

Manejo del estrés calórico en novillos en confinamiento

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Apoyan



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Fugas y oportunidades
para la ganadería de
recrea e invernada



Jornada de
Ganadería
Intensiva 2018



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INIA La Estanzuela

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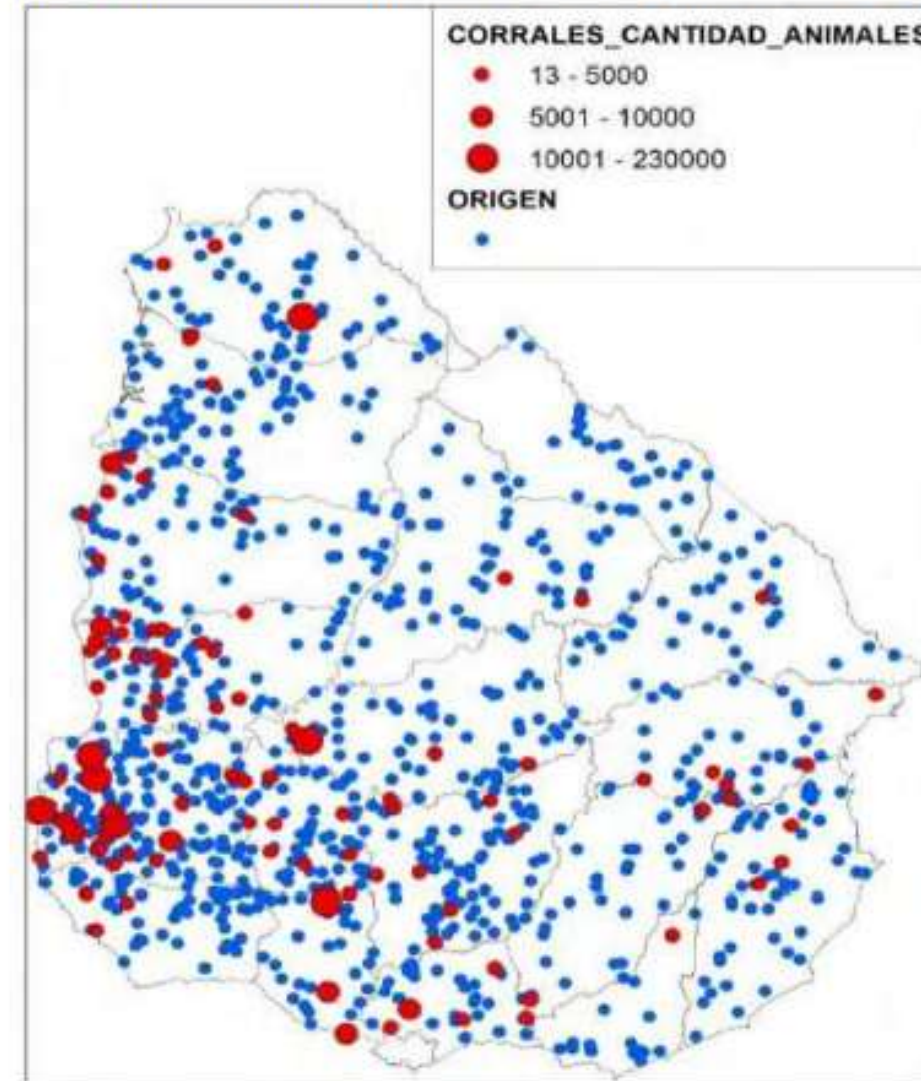


Antecedentes

Figura 1. Ubicación geográfica de los corrales de engorde y de los productores que envían animales a los corrales(ejercicio ganadero 2016/17)

➤ Ejercicio 2016/2017:

- Faena anual: 2.350.000 cabezas
- Faena de corrales de engorde: 254.000 cabezas (11 % del total faenado)



Fuente: OPYPA, con datos de SNIG

Antecedentes

- **Convenio INIA–MARFRIG:**
 - **Firmado en agosto 2016**
 - **Duración: 5 años**
- **Objetivo:** Determinar las variables de mayor impacto técnico-productivas para que los corrales de engorde no se hayan desarrollado como ha sucedido en el resto de los países productores de carne en el mundo, y detectar medidas viables económicamente en el país.
 - **Temas abordados hasta ahora:**
 - **Estrés calórico**
 - **Nuevas fuentes de fibra**
 - **Aditivos**



Antecedentes

➤ Marfrig

➤ Novillos

| GMD | 2016 | 2017 | 2018 |
|-----|-------|-------|-------|
| 1er | 1.501 | 1.377 | 1.544 |
| 2do | 1.375 | 1.335 | |
| 3er | 1.455 | 1.625 | |
| 4to | 1.592 | 1.681 | |

| EC | 2016 | 2017 | 2018 |
|-----|------|------|------|
| 1er | 7.67 | 7.64 | 7.16 |
| 2do | 8.18 | 7.24 | |
| 3er | 7.30 | 6.82 | |
| 4to | 7.07 | 6.94 | |

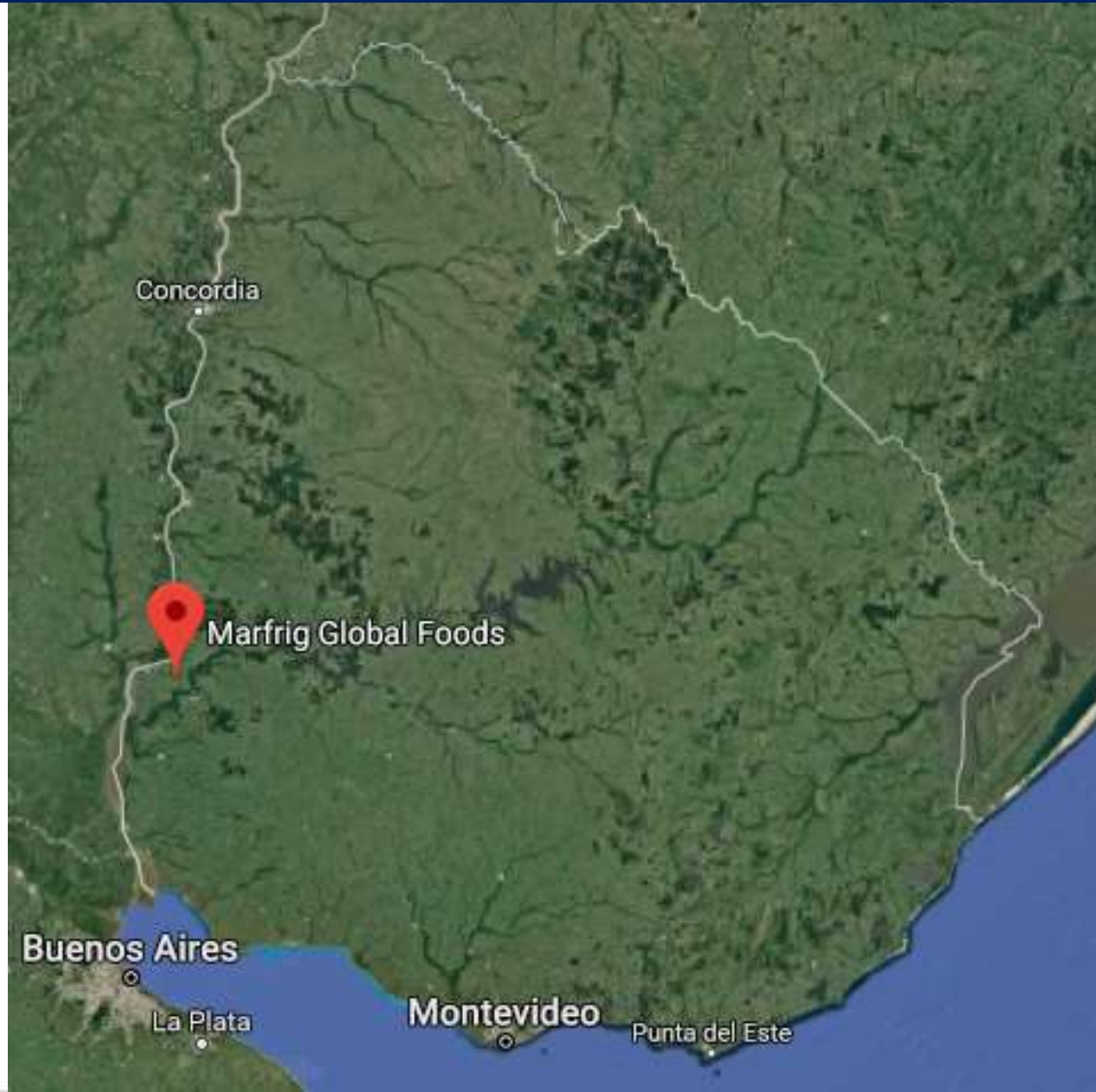
➤ Vaquillonas

| GMD | 2016 | 2017 | 2018 |
|-----|-------|-------|-------|
| 1er | 1.440 | 1.375 | 1.369 |
| 2do | 1.232 | 1.285 | |
| 3er | 1.328 | 1.485 | |
| 4to | 1.408 | 1.421 | |

| EC | 2016 | 2017 | 2018 |
|-----|------|------|------|
| 1er | 7.86 | 7.60 | 7.44 |
| 2do | 8.77 | 7.64 | |
| 3er | 7.43 | 7.16 | |
| 4to | 7.56 | 7.13 | |



Establecimiento “El Impulso”



Objetivo

Evaluar diferentes estrategias de mitigación del estrés calórico, sobre variables fisiológicas, comportamiento ingestivo, consumo y desempeño animal



Ensayo N° 1: Verano 2016/2017

➤ Ubicación y Duración:

- Corrales de engorde intensivo de Marfrig “El Impulso”
- 78 días (13 días de adaptación a la dieta y 65 días de ensayo)

➤ Diseño experimental:

- Completamente al azar con tres tratamientos y 4 repeticiones por tratamiento (12 corrales en total)

➤ Tratamientos:

- Sol (Testigo)
- Aspersión (desde las 11:00 a 19:00 hs, cuando ITH diario ≥ 75 o más de 5 hs con ITH ≥ 79 ; volumen: 9 litros/min; radio: 8,5 m)
- Sombra artificial (4,5m²/animal; altura: 4 m; material: chapa)



