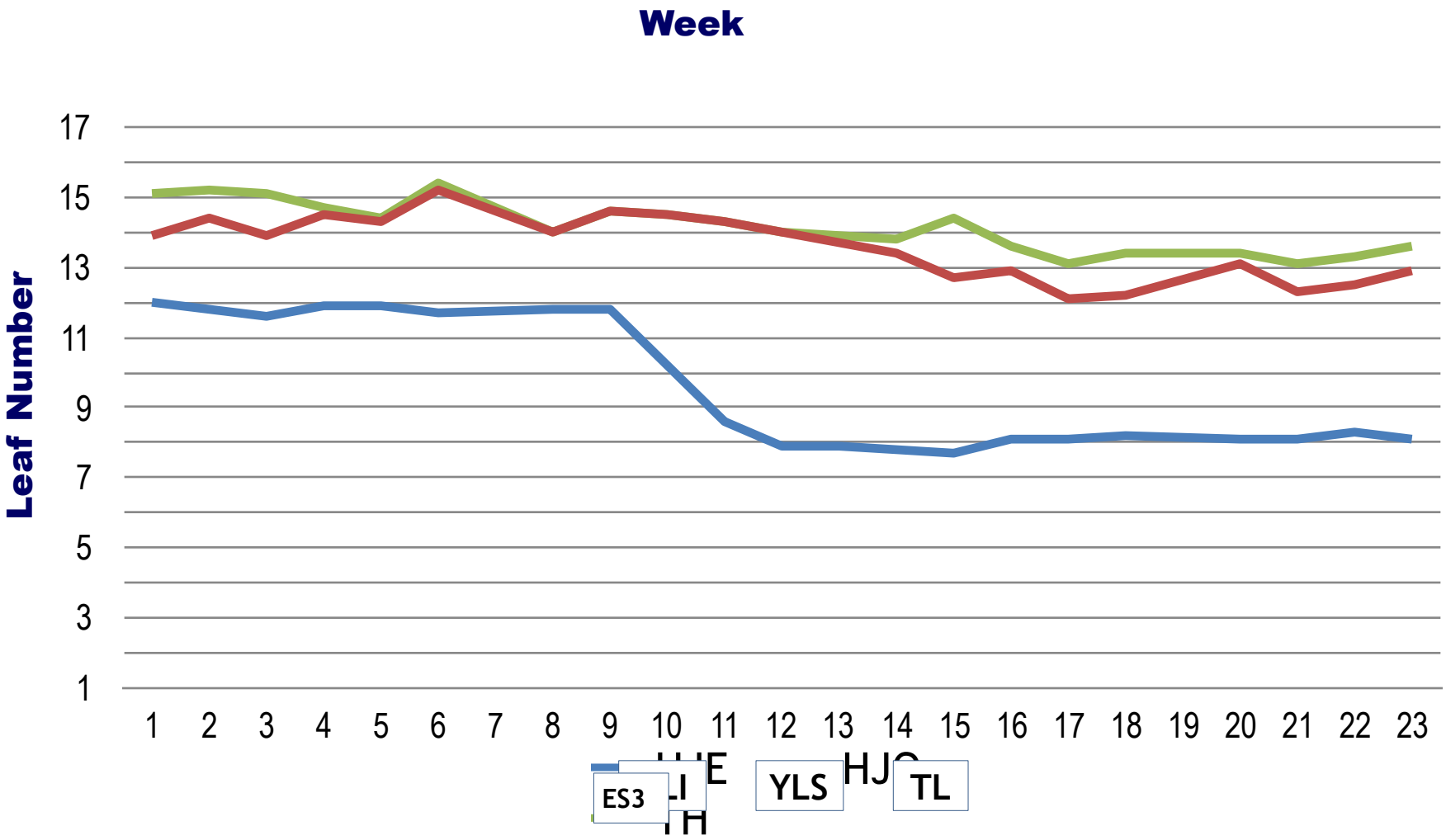
Valdivia Farm – "Close to flowering"



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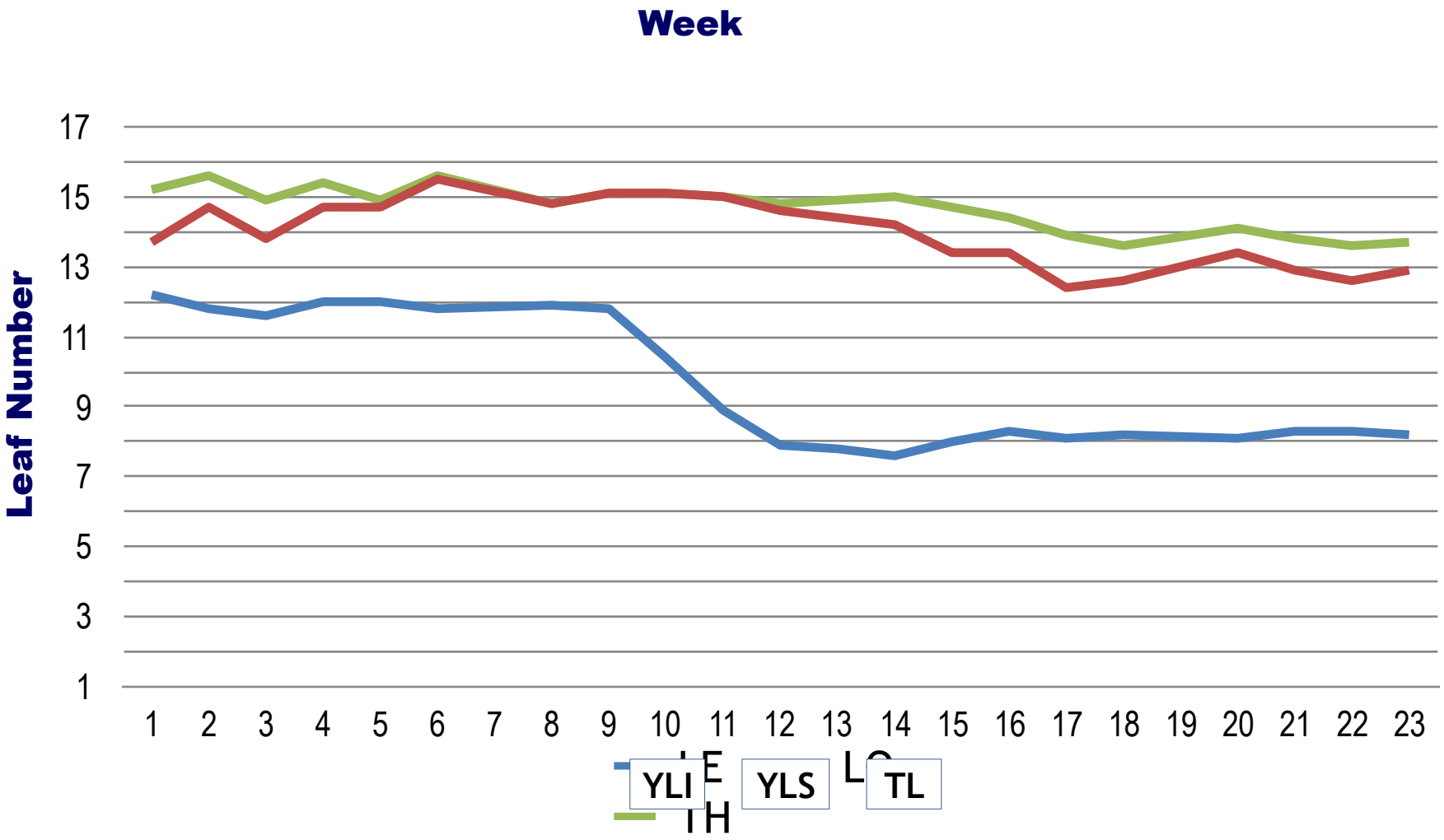
Valdivia Farm – “At flowering” Plants



