



# XLVII CONGRESO NACIONAL Y XXIII INTERNACIONAL

*de la Sociedad Española de Ovinotecnia y Caprinotecnia.*



## COMUNICACIONES

### **GB3: Resultados actuales del uso de sensores para la valoración de las condiciones ambientales en ovino y caprino lechero.**

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*Proyecto financiado por el programa H2020 de investigación e innovación de la Unión Europea (Contrato No 862050)*

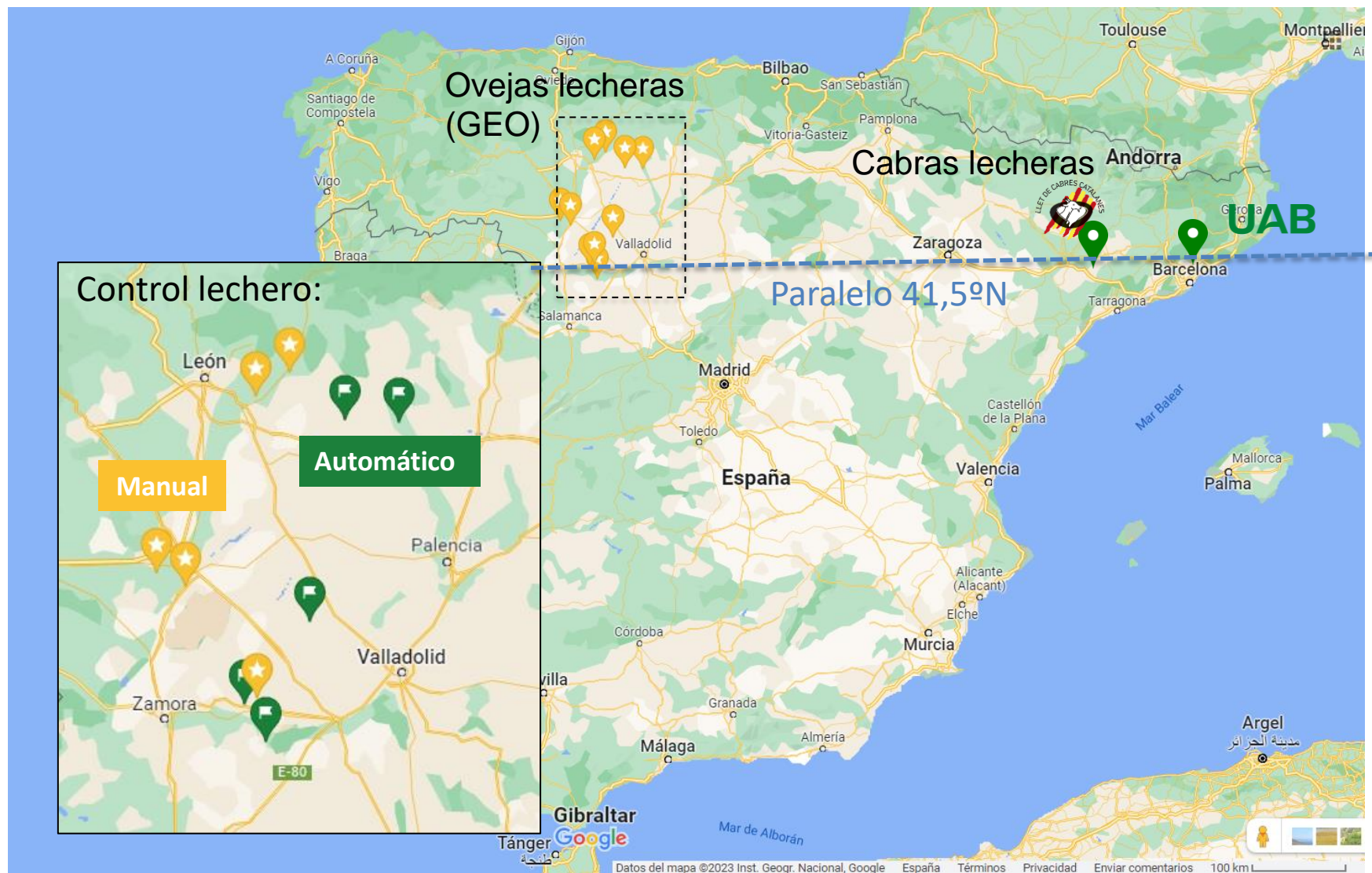
**TechCare:** Integración tecnologías innovadoras para la mejora del manejo del bienestar en la cadena de valor de los pequeños rumiantes UE H2020 Project Contract No 862050: [www.techcare-project.eu](http://www.techcare-project.eu)