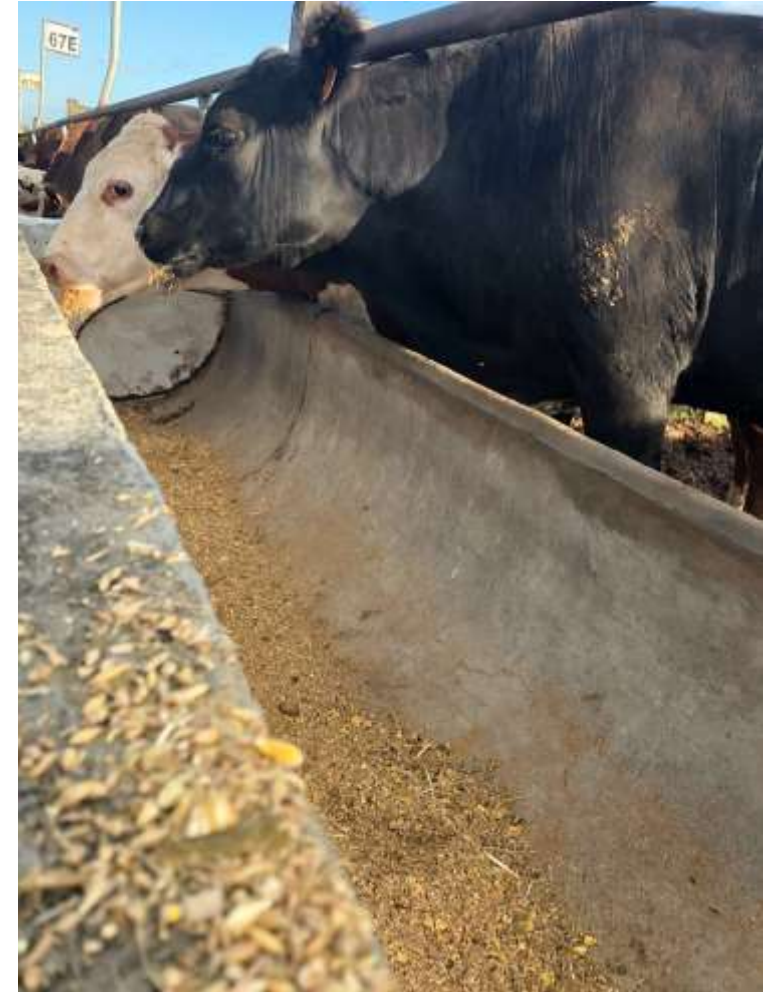
Ensayo N° 1: Verano 2016/2017

➤ Animales:

- 48 novillos de 24 meses de edad (4 animales/corral)
- Raza: Angus y cruce Hereford*Angus
- Peso inicial: 379 ± 8 kg
- Espacio: $22 \text{ m}^2/\text{animal}$
- Frente de comedero: $1,2 \text{ m}/\text{animal}$

➤ Dieta:

- 3 veces por día (6:30, 10:00 y 15:30 hs)



Ensayo N° 1: Verano 2016/2017

| <i>Ingredientes de la dieta</i> | Proporción (%) de la MS |
|--|----------------------------|
| Cebada quebrada | 34,0 |
| Maíz steam-flake | 25,5 |
| Avena entera | 10,8 |
| DDGS Maíz | 8,9 |
| Retornable fino | 8,9 |
| Cascara de soja | 6,8 |
| Harina de soja (HP) | 2,4 |
| Núcleo vitamínico-mineral | 2,6 |
| | |
| <i>Composición química de la dieta¹</i> | |
| Materia seca (%) | 74,0 |
| Cenizas (% MS) | 3,5 |
| Proteína cruda (% MS) | 14,5 |
| Fibra detergente neutra (% MS) | 28,3 |
| Lignina (% MS) | 3,7 |
| Extracto etéreo (% MS) | 3,6 |
| Energía metabolizable (Mcal/kg MS) | 2,92 |

¹En base a NRC, 2016



Ensayo N° 2: Verano 2017/2018

➤ Ubicación y Duración:

- Corrales de engorde intensivo de Marfrig “El Impulso”
- 71 días de ensayo

➤ Diseño experimental:

- Completamente al azar con tres tratamientos y 4 repeticiones por tratamiento (12 corrales en total)

➤ Tratamientos:

- Sol (Testigo)
- Aspersión (todos los días; 4 veces por día; 1,5 hs cada vez (10:00, 13:00, 15:00 y 17:00); volumen: 9 litros/min; radio: 8,5 m)
- Sombra artificial (4,5m²/animal; altura: 4 m; material: chapa)



Ensayo N° 2: Verano 2017/2018

➤ Animales:

- 48 novillos de 24 meses de edad (4 animales/corral)
- Raza: Angus, Hereford y cruce Hereford*Angus
- Peso inicial: 457 ± 3 kg
- Espacio: $22 \text{ m}^2/\text{animal}$
- Frente de comedero: $1,2 \text{ m}/\text{animal}$

➤ Dieta:

- 3 veces por día (6:30, 9:30 y 15:00 hs)



Ensayo N° 2: Verano 2017/2018

| <i>Ingredientes de la dieta</i> | Proporción (%) de la MS |
|--|----------------------------|
| Trigo quebrado | 22,2 |
| Cebada quebrada | 21,8 |
| Maíz steam-flake | 17,6 |
| Avena entera | 12,8 |
| DDGS Maíz | 9,2 |
| Retornable fino | 8,2 |
| Harina de soja (HP) | 5,5 |
| Núcleo vitamínico-mineral | 2,7 |
| | |
| <i>Composición química de la dieta¹</i> | |
| Materia seca (%) | 75,4 |
| Cenizas (% MS) | 3,6 |
| Proteína cruda (% MS) | 16,3 |
| Fibra detergente neutra (% MS) | 24,1 |
| Lignina (% MS) | 3,5 |
| Extracto etéreo (% MS) | 3,6 |
| Energía metabolizable (Mcal/kg MS) | 2,93 |

¹En base a NRC, 2016



Índice de Temperatura y Humedad: ITH

$$ITH = 0,8 * \text{Temperatura del aire (}^\circ\text{C)} + (\text{Humedad relativa}/100) * (\text{Temperatura del aire (}^\circ\text{C)} - 14,4) + 46,4.$$

Fuente: Thorn, 1959

| | | Humedad Relativa (%) | | | | | | | | | | |
|------------------|----|----------------------|----|----|----|----|----|----|----|----|----|-----|
| | | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| Temperatura (°C) | 38 | 77 | 79 | 82 | 84 | 86 | 89 | 91 | 93 | 96 | 98 | 100 |
| | 37 | 76 | 79 | 81 | 83 | 85 | 87 | 90 | 92 | 94 | 96 | 99 |
| | 36 | 75 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 93 | 95 | 97 |
| | 35 | 75 | 77 | 79 | 81 | 83 | 85 | 87 | 89 | 91 | 93 | 95 |
| | 34 | 74 | 76 | 78 | 80 | 82 | 84 | 85 | 87 | 89 | 91 | 93 |
| | 33 | 73 | 75 | 77 | 79 | 80 | 82 | 84 | 86 | 88 | 90 | 91 |
| | 32 | 72 | 74 | 76 | 77 | 79 | 81 | 83 | 84 | 86 | 88 | 90 |
| | 31 | 71 | 73 | 75 | 76 | 78 | 80 | 81 | 83 | 85 | 86 | 88 |
| | 30 | 71 | 72 | 74 | 75 | 77 | 78 | 80 | 81 | 83 | 84 | 86 |
| | 29 | 70 | 71 | 73 | 74 | 76 | 77 | 78 | 80 | 81 | 83 | 84 |
| | 28 | 69 | 70 | 72 | 73 | 74 | 76 | 77 | 78 | 80 | 81 | 82 |
| | 27 | 68 | 69 | 71 | 72 | 73 | 74 | 76 | 77 | 78 | 79 | 81 |
| 26 | 67 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 77 | 78 | 79 | |
| 25 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | |
| 24 | 66 | 67 | 68 | 69 | 70 | 70 | 71 | 72 | 73 | 74 | 75 | |
| 23 | 65 | 66 | 67 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 73 | |

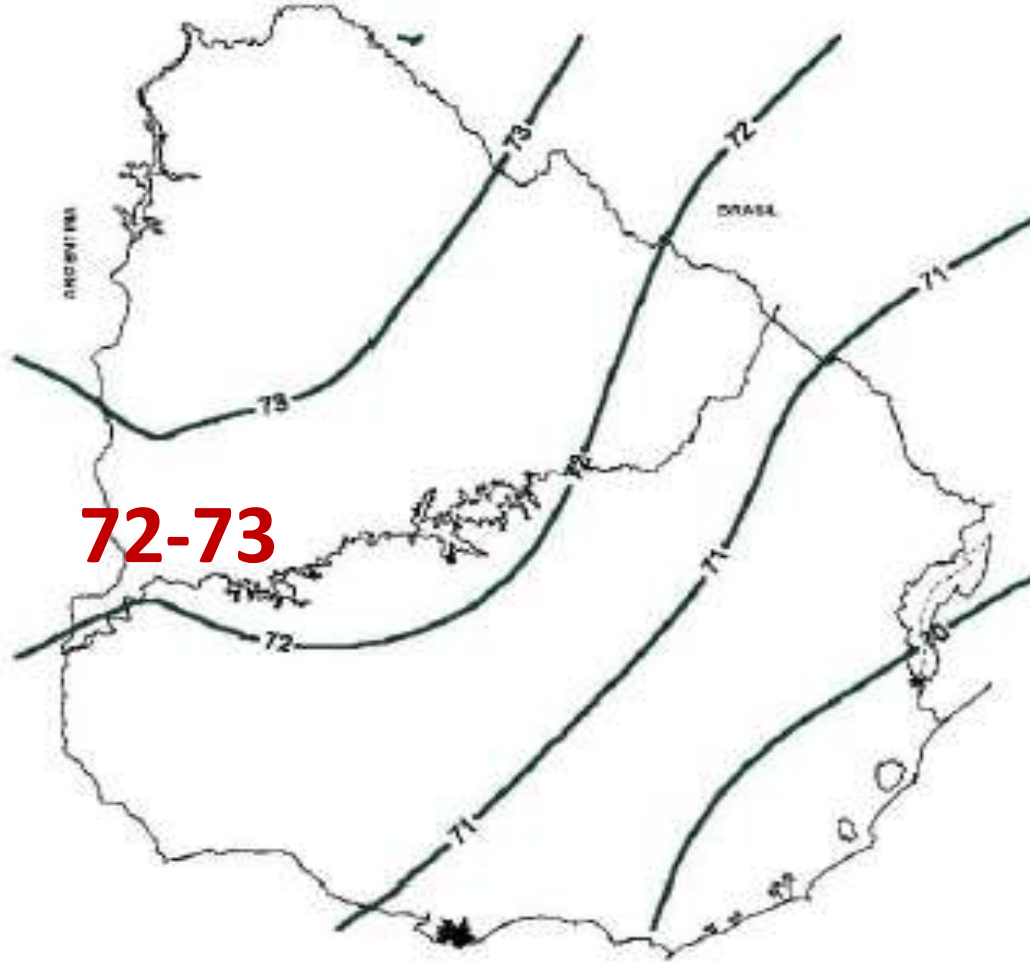
■ Normal
 ■ Alerta
 ■ Peligro
 ■ Emergencia