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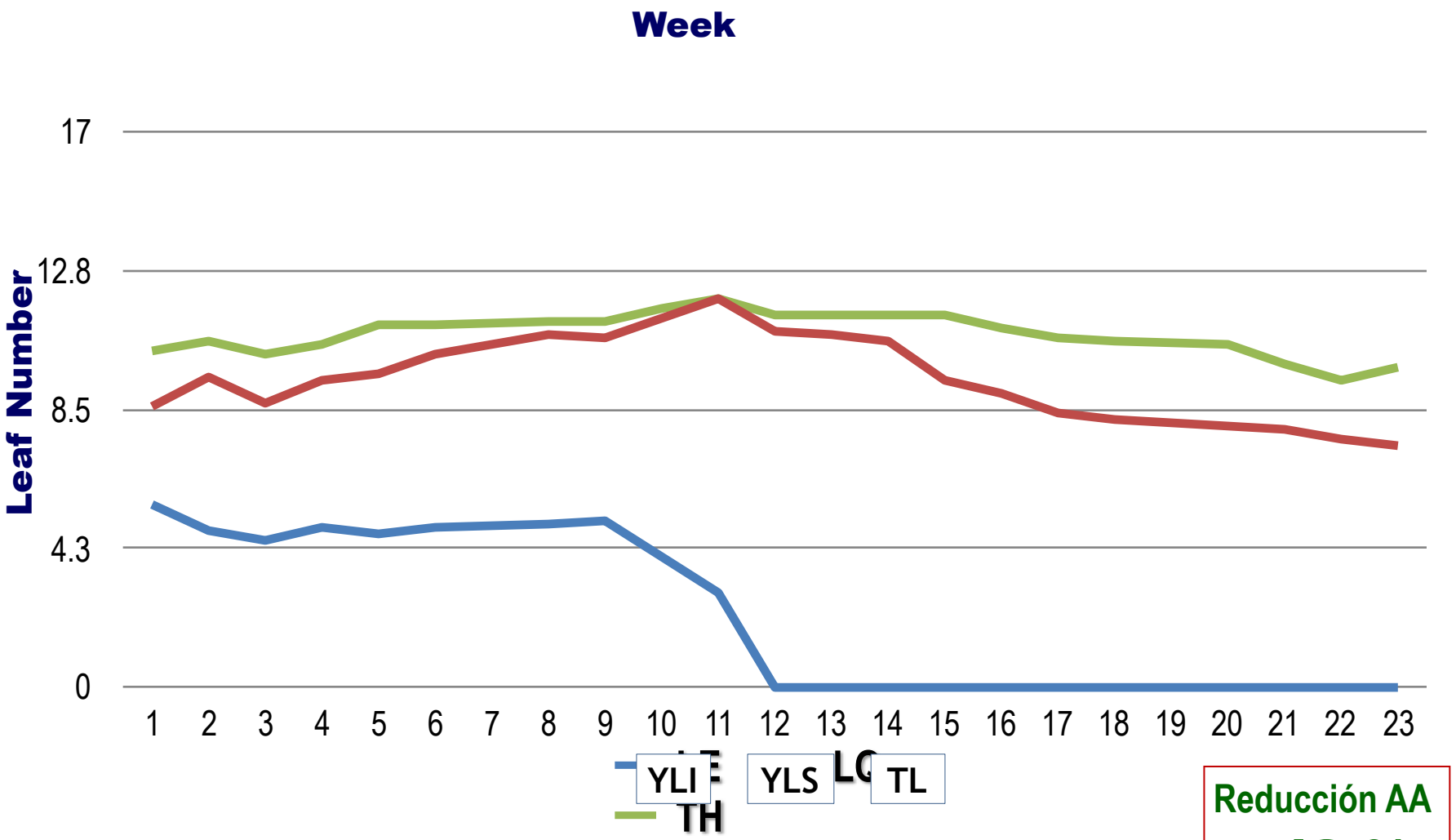
Valdivia – “Close to harvest” Plants



Reducción AA

- 42 %

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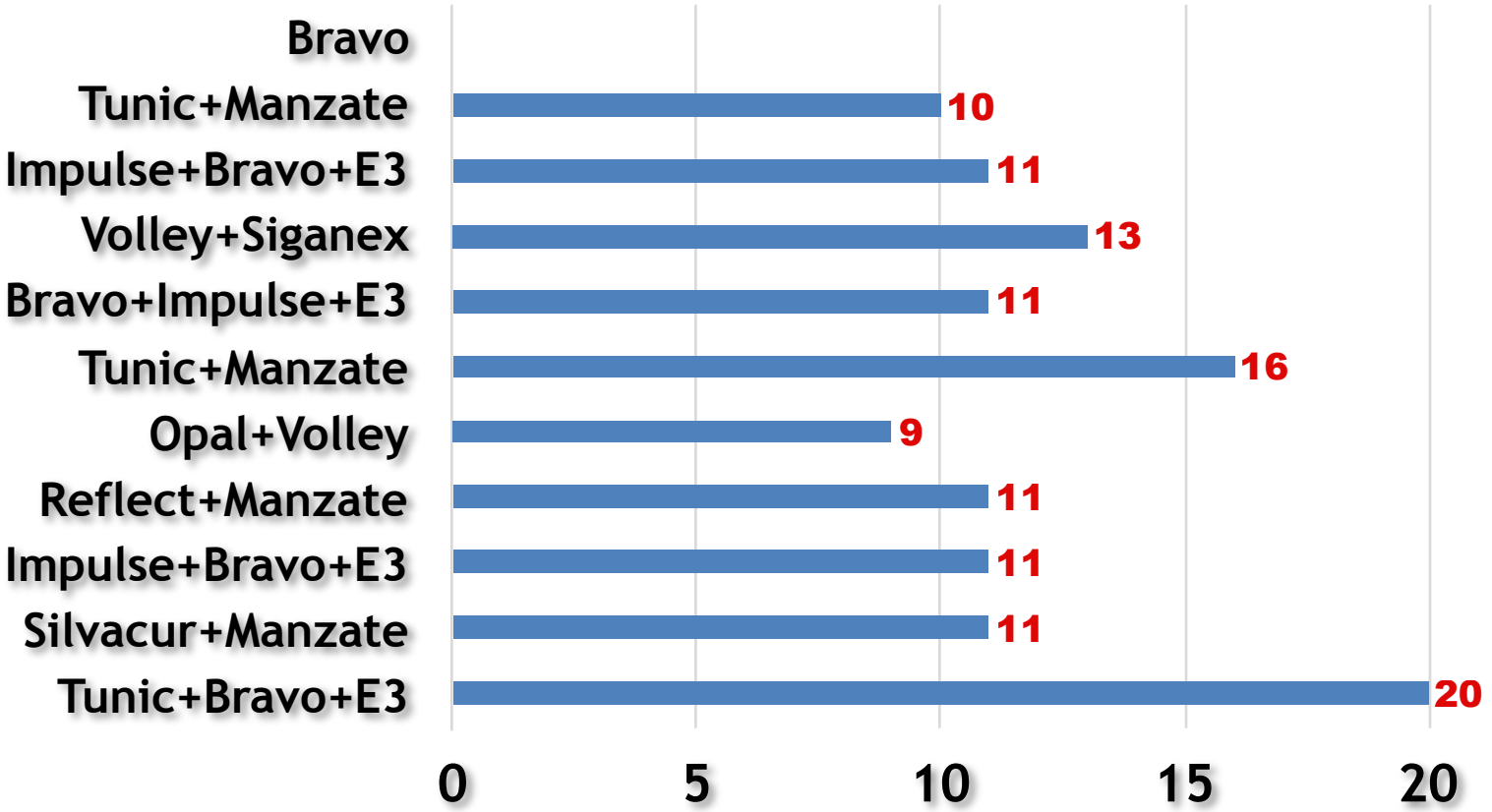
Valdivia – Apliccation frecuency