- **Priorización en ovejas y cabras lecheras: Condiciones intensivas en España**  
(Caja & Elhadi, 2021, 2022)

| Ovejas y cabras lecheras                                 | Prioridad | Votos      |
|--|-----------|------------|
| <b>Problemas de bienestar</b>                            |           |            |
| <b>Mastitis</b>  | <b>1</b>  | <b>79%</b> |
| <b>Nutrición</b>   | <b>2</b>  | <b>69%</b> |
| Ambiente y condiciones de los alojamientos               | 3         | 69%        |
| <b>Sensores y tecnologías</b>                            |           |            |
| <b>Estaciones meteorológicas internas-externas (THI)</b> | <b>1</b>  | <b>83%</b> |
| <b>Medidores electrónicos de leche (peso o volumen)</b>  | <b>2</b>  | <b>68%</b> |
| Básculas automáticas (PV)                                | 3         | 56%        |
| Acelerómetros-3A (actividad)                             | 4         | 51%        |



# Granjas de ovino y caprino lechero en España (n = 12): Localización



## Granjas de ovino y caprino lechero en España (n = 12): Características


| #Num                          | Granja    | Raza             | Cabezas       | Leche, L | Sala ordeño                    | Control        |
|-------------------------------|-----------|------------------|---------------|----------|--------------------------------|----------------|
| GEO01                         | Perihonda | Assaf            | 1.500         | 650      | 2x20 (40) GEA                  | Automático (A) |
| GEO02                         | Camperón  | Lacaune y cruces | 700           | 450      | 2x18 (18) DeLaval              | Manual (M)     |
| GEO03                         | Canseco   | Assaf            | 550           | 500      | 2x16 (16) DeLaval              | Manual         |
| GEO04                         | Maraña    | Assaf            | 900           | 660      | 2x20 (40) DeLaval              | Automático     |
| GEO05                         | Hernández | Lacaune          | 2.500         | 500      | 2x30 (30)<br>2x20 (40) DeLaval | Automático     |
| GEO06                         | González  | Assaf            | 1.400         | 480      | 2x20 (20) DeLaval              | Automático     |
| GEO07                         | Corral    | Assaf            | 1.400         | 380      | 2x20 (20) GEA                  | Automático     |
| GEO08                         | Britur    | Assaf            | 900           | 550      | 2x20 (20) DeLaval              | Manual         |
| GEO09                         | Conejo    | Assaf y cruces   | 900           | 470      | 2x12 (12) GEA                  | Manual         |
| GEO10                         | Tuda      | Assaf            | 650           | 500      | 2x16 (16) GEA                  | Manual         |
| <b>Total o media (n = 10)</b> |           |                  | <b>11.400</b> |          |                                | A:M = 50%      |
| CAP11                         | Urgellet  | Alpina           | 750           | 700      | Roto 46 (46) GEA               | Automático     |
| UAB01                         | UAB       | Ovino-caprino    | 300           | 400      | 2x12 (12) DeLaval              | Automático     |
| <b>Total (n = 12)</b>         |           |                  | <b>12.450</b> |          |                                | A:M = 58%      |