Fuente: Livestock Weather Safety Index



ITH en Uruguay (1961-1990)

Enero



Febrero



Fuente: Cruz y Saravia, 2008

Ensayo N° 1 y N° 2: Verano 2016/2017 y 2017/2018

Año 1

ITH: 71

| | Febrero | | | | | | | | | | | | | | Marzo | | | | | | | | | | | | | | | | | Abril | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 0 | 68 | 70 | 69 | 60 | 60 | 65 | 65 | 72 | 71 | 68 | 69 | 71 | 70 | 71 | 75 | 69 | 71 | 77 | 72 | 75 | 77 | 75 | 74 | 74 | 74 | 74 | 76 | 64 | 63 | 67 | 67 | 74 | 64 | 57 | 61 | 54 | 59 | 62 | 62 | 51 | 53 | 56 | 59 | 63 | 66 | 67 | 67 | 67 | 63 | 67 | 70 | 63 | 65 | 66 | 62 | 66 | 59 | 57 | 65 | 69 | | | | | | | |
| 1 | 67 | 70 | 68 | 61 | 59 | 64 | 64 | 72 | 70 | 69 | 68 | 70 | 70 | 70 | 68 | 62 | 69 | 70 | 77 | 73 | 74 | 76 | 74 | 75 | 73 | 74 | 72 | 74 | 72 | 74 | 66 | 63 | 62 | 65 | 67 | 76 | 62 | 55 | 60 | 55 | 57 | 60 | 62 | 51 | 52 | 54 | 59 | 62 | 66 | 65 | 65 | 65 | 66 | 66 | 66 | 62 | 65 | 67 | 63 | 63 | 65 | 61 | 65 | 58 | 56 | 66 | 68 |
| 2 | 66 | 68 | 67 | 60 | 58 | 63 | 64 | 73 | 71 | 69 | 67 | 70 | 70 | 70 | 70 | 67 | 67 | 68 | 69 | 76 | 72 | 74 | 75 | 73 | 74 | 72 | 74 | 71 | 74 | 66 | 63 | 62 | 65 | 67 | 76 | 62 | 55 | 60 | 55 | 57 | 60 | 62 | 51 | 52 | 54 | 59 | 62 | 66 | 65 | 65 | 65 | 66 | 66 | 66 | 62 | 65 | 67 | 63 | 63 | 65 | 61 | 65 | 58 | 56 | 66 | 68 | |
| 3 | 65 | 67 | 67 | 59 | 58 | 62 | 64 | 72 | 70 | 69 | 67 | 70 | 70 | 70 | 70 | 66 | 67 | 68 | 69 | 75 | 71 | 73 | 75 | 72 | 73 | 72 | 73 | 71 | 74 | 66 | 63 | 61 | 64 | 68 | 76 | 61 | 54 | 60 | 54 | 56 | 60 | 62 | 51 | 52 | 55 | 58 | 62 | 65 | 64 | 64 | 65 | 66 | 66 | 66 | 62 | 65 | 66 | 64 | 62 | 65 | 60 | 65 | 57 | 57 | 65 | 69 | |
| 4 | 64 | 66 | 66 | 58 | 56 | 61 | 65 | 72 | 70 | 69 | 67 | 70 | 70 | 70 | 70 | 69 | 66 | 67 | 69 | 75 | 71 | 73 | 75 | 71 | 72 | 71 | 73 | 71 | 73 | 66 | 62 | 60 | 64 | 67 | 73 | 60 | 55 | 60 | 53 | 55 | 60 | 61 | 51 | 52 | 53 | 57 | 61 | 65 | 64 | 64 | 65 | 65 | 66 | 65 | 62 | 64 | 65 | 64 | 61 | 64 | 61 | 64 | 56 | 57 | 65 | 69 | |
| 5 | 64 | 65 | 65 | 58 | 55 | 60 | 64 | 72 | 71 | 69 | 67 | 70 | 70 | 70 | 70 | 69 | 66 | 67 | 69 | 74 | 70 | 72 | 75 | 71 | 72 | 70 | 72 | 69 | 70 | 70 | 66 | 61 | 59 | 64 | 67 | 73 | 60 | 55 | 60 | 53 | 55 | 60 | 61 | 51 | 52 | 54 | 57 | 60 | 64 | 64 | 64 | 65 | 65 | 66 | 65 | 62 | 64 | 65 | 64 | 61 | 64 | 61 | 64 | 56 | 57 | 65 | 70 |
| 6 | 65 | 67 | 65 | 59 | 56 | 62 | 65 | 72 | 71 | 69 | 67 | 70 | 70 | 70 | 70 | 69 | 66 | 67 | 69 | 74 | 71 | 73 | 76 | 71 | 71 | 70 | 72 | 71 | 70 | 66 | 61 | 59 | 64 | 67 | 73 | 60 | 55 | 60 | 53 | 55 | 60 | 61 | 51 | 52 | 54 | 57 | 60 | 64 | 64 | 64 | 65 | 65 | 66 | 65 | 62 | 64 | 65 | 64 | 61 | 64 | 61 | 64 | 56 | 57 | 65 | 70 | |
| 7 | 68 | 70 | 66 | 61 | 61 | 64 | 67 | 72 | 72 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 73 | 75 | 72 | 77 | 79 | 74 | 73 | 75 | 74 | 74 | 74 | 69 | 67 | 63 | 67 | 68 | 67 | 61 | 58 | 64 | 61 | 63 | 65 | 61 | 61 | 59 | 60 | 63 | 64 | 68 | 68 | 68 | 71 | 69 | 69 | 70 | 67 | 67 | 68 | 66 | 65 | 68 | 67 | 68 | 65 | 61 | 69 | 71 | |
| 8 | 71 | 75 | 65 | 64 | 66 | 66 | 71 | 74 | 73 | 69 | 68 | 74 | 77 | 77 | 72 | 69 | 72 | 77 | 78 | 74 | 80 | 83 | 78 | 77 | 77 | 78 | 79 | 78 | 69 | 67 | 68 | 70 | 70 | 67 | 65 | 63 | 67 | 65 | 68 | 66 | 62 | 65 | 63 | 66 | 68 | 69 | 73 | 72 | 72 | 74 | 71 | 73 | 72 | 70 | 70 | 69 | 69 | 72 | 72 | 69 | 65 | 71 | 71 | | | | |
| 9 | 75 | 77 | 66 | 65 | 69 | 70 | 73 | 76 | 74 | 68 | 77 | 77 | 78 | 79 | 75 | 70 | 76 | 79 | 78 | 80 | 82 | 86 | 81 | 80 | 79 | 80 | 81 | 81 | 71 | 67 | 71 | 74 | 73 | 67 | 68 | 66 | 68 | 67 | 72 | 68 | 62 | 67 | 66 | 68 | 70 | 72 | 75 | 75 | 74 | 72 | 72 | 73 | 71 | 72 | 72 | 75 | 75 | 71 | 68 | 73 | 71 | | | | | | |
| 10 | 76 | 78 | 69 | 68 | 71 | 73 | 77 | 78 | 75 | 69 | 77 | 78 | 79 | 80 | 78 | 71 | 78 | 82 | 77 | 80 | 84 | 86 | 84 | 80 | 82 | 82 | 82 | 74 | 67 | 73 | 74 | 76 | 75 | 68 | 69 | 69 | 68 | 69 | 74 | 68 | 65 | 68 | 68 | 71 | 73 | 74 | 77 | 78 | 78 | 76 | 72 | 78 | 75 | 75 | 74 | 72 | 74 | 77 | 76 | 71 | 71 | 76 | 72 | | | | |
| 11 | 77 | 78 | 70 | 69 | 72 | 74 | 78 | 79 | 74 | 69 | 77 | 79 | 80 | 81 | 80 | 72 | 79 | 84 | 76 | 80 | 85 | 87 | 85 | 82 | 81 | 83 | 83 | 82 | 74 | 65 | 74 | 75 | 78 | 76 | 70 | 70 | 69 | 70 | 75 | 66 | 67 | 69 | 69 | 72 | 72 | 75 | 78 | 77 | 77 | 79 | 75 | 80 | 76 | 76 | 75 | 76 | 74 | 73 | 75 | 78 | 75 | 72 | 72 | 78 | 72 | | |
| 12 | 79 | 80 | 70 | 70 | 73 | 74 | 79 | 78 | 77 | 69 | 77 | 79 | 80 | 81 | 81 | 74 | 80 | 84 | 78 | 81 | 85 | 86 | 86 | 84 | 82 | 83 | 84 | 83 | 74 | 67 | 74 | 77 | 79 | 77 | 72 | 71 | 71 | 69 | 72 | 76 | 65 | 68 | 70 | 70 | 73 | 73 | 76 | 81 | 79 | 79 | 79 | 76 | 79 | 77 | 77 | 76 | 77 | 75 | 73 | 78 | 79 | 75 | 73 | 78 | 73 | | |
| 13 | 80 | 80 | 70 | 71 | 75 | 76 | 80 | 80 | 79 | 70 | 77 | 79 | 81 | 81 | 81 | 76 | 81 | 85 | 83 | 82 | 86 | 87 | 85 | 84 | 83 | 84 | 84 | 83 | 74 | 70 | 74 | 78 | 80 | 79 | 73 | 72 | 73 | 70 | 72 | 76 | 62 | 67 | 71 | 71 | 73 | 73 | 76 | 80 | 80 | 80 | 79 | 77 | 81 | 77 | 77 | 78 | 77 | 76 | 73 | 79 | 78 | 76 | 73 | 74 | 78 | 73 | |
| 14 | 80 | 79 | 69 | 72 | 74 | 76 | 79 | 79 | 78 | 72 | 77 | 80 | 81 | 82 | 82 | 77 | 82 | 85 | 84 | 84 | 86 | 87 | 86 | 84 | 83 | 84 | 85 | 84 | 73 | 71 | 76 | 79 | 79 | 73 | 73 | 72 | 69 | 73 | 77 | 61 | 67 | 70 | 72 | 73 | 73 | 76 | 79 | 79 | 79 | 79 | 76 | 80 | 77 | 77 | 79 | 76 | 76 | 73 | 77 | 78 | 76 | 74 | 74 | 76 | 71 | | |
| 15 | 81 | 72 | 68 | 72 | 75 | 77 | 80 | 77 | 78 | 72 | 77 | 80 | 81 | 80 | 82 | 77 | 82 | 85 | 85 | 84 | 86 | 87 | 85 | 84 | 82 | 84 | 85 | 84 | 73 | 72 | 75 | 79 | 80 | 80 | 74 | 72 | 73 | 69 | 73 | 77 | 62 | 66 | 69 | 71 | 73 | 72 | 75 | 78 | 79 | 79 | 78 | 76 | 79 | 76 | 77 | 78 | 76 | 76 | 73 | 77 | 78 | 74 | 72 | 74 | 76 | 70 | |
| 16 | 79 | 71 | 68 | 72 | 75 | 77 | 80 | 77 | 78 | 72 | 75 | 79 | 81 | 79 | 82 | 76 | 82 | 86 | 85 | 83 | 85 | 85 | 85 | 83 | 82 | 84 | 84 | 71 | 72 | 74 | 79 | 79 | 74 | 72 | 72 | 68 | 73 | 75 | 61 | 64 | 67 | 70 | 72 | 72 | 73 | 71 | 78 | 78 | 76 | 76 | 73 | 74 | 76 | 77 | 74 | 75 | 72 | 74 | 77 | 72 | 71 | 72 | 73 | 70 | | | |
| 17 | 79 | 71 | 67 | 72 | 75 | 77 | 80 | 77 | 77 | 70 | 74 | 78 | 82 | 80 | 81 | 76 | 82 | 84 | 84 | 84 | 85 | 84 | 82 | 82 | 83 | 84 | 84 | 70 | 72 | 74 | 78 | 78 | 76 | 76 | 72 | 68 | 65 | 70 | 71 | 59 | 61 | 64 | 66 | 69 | 69 | 71 | 68 | 76 | 73 | 73 | 76 | 71 | 73 | 75 | 71 | 72 | 70 | 71 | 75 | 69 | 69 | 70 | 70 | 71 | | | |
| 18 | 79 | 70 | 66 | 70 | 74 | 75 | 78 | 73 | 71 | 70 | 72 | 78 | 80 | 78 | 79 | 75 | 81 | 83 | 83 | 83 | 83 | 82 | 81 | 81 | 80 | 82 | 69 | 71 | 71 | 75 | 74 | 74 | 79 | 79 | 73 | 73 | 72 | 69 | 73 | 77 | 61 | 67 | 70 | 72 | 73 | 73 | 76 | 79 | 79 | 79 | 79 | 76 | 80 | 77 | 77 | 79 | 76 | 76 | 73 | 77 | 78 | 76 | 74 | 74 | 76 | 71 | |
| 19 | 75 | 70 | 65 | 67 | 70 | 72 | 76 | 70 | 68 | 70 | 71 | 73 | 78 | 75 | 77 | 74 | 77 | 81 | 76 | 81 | 81 | 82 | 81 | 78 | 79 | 80 | 82 | 68 | 69 | 71 | 71 | 75 | 74 | 71 | 72 | 66 | 64 | 61 | 64 | 66 | 59 | 57 | 59 | 63 | 66 | 67 | 69 | 68 | 72 | 72 | 69 | 70 | 73 | 68 | 71 | 73 | 68 | 69 | 67 | 67 | 72 | 65 | 64 | 68 | 70 | | |
| 20 | 73 | 70 | 64 | 66 | 69 | 70 | 74 | 71 | 69 | 69 | 71 | 73 | 75 | 73 | 76 | 72 | 75 | 80 | 75 | 79 | 80 | 79 | 77 | 78 | 77 | 78 | 79 | 67 | 67 | 68 | 72 | 72 | 70 | 70 | 64 | 62 | 59 | 63 | 64 | 60 | 56 | 59 | 62 | 63 | 65 | 69 | 68 | 71 | 71 | 68 | 69 | 72 | 68 | 70 | 72 | 67 | 69 | 67 | 66 | 70 | 65 | 63 | 66 | 68 | 71 | | |
| 21 | 72 | 70 | 64 | 64 | 68 | 69 | 73 | 70 | 69 | 69 | 71 | 72 | 72 | 75 | 70 | 74 | 79 | 75 | 78 | 79 | 77 | 79 | 76 | 76 | 76 | 78 | 67 | 66 | 67 | 70 | 70 | 70 | 68 | 62 | 60 | 58 | 61 | 64 | 60 | 55 | 58 | 61 | 63 | 64 | 68 | 68 | 70 | 70 | 69 | 68 | 70 | 66 | 69 | 71 | 66 | 68 | 67 | 65 | 70 | 63 | 61 | 66 | 68 | 71 | | | |
| 22 | 72 | 70 | 63 | 63 | 66 | 68 | 72 | 70 | 69 | 69 | 71 | 72 | 72 | 70 | 75 | 70 | 73 | 78 | 73 | 77 | 79 | 76 | 78 | 75 | 77 | 75 | 77 | 67 | 65 | 65 | 69 | 69 | 72 | 68 | 60 | 60 | 57 | 60 | 64 | 60 | 54 | 57 | 58 | 61 | 64 | 68 | 67 | 70 | 67 | 68 | 69 | 65 | 68 | 71 | 65 | 67 | 66 | 62 | 70 | 62 | 61 | 66 | 68 | 71 | | | |
| 23 | 71 | 70 | 61 | 62 | 65 | 67 | 71 | 71 | 68 | 69 | 71 | 70 | 72 | 74 | 70 | 71 | 78 | 72 | 76 | 78 | 76 | 77 | 74 | 75 | 73 | 74 | 76 | 66 | 65 | 63 | 68 | 68 | 73 | 66 | 58 | 60 | 55 | 60 | 63 | 61 | 53 | 55 | 57 | 60 | 63 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 68 | 64 | 68 | 70 | 64 | 67 | 66 | 61 | 65 | 61 | 59 | 65 | 68 | 71 |
| Prom. | 73 | 72 | 67 | 65 | 67 | 69 | 73 | 74 | 73 | 69 | 71 | 74 | 76 | 75 | 74 | 78 | 77 | 77 | 80 | 81 | 79 | 78 | 77 | 78 | 79 | 78 | 68 | 68 | 70 | 72 | 72 | 71 | 65 | 63 | 63 | 63 | 66 | 62 | 61 | 61 | 62 | 64 | 66 | 69 | 70 | 72 | 72 | 71 | 70 | 73 | 70 | 70 | 71 | 70 | 69 | 68 | 69 | 70 | 68 | 65 | 66 | 70 | 71 | | | | |