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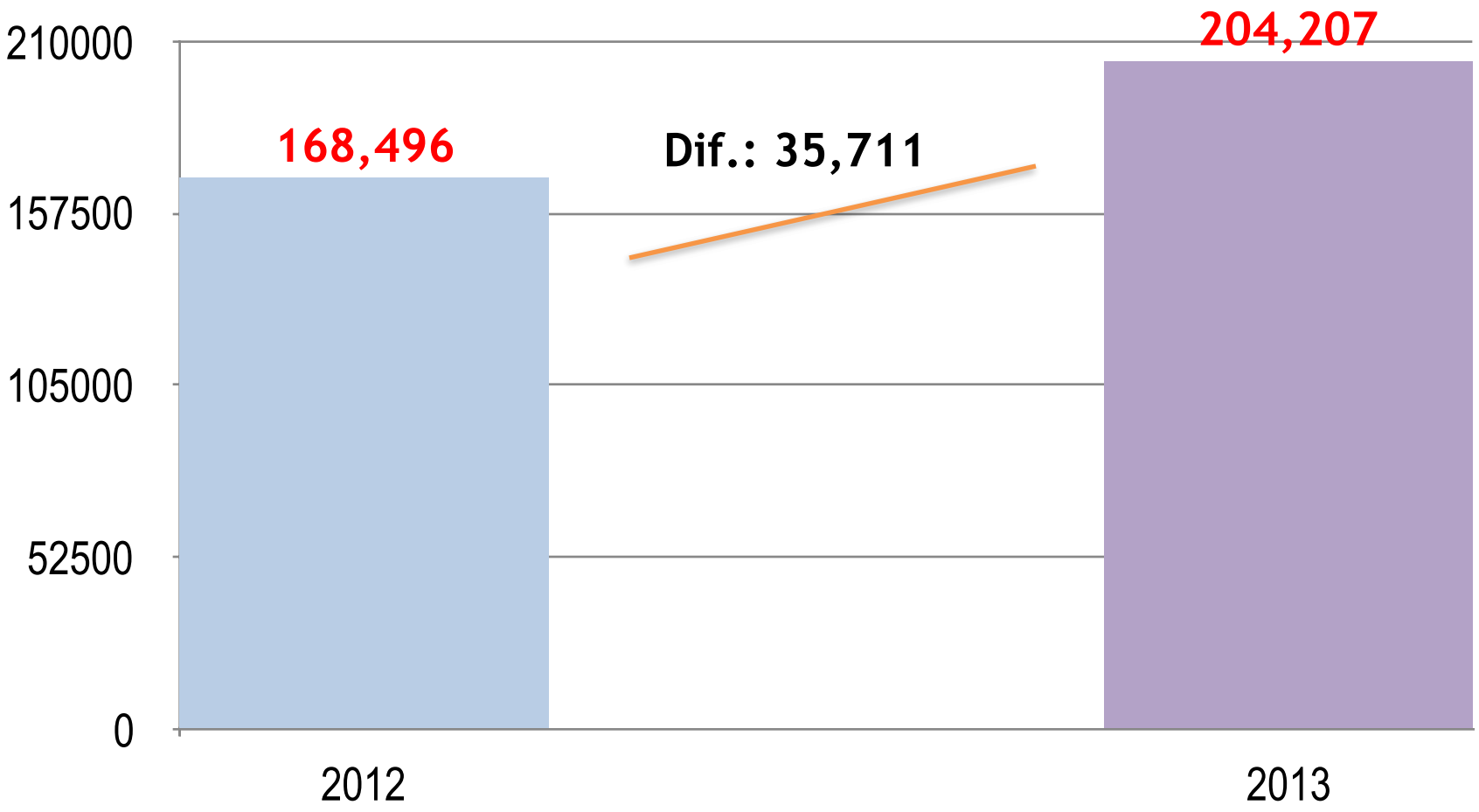
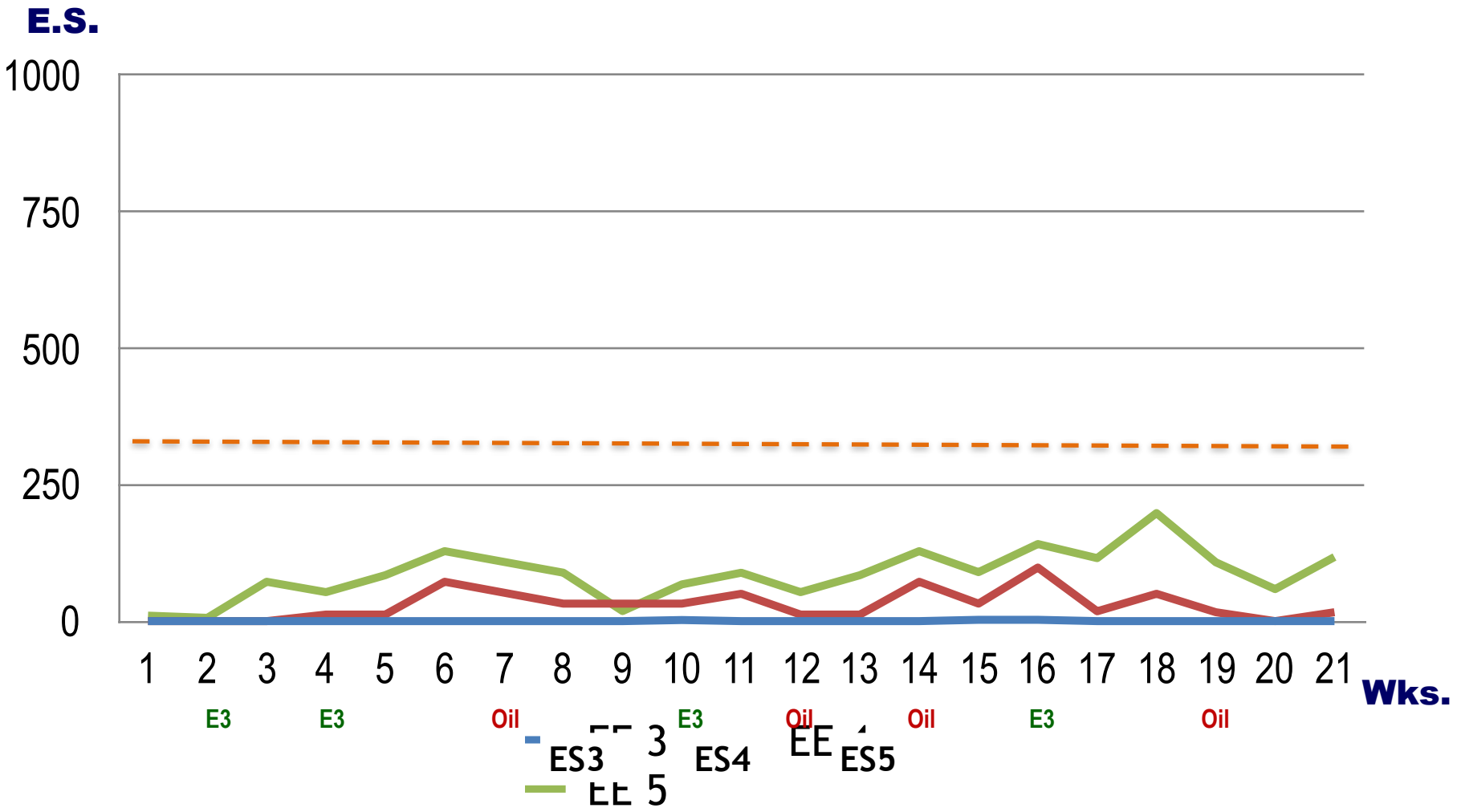
Valdivia: Boxes produced till to week 22