# TechCare: Implementación de estación meteorológica con sensores (ext. e int.) (Froggit HP1000SE PRO Wi-Fi)



# TechCare: 1. Estación meteorológica y sensores en granja experimental: UAB (Bellaterra, B): 35 m

Wi-fi = 

Outdoor weather station = 


Internal central console (tablet) = 

Indoor temperature-humidity-pressure sensor = P

Indoor temperature-humidity sensors = ①-⑧

Soil humidity sensors = ①-⑧

Dust particle sensors = ①-②

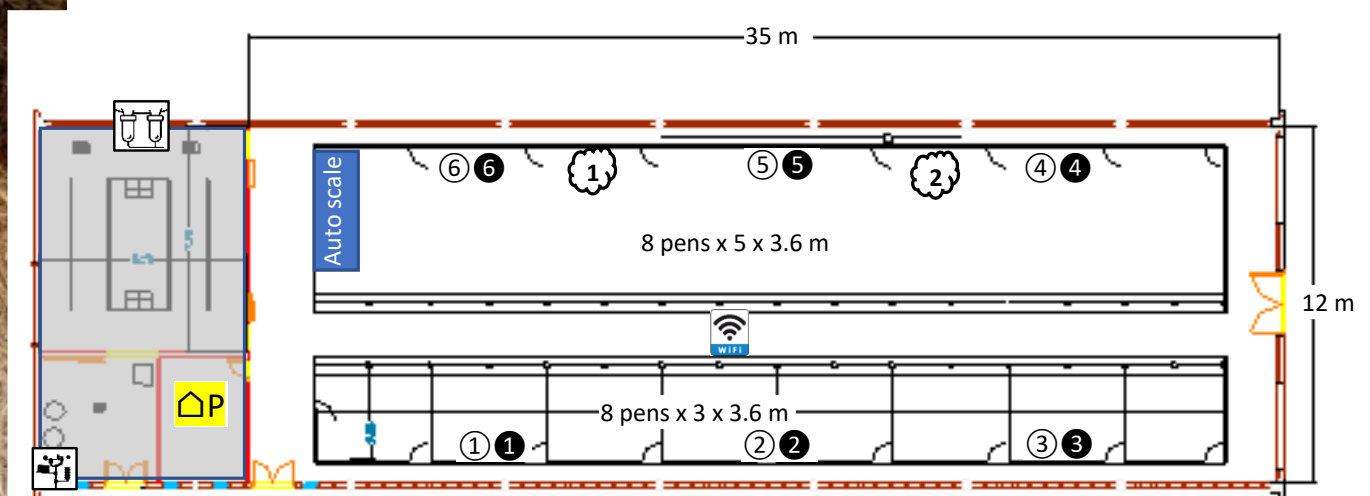
Milking parlor = 




①




②



## TechCare: 2. Estación meteorológica en granja comercial compacta: FCM (Villavendimio, ZA): < 50 m

Wi-fi = 



Outdoor weather station = 

Internal central console (tablet) = 

Indoor temperature-humidity-pressure sensor = P

Indoor temperature-humidity sensors = ①-⑧


Soil humidity sensors = ① - ⑧


Dust particle sensors =  - 

Milking parlor = 



# TechCare: Estación meteorológica y sensores en granja comercial de tipo lineal: **OOC** (Toro, ZA): 100 m

Wi-fi = 

Outdoor weather station = 

Internal central console (tablet) = 

Indoor temperature-humidity-pressure sensor = P

Indoor temperature-humidity sensors = ①-⑧

Soil humidity sensors = ①-⑧

Dust particle sensors = ①-②

Milking parlor = 





# TechCare – Proyectos a gran escala en granjas comerciales (n = 12)

## Estaciones meteo (1 estación/granja) 18 meses

| #     | Farm      | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|-------|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| UAB01 | UAB       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| GEO01 | Perihonda |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| GEO02 | Camperón  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| GEO03 | Canseco   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| GEO04 | Maraña    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| GEO05 | Hernández |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| GEO06 | FGG Ovina |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| GEO07 | Corral    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| GEO08 | Britur    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| GEO09 | Conejo    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| GEO10 | Tuda      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| CAP11 | Urgellet  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |

■ Power Prob.  
■ WiFi Prob.  
■ Unknown prob.