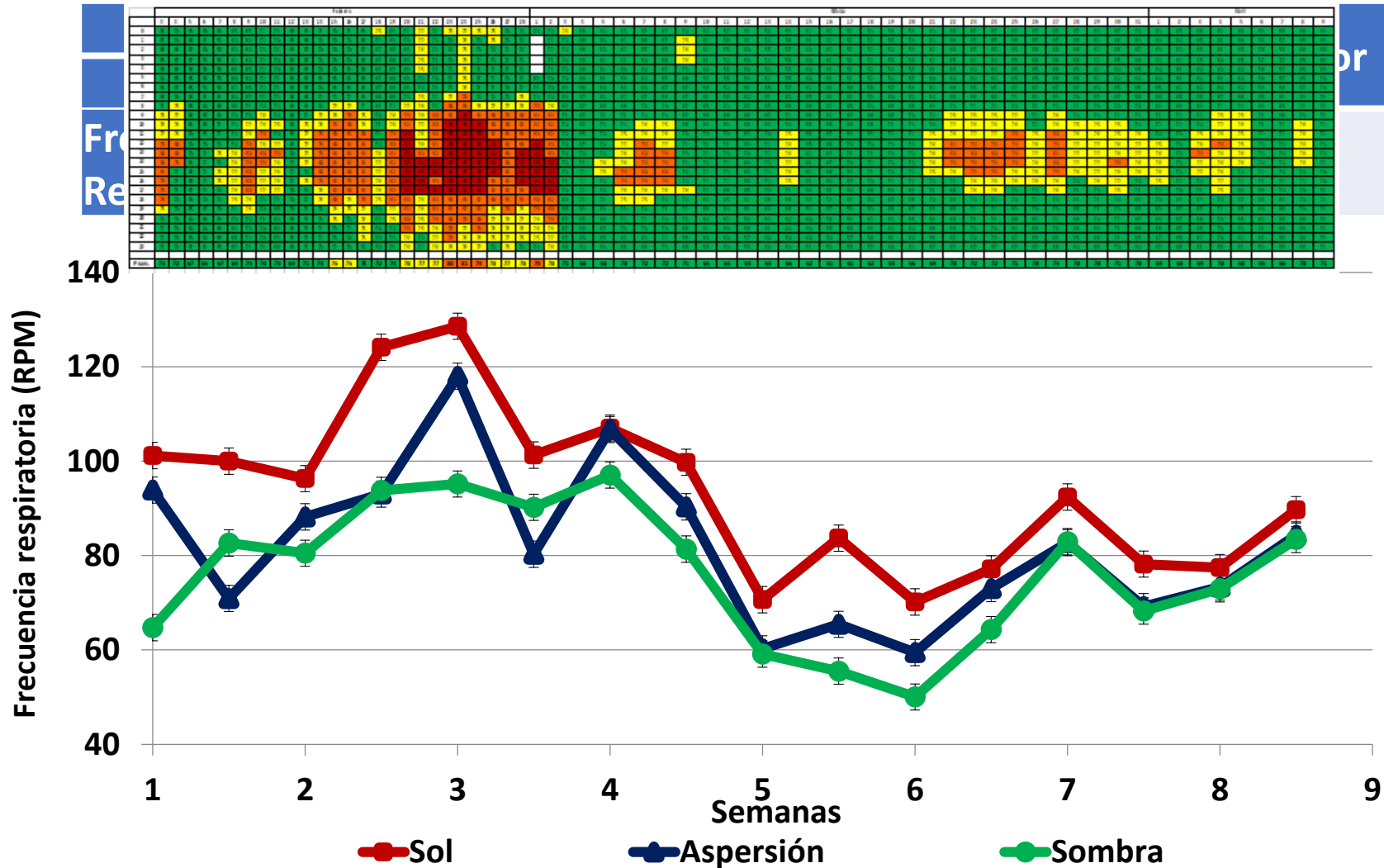
Frecuencia Respiratoria

| Frecuencia Respiratoria | Nivel de Riesgo |
|-------------------------|-----------------|
| 40-60 | Bajo |
| 60-80 | Medio |
| 80-120 | Alto |
| >120 | Severo |