Kimberly – Evolutivo Stages



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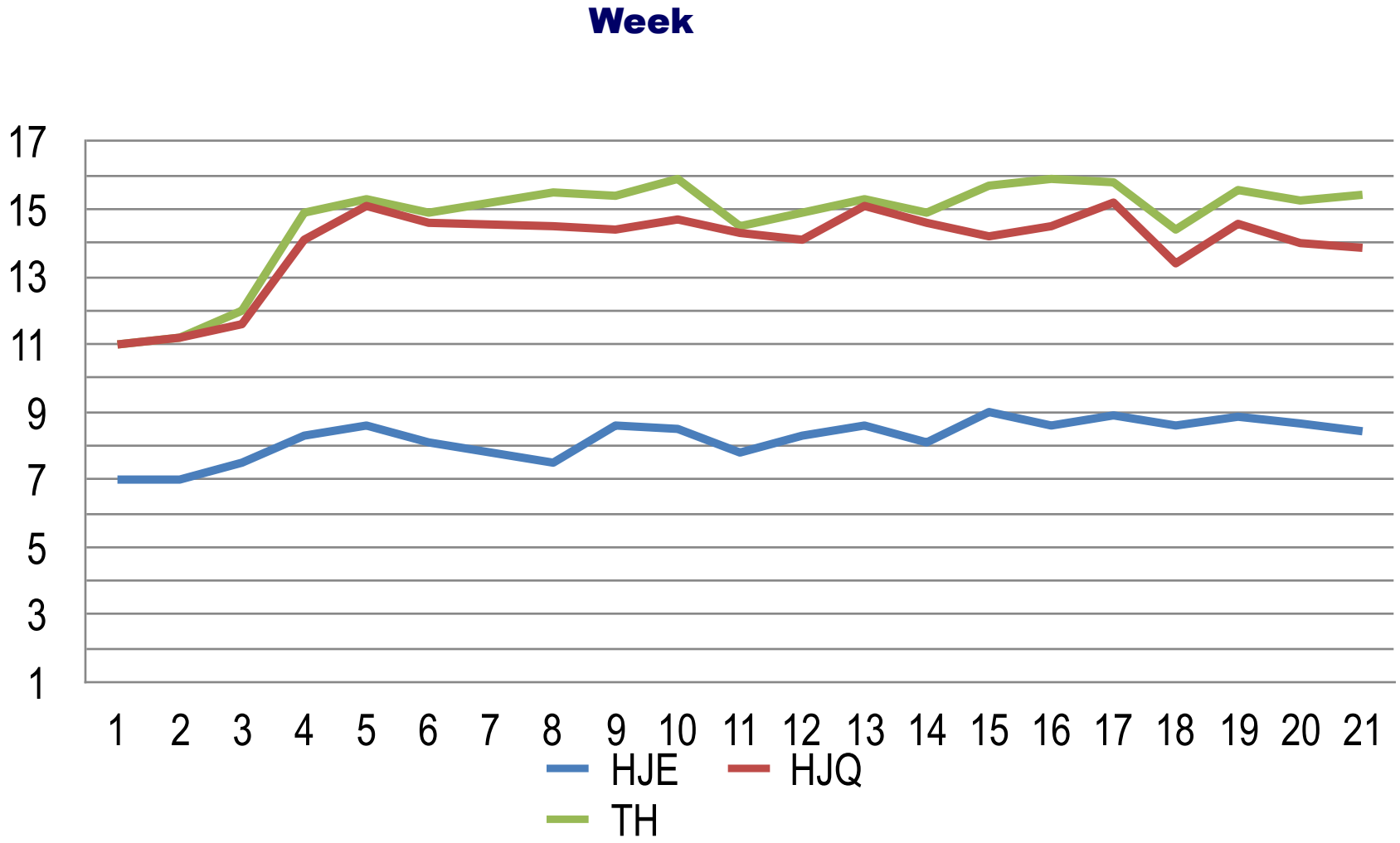
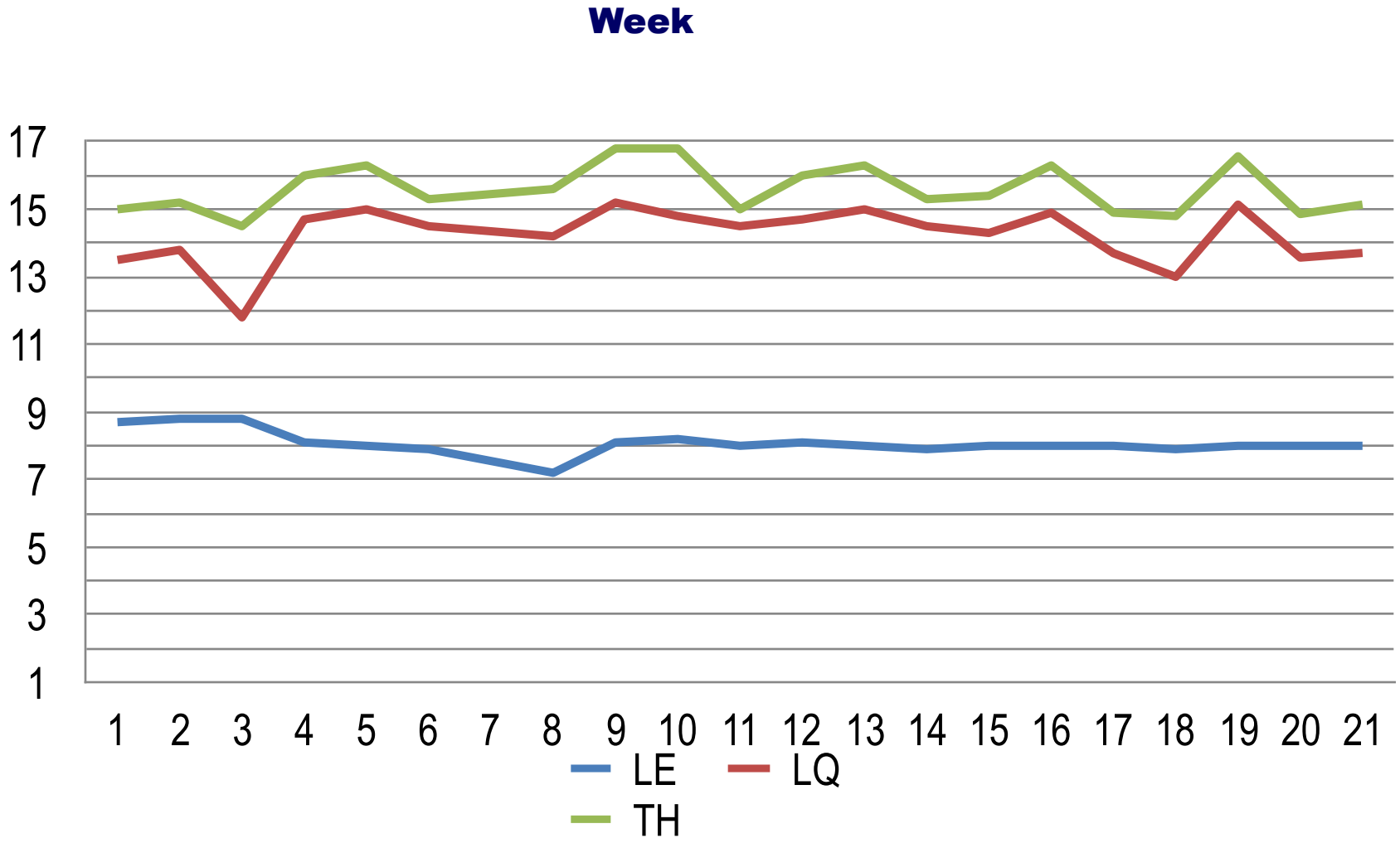
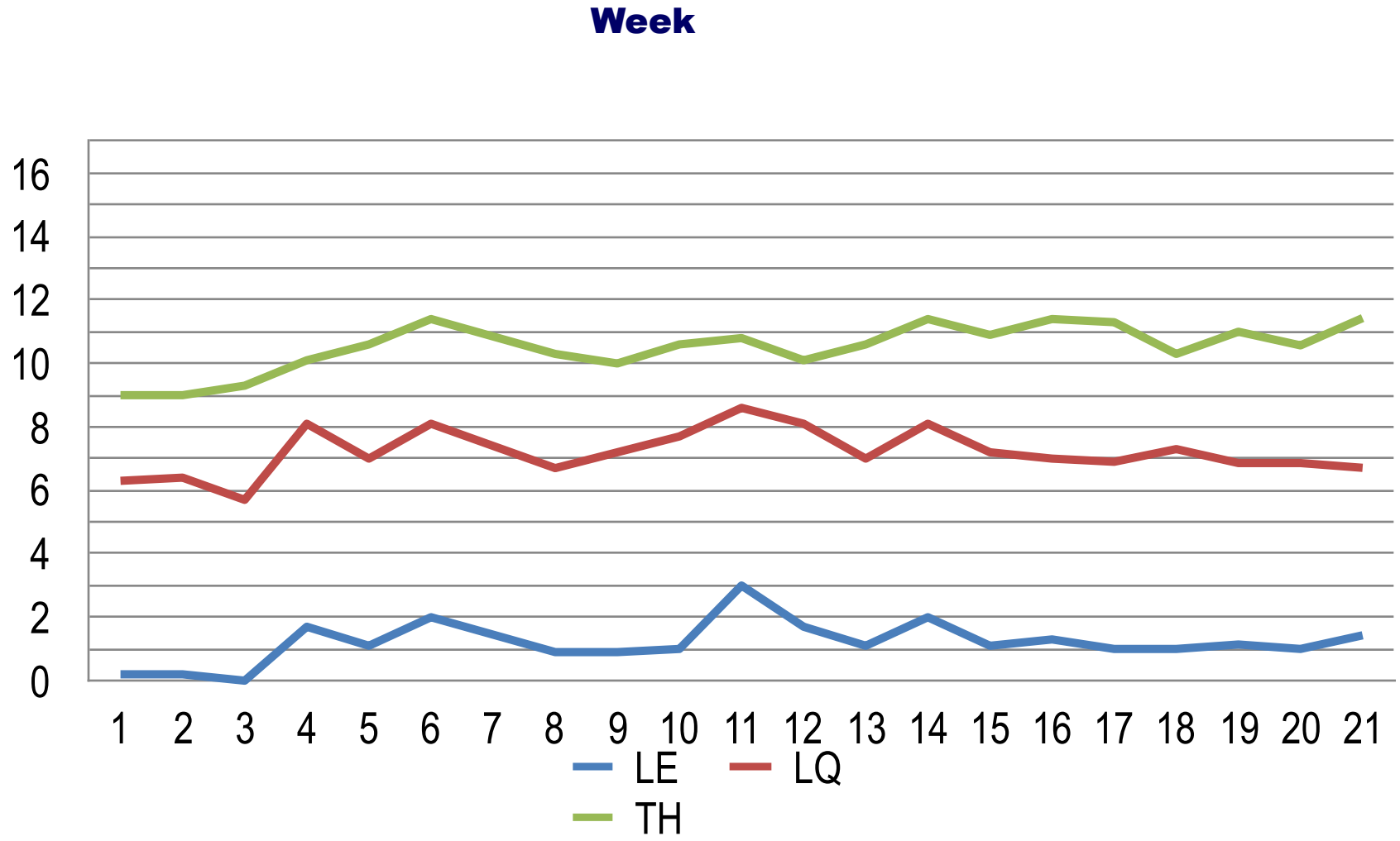
Kimberly – “Close to flowering” Plants