Necesidad de conexión permanente! (tarjeta de memoria?)



# TechCare: Índice termohigrométrico (THI) o índice de riesgo térmico

$$\text{THI}_{0C} \text{ (NRC, 1971)} = 1,8 \cdot T + 32 - (0,55 - 0,55 \cdot \text{HR}/100) \cdot (1,8 \cdot T - 26) =$$

$$= 0,81 \cdot T - 14,3 \cdot \text{HR}/100 + 0,99 \cdot \text{HR}/100 \cdot T + 46,3$$

$$\text{THI}_{0C} \text{ (Mader et al., 2006)} = 0,8 \cdot T + \text{HR}/100 \cdot (T - 14,41) + 46,4$$

## Vacas lecheras:

- <68, 100% normalidad
- 68-72, calor leve
- 72-79, calor moderado
- 80-89, calor severo
- >90 calor fatal



1. RIESGOS TERMICOS EN VACUNO (Mader et al., 2006): Producción de LECHE

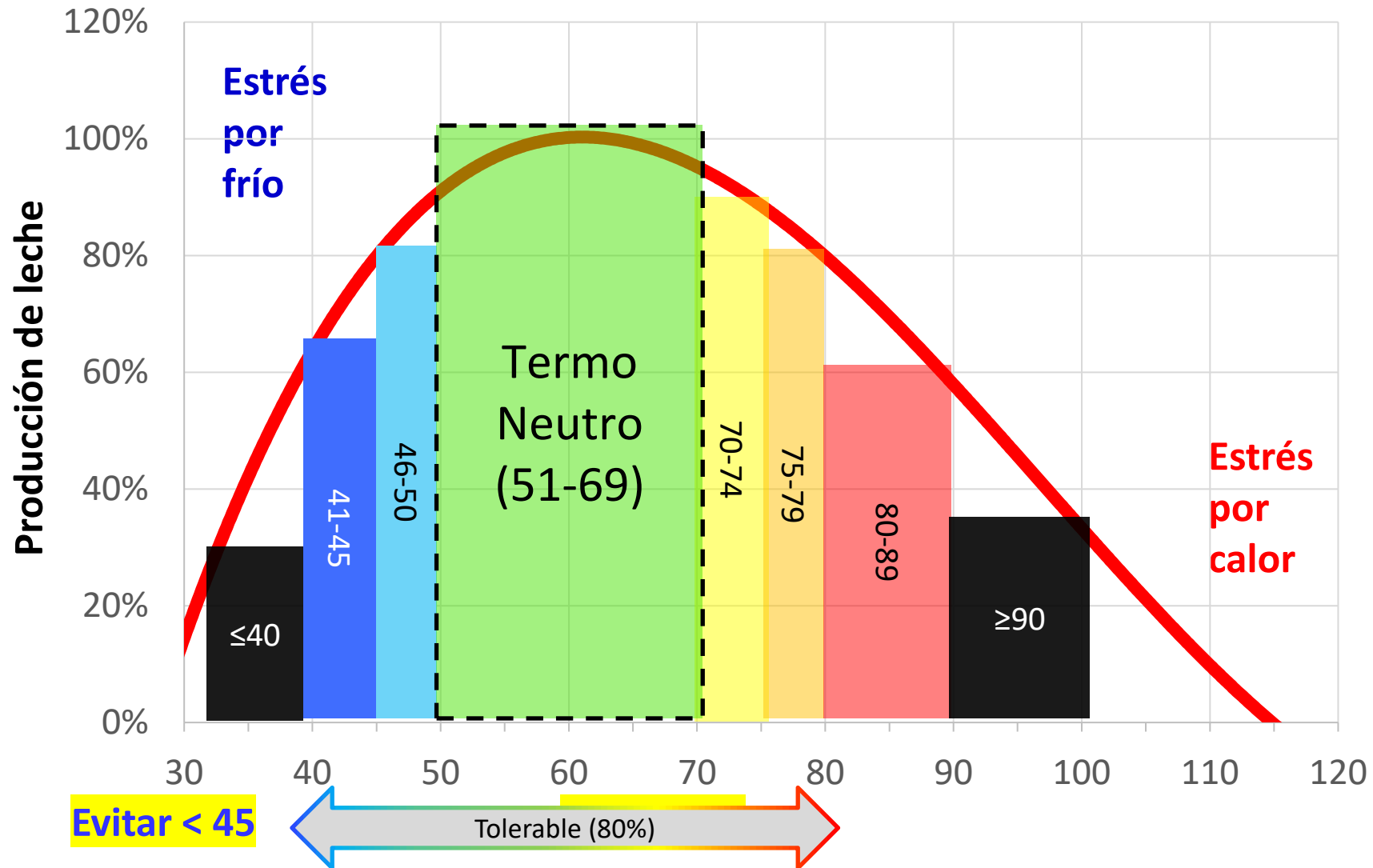
|                     |     | Temperatura, °C |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |     |     |     |
|---------------------|-----|-----------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
|                     |     | -10             | -8 | -6 | -4 | -2 | 2  | 4  | 6  | 8  | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38  | 40  | 42  | 44  |
| Humedad relativa, % | 10  | 36              | 38 | 40 | 41 | 43 | 47 | 49 | 50 | 52 | 54 | 56 | 58 | 59 | 61 | 63 | 65 | 67 | 68 | 70 | 72 | 74 | 76 | 77 | 79  | 81  | 83  | 85  |