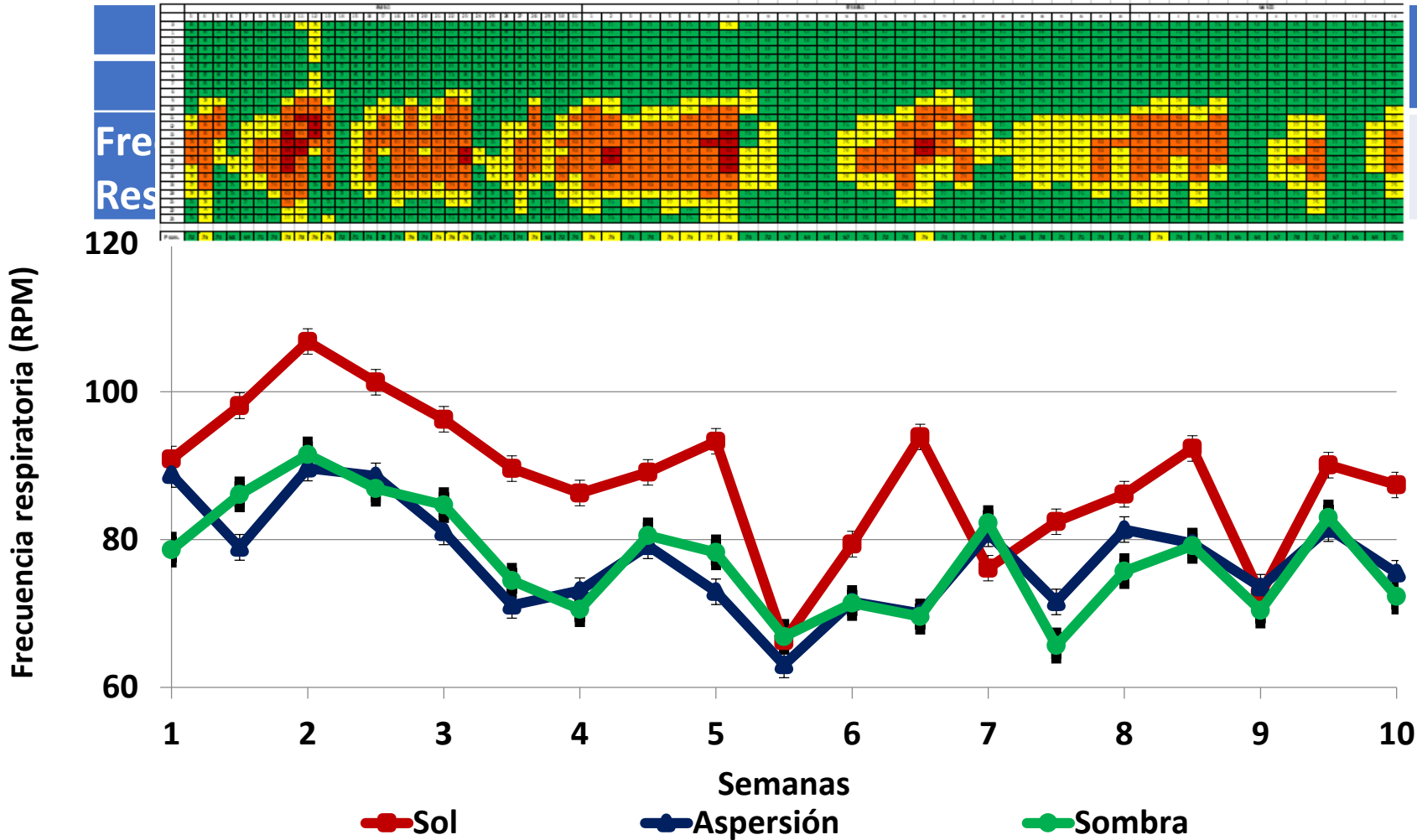
Fuente: Silankove, 2000



Ensayo N° 1: Verano 2016/2017



Ensayo N° 2: Verano 2017/2018



Escala de Jadeo

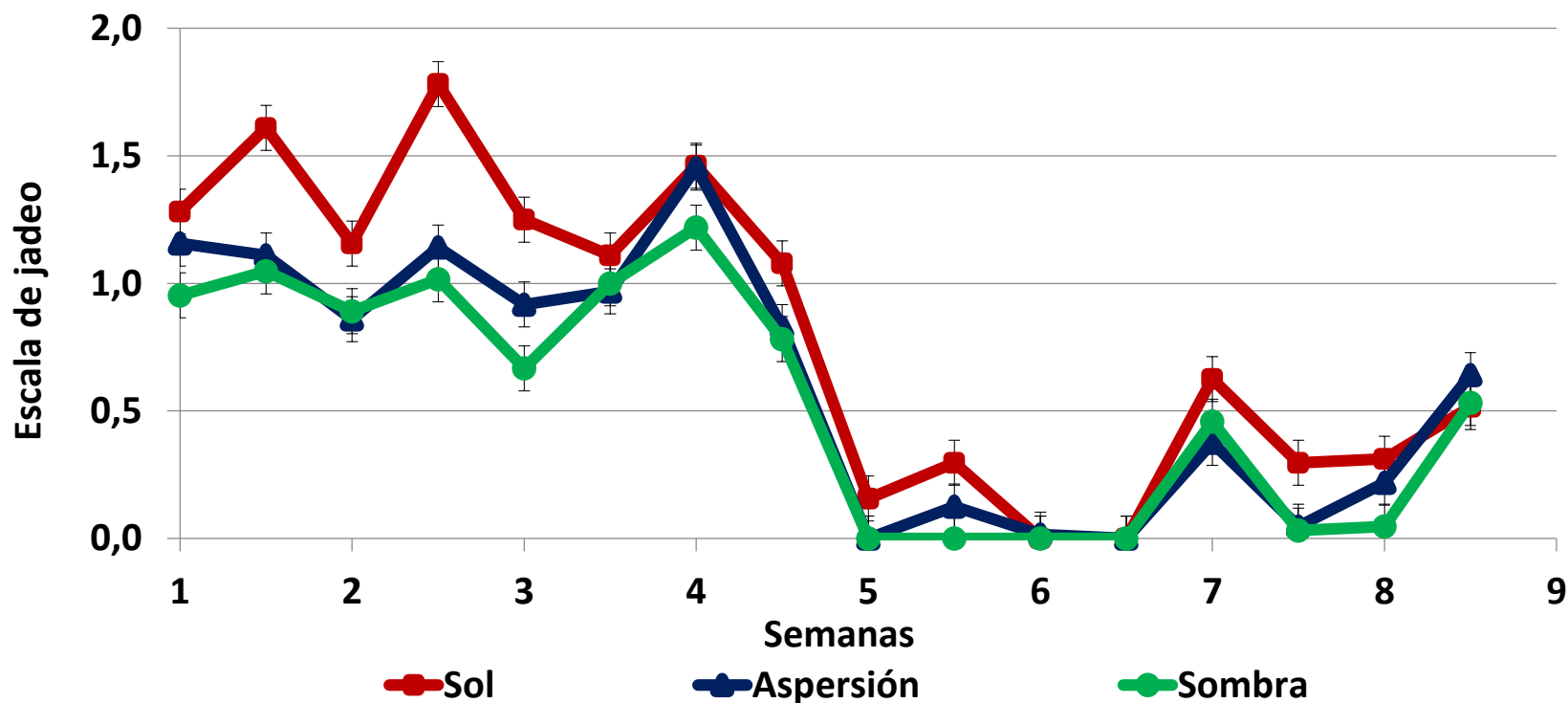
| Grado | Jadeo |
|-------|---|
| 0 | Ausente |
| 1 | Jadeo leve, boca cerrada, sin babeo ni espuma |
| 2 | Jadeo acelerado, babeo o espuma presente en la boca |
| 2,5 | Igual al anterior, pero boca abierta |
| 3 | Boca abierta, babeo, nuca extendida, cabeza generalmente hacia arriba |
| 3,5 | Igual al anterior, pero con lengua hacia afuera |
| 4 | Boca abierta, lengua hacia afuera, babeo, nuca extendida, cabeza hacia arriba |
| 4,5 | Igual que el anterior, pero cabeza hacia abajo |

Fuente: Gaughan et al., 2008



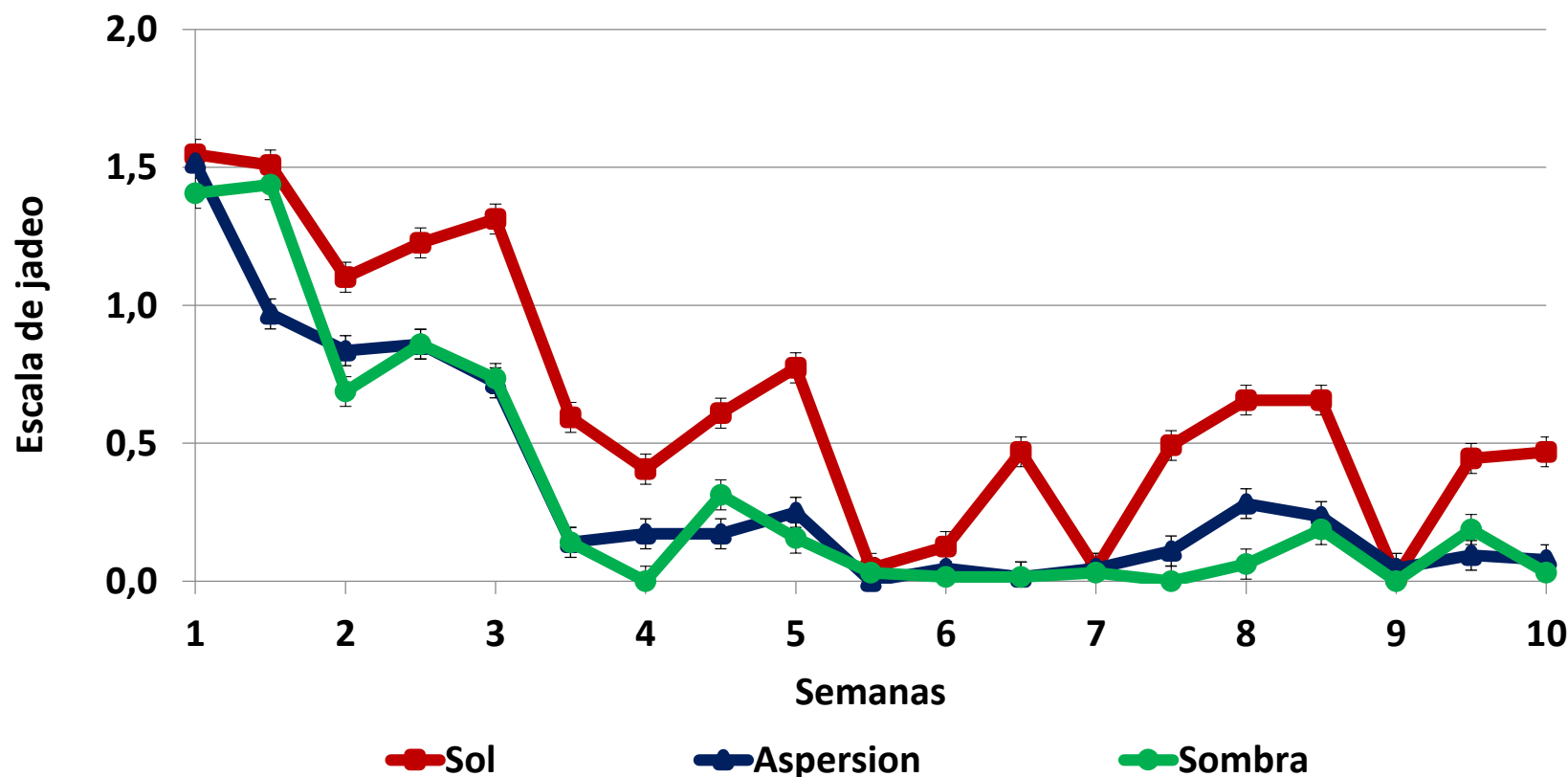
Ensayo N° 1: Verano 2016/2017

| | Tratamiento | | | ee | P-valor |
|-----------------|-------------|-----------|--------|------|---------|
| | Sol | Aspersión | Sombra | | |
| Escala de Jadeo | 0,78c | 0,59b | 0,52a | 0,02 | ** |