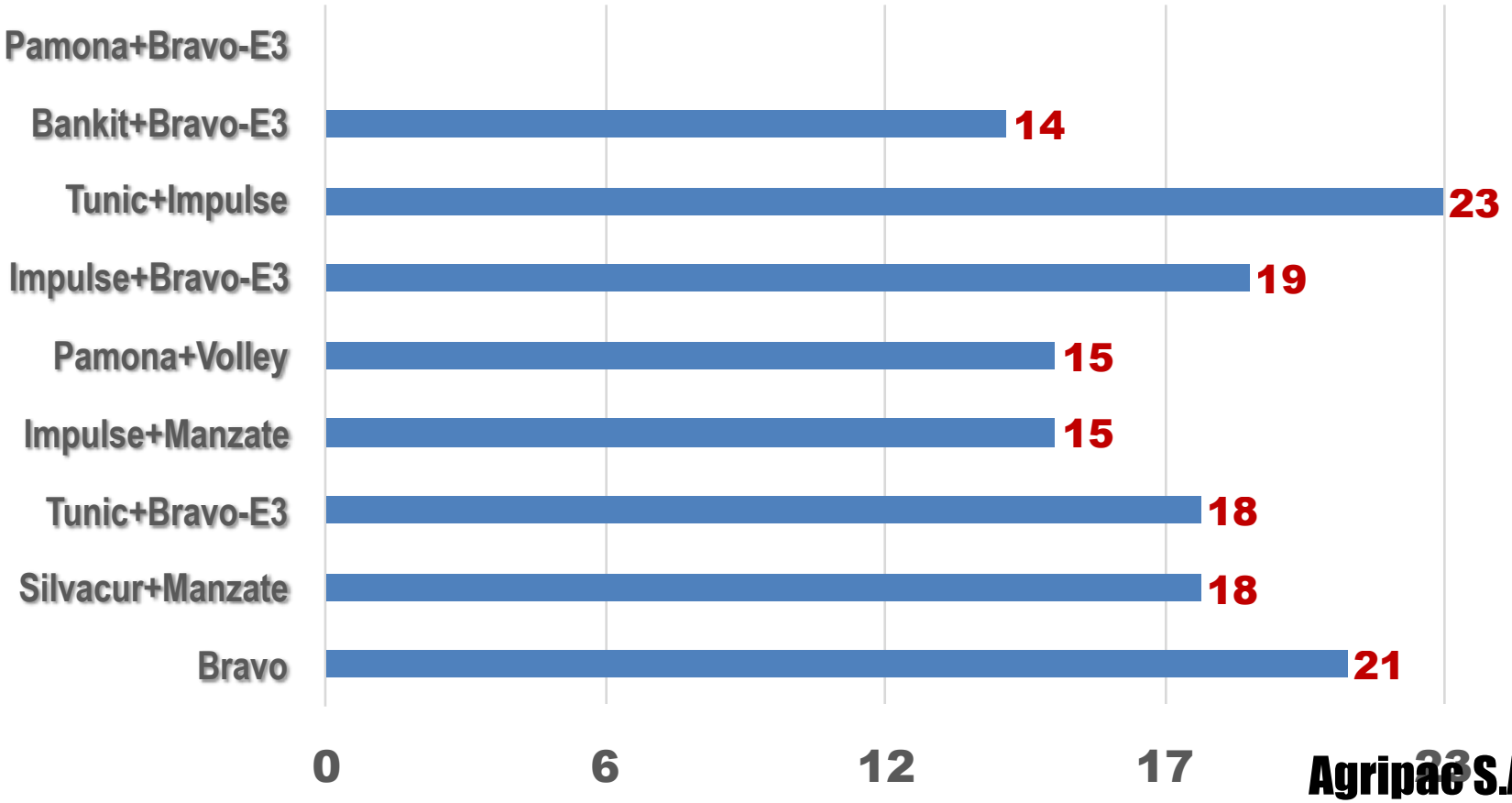
Kimberley – “At flowering” Plants



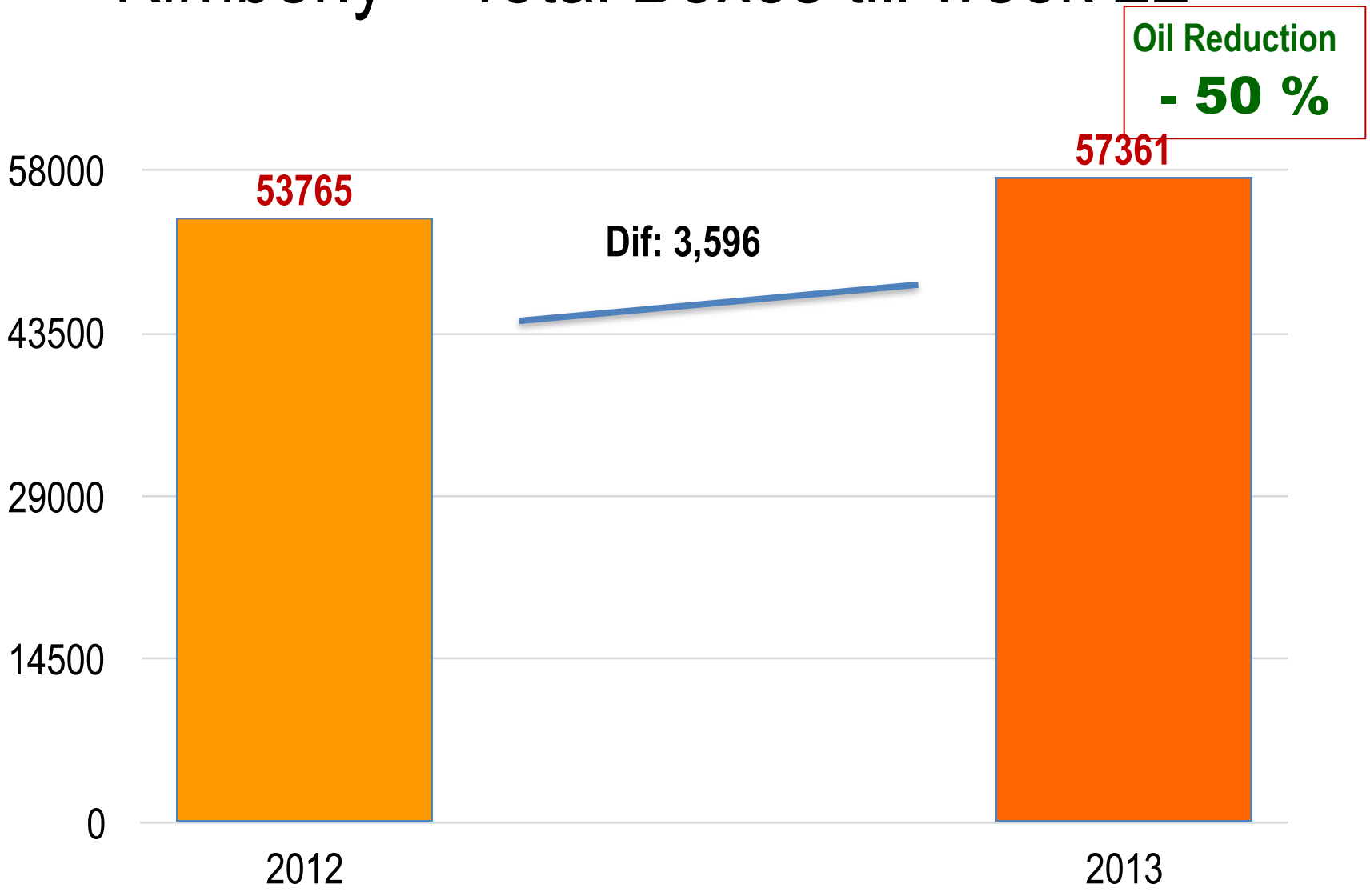
Kimberley – “Close to harvest” Plants



Kimberley - Frecuencias



Kimberly – Total Boxes till week 22



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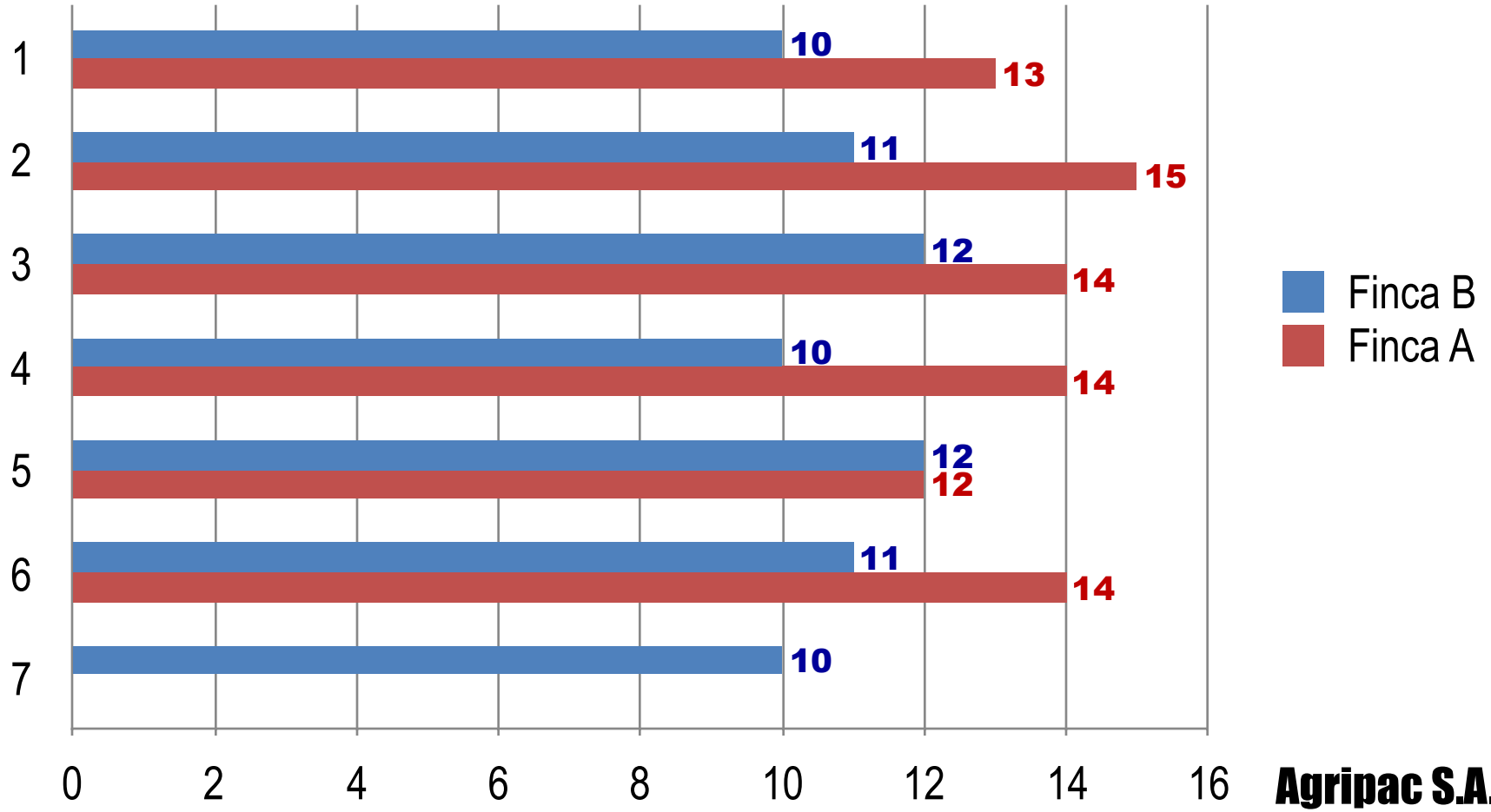
FRECUENCIES COMPARISSON

Farm A (Guayas) and Valdivia (B-Los Rios)