Ensayo N° 2: Verano 2017/2018

| | Tratamiento | | | ee | P-valor |
|-----------------|-------------|-----------|--------|------|---------|
| | Sol | Aspersión | Sombra | | |
| Escala de Jadeo | 0,66b | 0,35a | 0,33a | 0,02 | ** |



Asociación entre medidas de estrés calórico e ITH

| Puntaje | Descripción |
|---------|---|
| 0 | Respiración normal, ~ 60 o menos exhalaciones por minuto (epm) |
| 1 | Respiración ligeramente elevada, 60-90 epm |
| 2 | Jadeo moderado y/o presencia de babas o pequeña cantidad de saliva, 90-120 epm |
| 3 | Jadeo grave con boca abierta, saliva usualmente presente, 120-150 epm |
| 4 | Jadeo severo con la boca abierta acompañado por proyección de la lengua y excesiva salivación, usualmente la cabeza y cuello se encuentra extendidos. |

Fuente: Mader y col., 2002



Ensayo N° 1 y N° 2: Verano 2016/2017 y 2017/2018

| | Tratamiento | | | | | | ee | P-valor |
|-----------------------|-------------|---|-----------|---|--------|---|----|---------|
| | Sol | | Aspersión | | Sombra | | | |
| Comiendo (min; Año 1) | 70 | b | 75 | b | 95 | a | 7 | # |
| Comiendo (min; Año 2) | 80 | b | 81 | b | 97 | a | 5 | * |

= P < 0,10; * = P < 0,05.



Ensayo N° 1 y N° 2: Verano 2016/2017 y 2017/2018

| | Tratamiento | | | | | | ee | P-valor |
|--|-------------|--|-----------|--|--------|--|------|---------|
| | Sol | | Aspersión | | Sombra | | | |
| Año 1: GMD Período 1 (kg/día); 33 días; ITH = 74 | 0,52 b | | 0,81 a | | 0,72 a | | 0,09 | # |

| | Febrero | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 1 | 2 | 3 | |
| 0 | 68 | 70 | 69 | 60 | 60 | 65 | 65 | 72 | 71 | 68 | 69 | 71 | 70 | 71 | 69 | 75 | 69 | 71 | 77 | 72 | 75 | 77 | 75 | 75 | 74 | 74 | 74 | 74 | 76 | |
| 1 | 67 | 70 | 68 | 61 | 59 | 64 | 64 | 72 | 70 | 69 | 68 | 70 | 70 | 70 | 68 | 72 | 69 | 70 | 77 | 73 | 74 | 76 | 74 | 75 | 73 | 74 | | | 72 | 74 |
| 2 | 66 | 68 | 67 | 60 | 58 | 63 | 64 | 73 | 71 | 69 | 67 | 70 | 70 | 70 | 67 | 67 | 68 | 69 | 76 | 72 | 74 | 75 | 73 | 74 | 72 | 74 | | | 72 | 74 |
| 3 | 65 | 67 | 67 | 59 | 58 | 62 | 64 | 72 | 70 | 69 | 67 | 70 | 70 | 66 | 67 | 68 | 69 | 75 | 71 | 73 | 75 | 72 | 73 | 72 | 73 | | | 71 | 74 | |
| 4 | 65 | 66 | 66 | 58 | 56 | 61 | 65 | 72 | 70 | 69 | 67 | 70 | 70 | 69 | 66 | 67 | 67 | 69 | 75 | 71 | 73 | 75 | 71 | 72 | 71 | 73 | | | 71 | 73 |
| 5 | 64 | 65 | 65 | 58 | 55 | 60 | 64 | 72 | 71 | 69 | 67 | 69 | 69 | 69 | 66 | 67 | 66 | 69 | 74 | 70 | 72 | 75 | 71 | 72 | 70 | 72 | 69 | 70 | 70 | |
| 6 | 65 | 67 | 65 | 59 | 56 | 62 | 65 | 72 | 71 | 69 | 67 | 70 | 69 | 69 | 66 | 67 | 66 | 69 | 74 | 71 | 73 | 76 | 71 | 71 | 70 | 72 | 71 | 70 | 69 | |
| 7 | 68 | 70 | 66 | 61 | 61 | 64 | 67 | 72 | 72 | 68 | 68 | 72 | 73 | 72 | 69 | 68 | 68 | 73 | 75 | 72 | 77 | 79 | 74 | 74 | 73 | 75 | 74 | 74 | 69 | |
| 8 | 71 | 75 | 65 | 64 | 66 | 66 | 71 | 74 | 73 | 69 | 69 | 74 | 77 | 77 | 72 | 69 | 72 | 77 | 78 | 74 | 80 | 83 | 78 | 77 | 77 | 78 | 79 | 78 | 69 | |
| 9 | 75 | 77 | 66 | 65 | 69 | 70 | 73 | 76 | 74 | 68 | 72 | 77 | 78 | 79 | 75 | 70 | 76 | 79 | 78 | 80 | 82 | 86 | 81 | 80 | 79 | 80 | 81 | 81 | 71 | |
| 10 | 76 | 78 | 69 | 68 | 71 | 73 | 77 | 78 | 75 | 69 | 75 | 78 | 79 | 80 | 78 | 71 | 78 | 82 | 77 | 80 | 84 | 86 | 84 | 80 | 80 | 82 | 82 | 82 | 74 | |
| 11 | 77 | 78 | 70 | 69 | 72 | 74 | 78 | 79 | 74 | 69 | 77 | 79 | 80 | 81 | 80 | 72 | 79 | 84 | 76 | 80 | 85 | 87 | 85 | 82 | 81 | 83 | 83 | 82 | 74 | |
| 12 | 79 | 80 | 70 | 70 | 73 | 74 | 79 | 78 | 77 | 69 | 77 | 79 | 80 | 81 | 81 | 74 | 80 | 84 | 78 | 81 | 85 | 86 | 86 | 84 | 82 | 83 | 84 | 83 | 74 | |
| 13 | 80 | 80 | 70 | 71 | 75 | 76 | 80 | 80 | 79 | 70 | 77 | 79 | 81 | 81 | 81 | 76 | 81 | 85 | 83 | 82 | 86 | 87 | 85 | 84 | 83 | 84 | 84 | 83 | 74 | |
| 14 | 80 | 79 | 69 | 72 | 78 | 76 | 79 | 79 | 78 | 72 | 77 | 80 | 81 | 82 | 82 | 77 | 82 | 85 | 84 | 84 | 86 | 87 | 86 | 84 | 83 | 84 | 85 | 84 | 73 | |
| 15 | 81 | 72 | 68 | 72 | 75 | 77 | 80 | 77 | 78 | 72 | 74 | 80 | 81 | 80 | 82 | 77 | 82 | 85 | 85 | 84 | 86 | 87 | 85 | 84 | 82 | 84 | 85 | 84 | 73 | |
| 16 | 79 | 71 | 68 | 72 | 75 | 77 | 80 | 77 | 78 | 72 | 75 | 79 | 81 | 79 | 82 | 76 | 82 | 86 | 85 | 83 | 85 | 85 | 85 | 83 | 82 | 84 | 84 | 84 | 71 | |
| 17 | 79 | 71 | 67 | 72 | 74 | 76 | 80 | 77 | 77 | 70 | 74 | 78 | 82 | 80 | 81 | 76 | 82 | 84 | 84 | 84 | 85 | 84 | 84 | 82 | 82 | 83 | 84 | 84 | 70 | |
| 18 | 79 | 70 | 66 | 70 | 74 | 75 | 78 | 73 | 71 | 70 | 72 | 76 | 80 | 78 | 79 | 75 | 81 | 83 | 78 | 83 | 83 | 83 | 82 | 80 | 81 | 81 | 80 | 82 | 69 | |
| 19 | 75 | 70 | 65 | 67 | 70 | 72 | 76 | 70 | 68 | 70 | 71 | 74 | 78 | 75 | 77 | 74 | 77 | 81 | 76 | 81 | 81 | 82 | 81 | 78 | 79 | 78 | 79 | 80 | 68 | |
| 20 | 73 | 70 | 64 | 66 | 69 | 70 | 74 | 71 | 69 | 69 | 71 | 73 | 75 | 73 | 76 | 72 | 75 | 80 | 75 | 79 | 80 | 79 | 80 | 77 | 78 | 77 | 78 | 79 | 67 | |
| 21 | 72 | 70 | 64 | 64 | 68 | 69 | 73 | 70 | 69 | 69 | 71 | 72 | 73 | 72 | 75 | 70 | 74 | 79 | 75 | 78 | 79 | 77 | 79 | 76 | 76 | 76 | 76 | 78 | 67 | |
| 22 | 72 | 70 | 63 | 63 | 66 | 68 | 72 | 70 | 69 | 69 | 71 | 72 | 73 | 70 | 75 | 70 | 73 | 78 | 73 | 77 | 79 | 76 | 78 | 75 | 77 | 75 | 75 | 77 | 67 | |
| 23 | 71 | 70 | 61 | 62 | 65 | 67 | 71 | 71 | 68 | 69 | 71 | 70 | 72 | 70 | 74 | 70 | 71 | 78 | 72 | 76 | 78 | 76 | 77 | 74 | 75 | 73 | 74 | 76 | 66 | |
| Prom. | 73 | 72 | 67 | 65 | 67 | 69 | 73 | 74 | 73 | 69 | 71 | 74 | 76 | 75 | 74 | 72 | 74 | 78 | 77 | 77 | 80 | 81 | 79 | 78 | 77 | 78 | 79 | 78 | 71 | |