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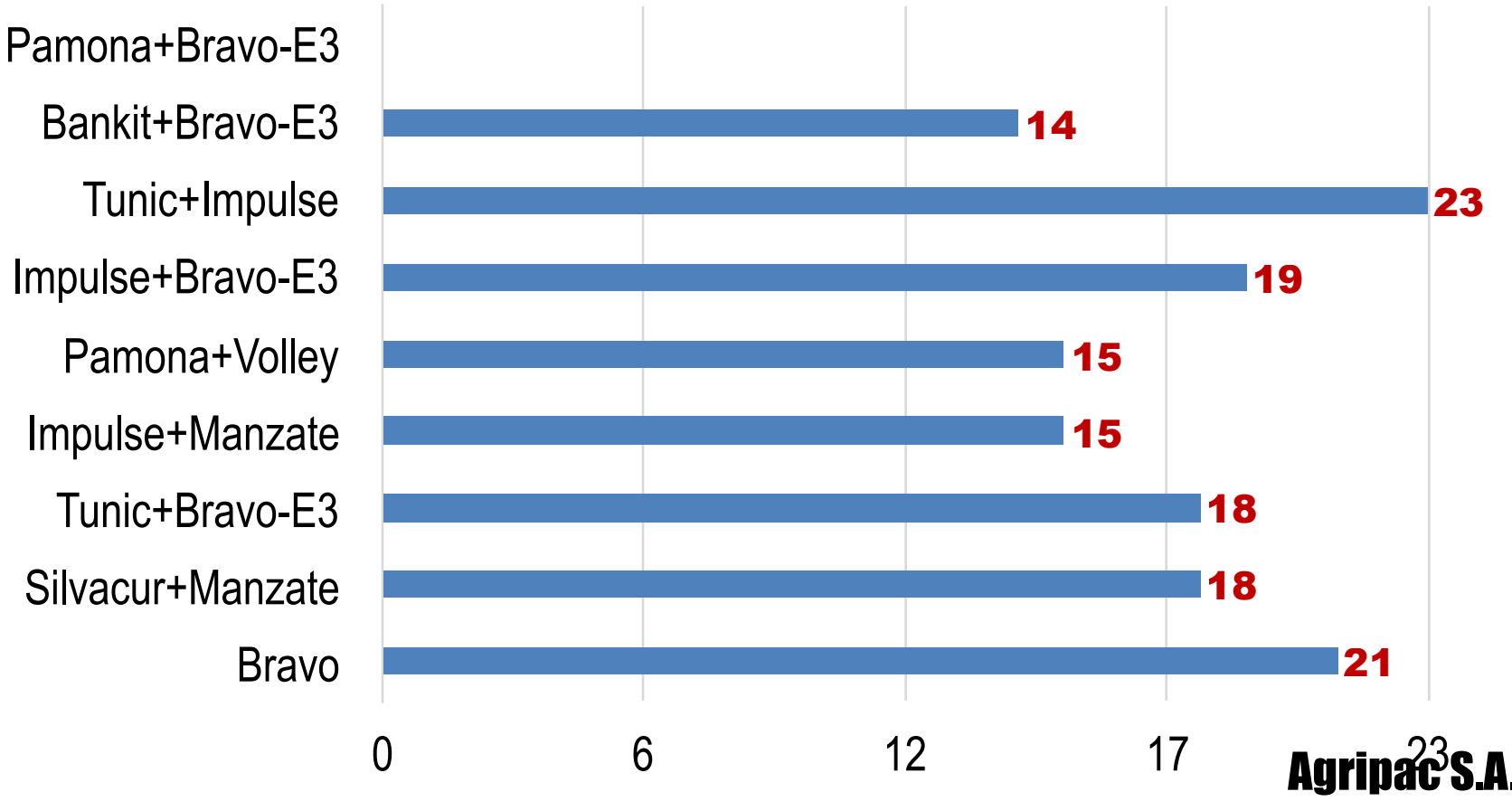
Kimberly – El Oro



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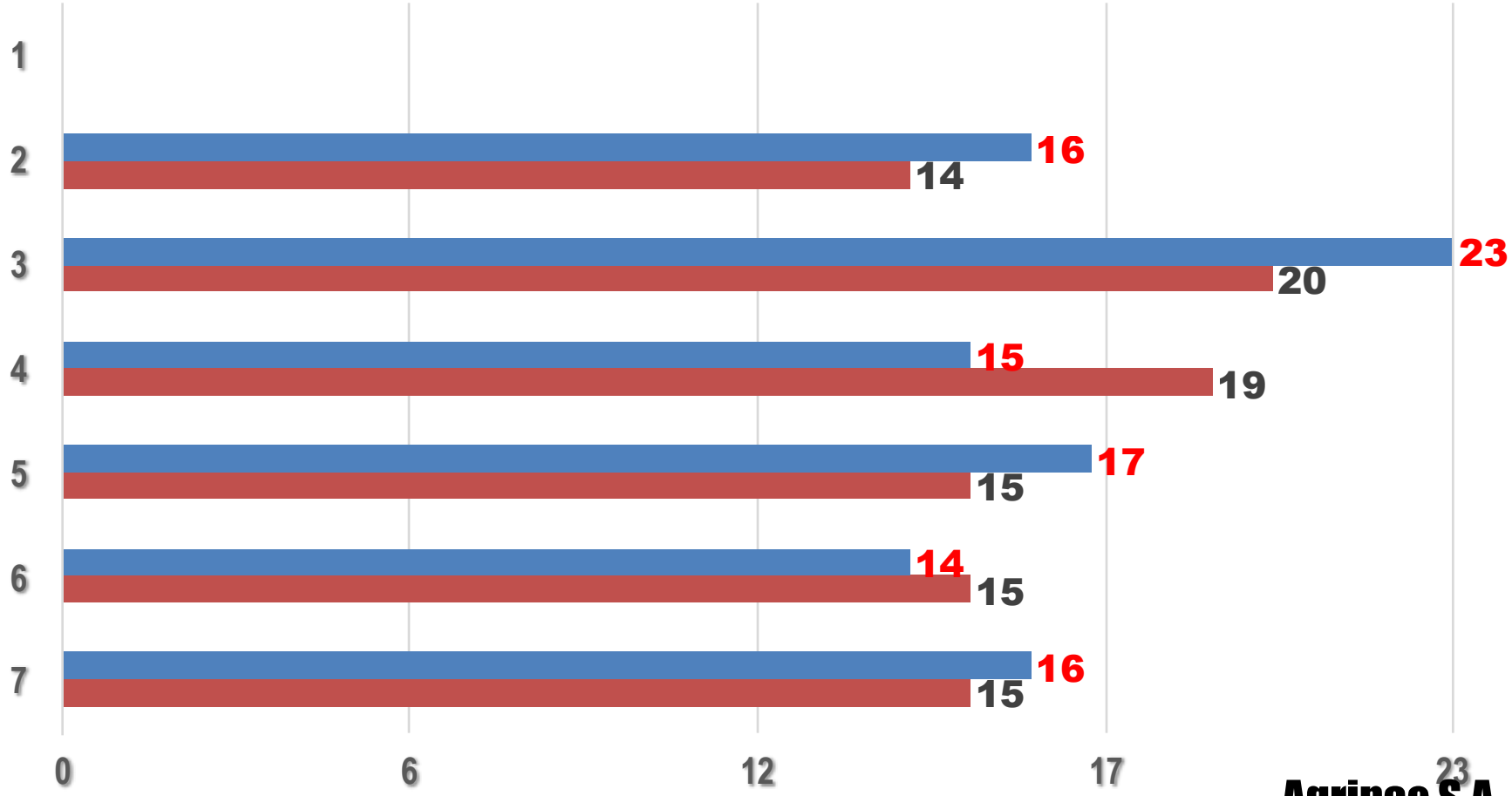
Kimberly Farm and D Farm – El Oro



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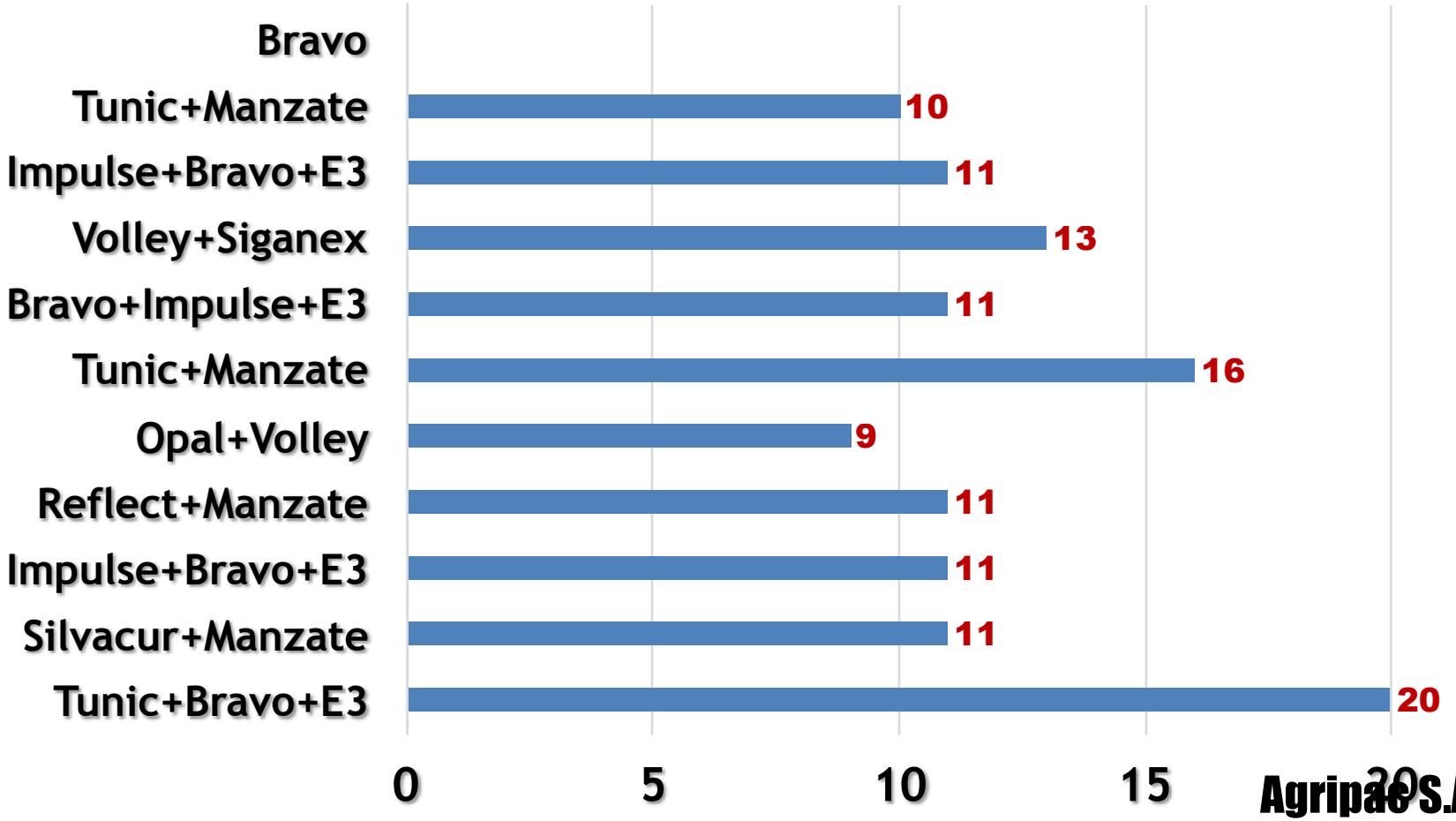
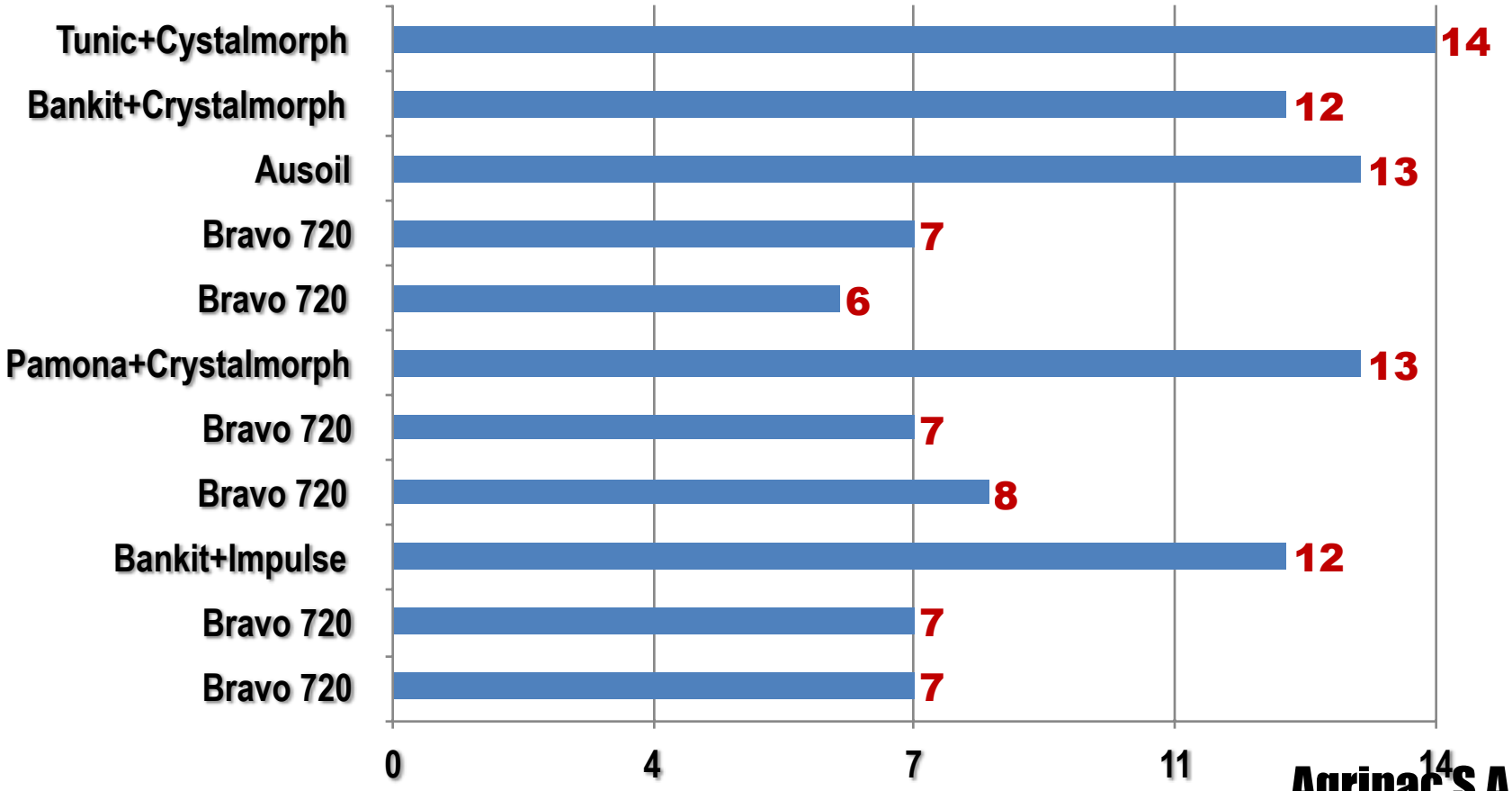
Valdivia: Los Ríos



Bravo alone – Los Ríos



Adjuvant Capabilities Comparison

ADJUVANTS	STICKER	SPREADER	RAIN FAST	MOISTURE INTELEGENCE *	DRIFT RETARDANT	WETTING	CHEMICAL COMPATIBILITY	PENETRANT
Silwet HS 312		✓						
Silwet HS 429								✓
6001 High Impact						✓		✓
Activator		✓						
Activator PH						✓	✓	
PDS	✓	✓	✓	✓	✓	✓	✓	✓
Airtight					✓			
Blendex VHC							✓	
Induce PH		✓				✓		
Cohere	✓	✓						
SurFix	✓	✓				✓	✓	
Cell-u-Wet	✓	✓						

Moisture Intelligence
The ability to protect and hold the added chemicals on the target surfaces in the face of hard rain, and the ability to help redistribute added chemicals over the target surface with ambient moisture (dew).

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Agripac S.A.

Drop Analysis – Cessnas Airplanes

Treatment	Drop size(µ)	Drop/cm2	Recuperation (%)	CV (%)	Swath (m)
1 CFX	225	64	46	52	22
2 CKA	223	54	45	43	20
3 CKA **E3**	264	99	108	30	22

*Howard Terry, Informe Calibración de aviones, inspección de pistas y operaciones. 28 de Octubre - 6 Noviembre 2013

Drop Analysis – Turbos Airplanes

Treatmint	Dop size (µ)	Drop/cm2	Recuperation (%)	CV (%)	Swath (m)
4 CLS	236	54	52	31	24
5 CNO	204	84	51	45	22
6 CNO **E3**	244	126	111	26	24

*Howard Terry, Informe Calibración de aviones, inspección de pistas y operaciones. 28 de Octubre - 6 Noviembre 2013

Conclusions

- E3 is recomended to be used for Black Sigatoka control, to reduce plant stress and to improve yield.
- It is better to alternate with water-in-oil emulsions aerial sprays to obtain a good disease control.
- The frequency of application is key to controlling the disease, depending on the area of the country.
- Keeping a good plant health on the rainy season is a key to good control of the disease annually.
- E3 is an adjuvant that can reduce up to 50% of all oil annually used for all its exhibited properties.

What do we need for a near future?

- Studies to know how much funficide get into the leaf compared with oil in water emulsions and water alone.
- It is possible to get a product like E3 to control the disease by itself without any chemical?