Ensayo N° 1 y N° 2: Verano 2016/2017 y 2017/2018

| | Tratamiento | | | | ee | P-valor |
|---|-------------|---|-----------|--------|------|---------|
| | Sol | | Aspersión | Sombra | | |
| Año 1: GMD Período 1 (kg/día); 33 días; ITH = 74 | 0,52 | b | 0,81 | a | 0,09 | # |
| Año 1: GMD Período 2 (kg/día) ; 32 días; ITH = 68 | 1,48 | | 1,32 | | 0,16 | ns |

| Marzo | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Abril | | | | | | | | |
|-------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|--|
| 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | | |
| 66 | 64 | 63 | 67 | 67 | 74 | 64 | 57 | 61 | 54 | 59 | 62 | 62 | 51 | 53 | 56 | 59 | 63 | 66 | 67 | 67 | 67 | 67 | 67 | 67 | 63 | 67 | 70 | 63 | 65 | 66 | 62 | 66 | 59 | 58 | 66 | 69 | | | |
| 66 | 63 | 62 | 66 | 67 | 75 | 62 | 56 | 61 | 54 | 58 | 61 | 62 | 51 | 52 | 55 | 59 | 63 | 66 | 65 | 65 | 66 | 67 | 67 | 66 | 62 | 66 | 69 | 64 | 64 | 65 | 61 | 66 | 59 | 57 | 65 | 69 | | | |
| 66 | 63 | 62 | 65 | 67 | 76 | 62 | 55 | 60 | 55 | 57 | 60 | 62 | 51 | 52 | 54 | 59 | 62 | 66 | 65 | 65 | 65 | 66 | 66 | 66 | 62 | 65 | 67 | 63 | 63 | 65 | 61 | 65 | 58 | 56 | 66 | 68 | | | |
| 66 | 62 | 61 | 64 | 68 | 76 | 61 | 54 | 60 | 54 | 56 | 60 | 62 | 51 | 52 | 55 | 58 | 62 | 65 | 64 | 64 | 65 | 66 | 66 | 66 | 62 | 65 | 66 | 64 | 62 | 65 | 60 | 65 | 57 | 57 | 65 | 69 | | | |
| 66 | 62 | 60 | 64 | 67 | 73 | 60 | 55 | 60 | 53 | 55 | 60 | 61 | 51 | 52 | 53 | 57 | 61 | 65 | 64 | 64 | 65 | 65 | 66 | 65 | 62 | 64 | 64 | 61 | 64 | 61 | 64 | 56 | 57 | 65 | 69 | | | | |
| 66 | 61 | 59 | 64 | 67 | 66 | 59 | 55 | 59 | 52 | 55 | 60 | 61 | 51 | 52 | 54 | 57 | 60 | 64 | 64 | 64 | 65 | 65 | 66 | 65 | 62 | 64 | 64 | 61 | 64 | 61 | 64 | 56 | 57 | 65 | 70 | | | | |
| 66 | 60 | 59 | 63 | 67 | 67 | 58 | 54 | 61 | 55 | 57 | 62 | 61 | 56 | 56 | 57 | 59 | 62 | 66 | 65 | 65 | 67 | 67 | 67 | 67 | 63 | 65 | 65 | 65 | 62 | 64 | 64 | 59 | 58 | 67 | 70 | | | | |
| 67 | 63 | 62 | 67 | 68 | 67 | 61 | 58 | 64 | 61 | 63 | 65 | 61 | 61 | 59 | 60 | 63 | 64 | 68 | 68 | 68 | 71 | 69 | 69 | 70 | 67 | 68 | 66 | 65 | 68 | 67 | 68 | 65 | 61 | 69 | 71 | | | | |
| 67 | 68 | 66 | 70 | 70 | 67 | 65 | 63 | 67 | 65 | 68 | 66 | 62 | 65 | 63 | 66 | 68 | 69 | 73 | 72 | 72 | 74 | 71 | 73 | 72 | 70 | 70 | 70 | 69 | 69 | 69 | 72 | 69 | 65 | 71 | 71 | | | | |
| 67 | 71 | 71 | 74 | 73 | 67 | 68 | 66 | 68 | 67 | 72 | 68 | 62 | 67 | 66 | 68 | 70 | 72 | 75 | 75 | 75 | 77 | 72 | 76 | 73 | 73 | 73 | 71 | 72 | 72 | 75 | 75 | 71 | 68 | 73 | 71 | | | | |
| 67 | 73 | 74 | 76 | 75 | 68 | 69 | 69 | 68 | 69 | 74 | 68 | 65 | 68 | 68 | 71 | 73 | 74 | 77 | 78 | 78 | 78 | 78 | 72 | 78 | 75 | 75 | 74 | 72 | 72 | 74 | 77 | 76 | 71 | 71 | 76 | 72 | | | |
| 65 | 74 | 75 | 78 | 76 | 70 | 70 | 70 | 69 | 70 | 75 | 66 | 67 | 69 | 69 | 72 | 72 | 75 | 78 | 77 | 77 | 79 | 75 | 80 | 76 | 76 | 75 | 76 | 74 | 73 | 75 | 78 | 75 | 72 | 78 | 72 | | | | |
| 67 | 74 | 77 | 79 | 77 | 72 | 71 | 71 | 69 | 72 | 76 | 65 | 68 | 70 | 70 | 73 | 73 | 76 | 81 | 79 | 79 | 79 | 76 | 79 | 77 | 77 | 76 | 77 | 75 | 73 | 78 | 79 | 75 | 73 | 73 | 78 | 73 | | | |
| 70 | 74 | 78 | 80 | 79 | 73 | 72 | 73 | 70 | 72 | 76 | 62 | 67 | 71 | 71 | 73 | 73 | 76 | 80 | 80 | 80 | 79 | 77 | 81 | 77 | 77 | 78 | 77 | 76 | 73 | 79 | 78 | 76 | 73 | 74 | 78 | 73 | | | |
| 71 | 76 | 78 | 79 | 79 | 73 | 73 | 72 | 69 | 73 | 77 | 61 | 67 | 70 | 72 | 73 | 73 | 76 | 79 | 79 | 79 | 78 | 76 | 80 | 77 | 77 | 79 | 76 | 76 | 73 | 77 | 78 | 76 | 74 | 74 | 76 | 71 | | | |
| 72 | 75 | 79 | 80 | 80 | 74 | 72 | 73 | 69 | 73 | 76 | 62 | 66 | 69 | 71 | 73 | 72 | 75 | 78 | 79 | 79 | 78 | 76 | 79 | 76 | 77 | 78 | 76 | 73 | 77 | 78 | 74 | 72 | 74 | 74 | 70 | | | | |
| 72 | 74 | 79 | 79 | 79 | 74 | 72 | 72 | 68 | 73 | 75 | 61 | 64 | 67 | 70 | 72 | 72 | 73 | 71 | 78 | 78 | 76 | 76 | 78 | 74 | 76 | 77 | 74 | 75 | 72 | 74 | 77 | 72 | 71 | 72 | 73 | 70 | | | |
| 72 | 74 | 78 | 78 | 76 | 76 | 72 | 68 | 65 | 70 | 71 | 59 | 61 | 64 | 66 | 69 | 69 | 71 | 68 | 76 | 76 | 73 | 73 | 76 | 71 | 73 | 75 | 71 | 72 | 70 | 71 | 75 | 69 | 69 | 70 | 71 | | | | |
| 71 | 71 | 75 | 75 | 74 | 74 | 69 | 65 | 62 | 66 | 68 | 59 | 59 | 61 | 64 | 67 | 68 | 70 | 68 | 74 | 74 | 70 | 72 | 74 | 69 | 71 | 74 | 69 | 70 | 69 | 69 | 74 | 67 | 66 | 69 | 70 | | | | |
| 69 | 69 | 73 | 74 | 71 | 72 | 66 | 64 | 61 | 64 | 66 | 59 | 57 | 59 | 63 | 66 | 67 | 69 | 68 | 72 | 72 | 69 | 70 | 73 | 68 | 71 | 73 | 68 | 69 | 67 | 67 | 72 | 65 | 64 | 68 | 70 | | | | |
| 67 | 68 | 72 | 72 | 70 | 70 | 64 | 62 | 59 | 63 | 64 | 60 | 56 | 59 | 62 | 63 | 65 | 69 | 68 | 71 | 71 | 68 | 69 | 72 | 68 | 70 | 72 | 67 | 69 | 67 | 66 | 70 | 65 | 63 | 66 | 68 | 71 | | | |
| 66 | 67 | 70 | 70 | 70 | 68 | 62 | 60 | 58 | 61 | 63 | 64 | 60 | 55 | 58 | 61 | 63 | 64 | 68 | 68 | 70 | 69 | 68 | 70 | 66 | 69 | 71 | 66 | 68 | 67 | 65 | 70 | 63 | 61 | 66 | 68 | 71 | | | |
| 65 | 65 | 69 | 69 | 72 | 68 | 60 | 60 | 57 | 60 | 64 | 60 | 54 | 57 | 58 | 61 | 64 | 68 | 67 | 70 | 70 | 67 | 68 | 69 | 65 | 68 | 71 | 65 | 67 | 66 | 62 | 70 | 62 | 61 | 66 | 68 | 71 | | | |
| 64 | 63 | 68 | 68 | 73 | 66 | 58 | 60 | 55 | 60 | 63 | 61 | 53 | 55 | 57 | 60 | 63 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 68 | 64 | 68 | 70 | 64 | 67 | 66 | 61 | 65 | 61 | 59 | 65 | 68 | 71 | |
| 68 | 68 | 70 | 72 | 72 | 71 | 65 | 63 | 63 | 63 | 66 | 62 | 61 | 61 | 62 | 64 | 66 | 69 | 70 | 72 | 72 | 71 | 70 | 73 | 70 | 70 | 71 | 70 | 69 | 68 | 69 | 70 | 68 | 65 | 66 | 70 | 71 | | | |

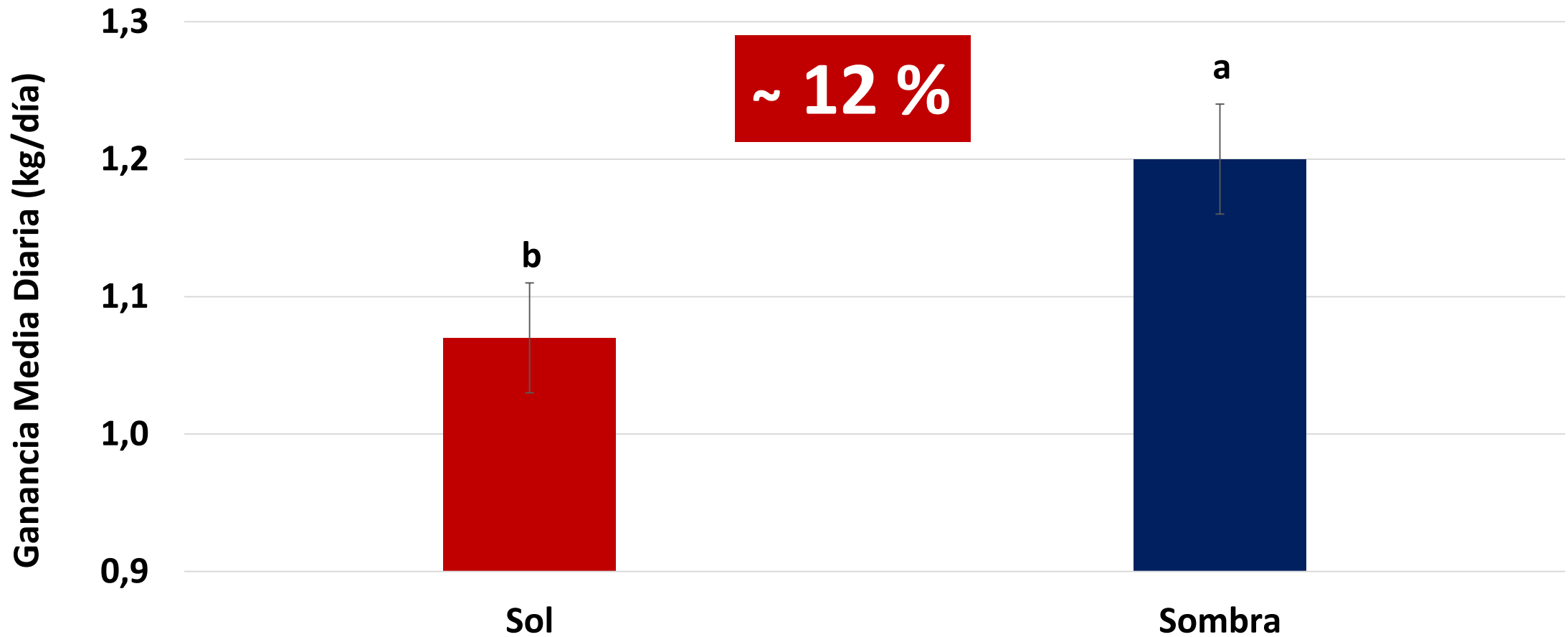


Ensayo N° 1 y N° 2: Verano 2016/2017 y 2017/2018

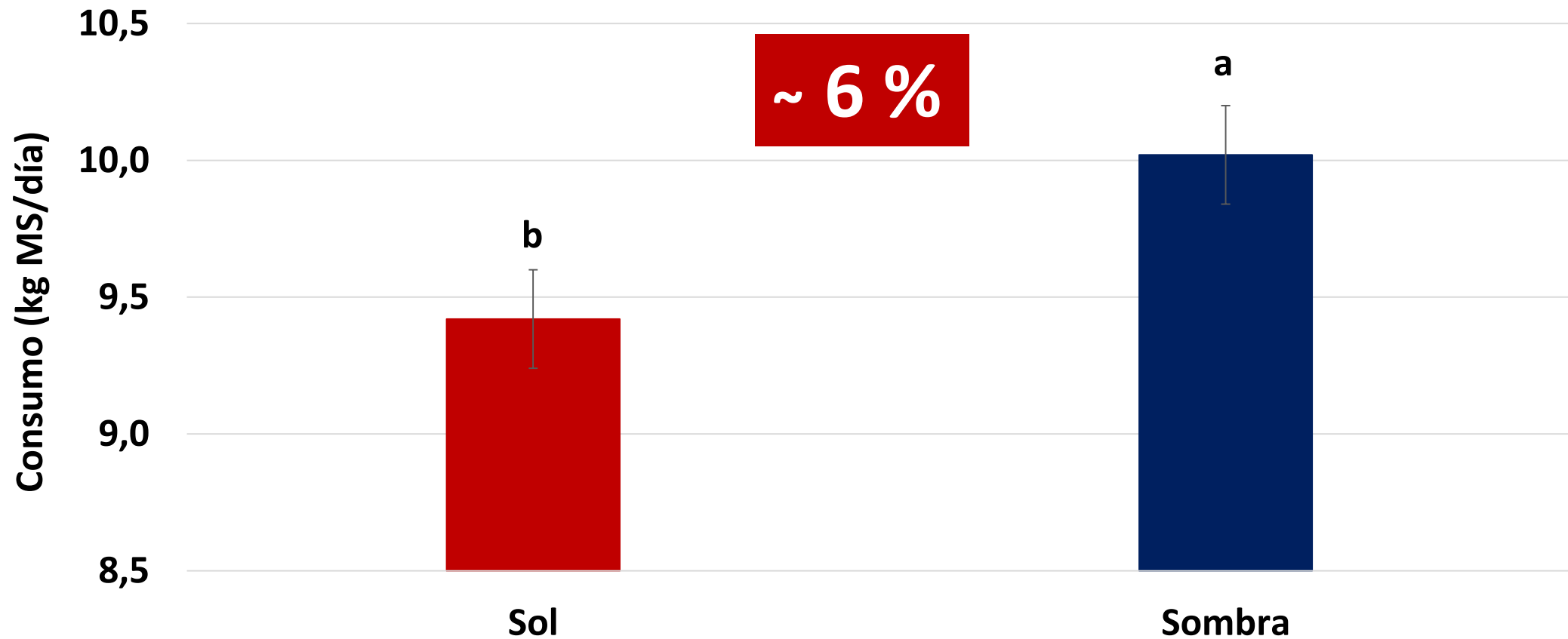
| | Tratamiento | | | ee | P-valor |
|---|-------------|-----------|--------|------|---------|
| | Sol | Aspersión | Sombra | | |
| Año 1: GMD Período 1 (kg/día); 33 días; ITH = 74 | 0,52 b | 0,81 a | 0,72 a | 0,09 | # |
| Año 1: GMD Período 2 (kg/día) ; 32 días; ITH = 68 | 1,48 | 1,32 | 1,51 | 0,16 | ns |
| Año 2: GMD (kg/día) ; 71 días, ITH = 72 | 1,07 | 0,99 | 1,18 | 0,06 | ns |



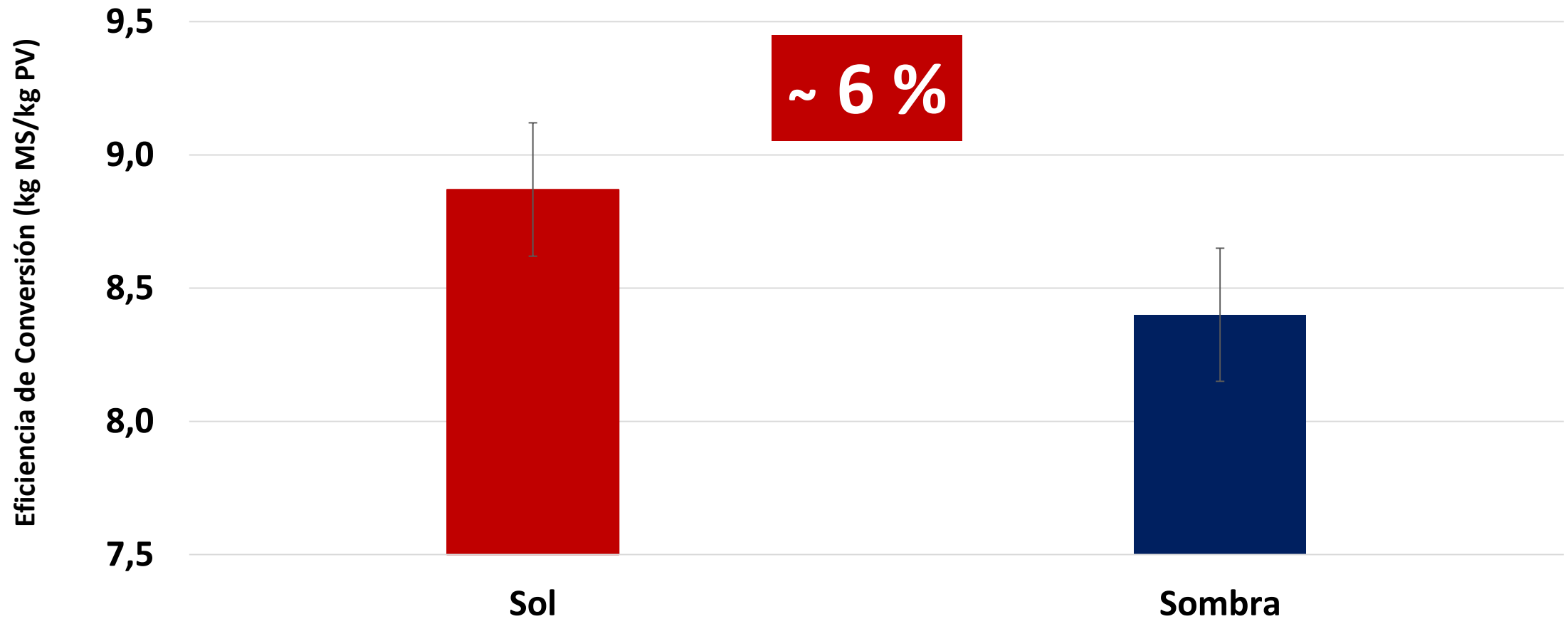
Ensayo N° 1 + N° 2: Verano 2016/2017 + 2017/2018



Ensayo N° 1 + N° 2: Verano 2016/2017 + 2017/2018



Ensayo N° 1 + N° 2: Verano 2016/2017 + 2017/2018



Mensajes finales

- En los dos veranos evaluados se observaron períodos con ola de calor (ITH diario mayor a 74 por 3 días consecutivos).
- Ambas medidas de mitigación (Sombra y Aspersión) mejoraron el confort animal reflejado en la frecuencia respiratoria y la escala de jadeo.
- El acceso a Sombra mejoró el desempeño productivo de los animales.
- Es necesario seguir evaluando la mejor forma de aplicar la Aspersión, ya que la misma mostró mejorar el confort animal pero no el desempeño productivo de los animales.



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