|                     | 20  | 34              | 36 | 38 | 40 | 42 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82  | 84  | 86  | 88  |
|                     | 30  | 31              | 33 | 35 | 38 | 40 | 44 | 46 | 49 | 51 | 53 | 55 | 57 | 60 | 62 | 64 | 66 | 68 | 71 | 73 | 75 | 77 | 79 | 82 | 84  | 86  | 88  | 90  |
|                     | 40  | 29              | 31 | 33 | 36 | 38 | 43 | 45 | 48 | 50 | 53 | 55 | 57 | 60 | 62 | 65 | 67 | 69 | 72 | 74 | 77 | 79 | 81 | 84 | 86  | 89  | 91  | 93  |
|                     | 50  | 26              | 29 | 31 | 34 | 37 | 42 | 44 | 47 | 50 | 52 | 55 | 57 | 60 | 63 | 65 | 68 | 70 | 73 | 76 | 78 | 81 | 83 | 86 | 89  | 91  | 94  | 96  |
|                     | 60  | 24              | 27 | 29 | 32 | 35 | 41 | 43 | 46 | 49 | 52 | 55 | 57 | 60 | 63 | 66 | 69 | 71 | 74 | 77 | 80 | 83 | 85 | 88 | 91  | 94  | 97  | 99  |
|                     | 70  | 21              | 24 | 27 | 30 | 33 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 72 | 75 | 78 | 81 | 84 | 87 | 90 | 93  | 96  | 99  | 102 |
|                     | 80  | 19              | 22 | 25 | 28 | 32 | 38 | 41 | 44 | 48 | 51 | 54 | 57 | 60 | 64 | 67 | 70 | 73 | 76 | 80 | 83 | 86 | 89 | 92 | 96  | 99  | 102 | 105 |
|                     | 90  | 16              | 20 | 23 | 27 | 30 | 37 | 40 | 44 | 47 | 50 | 54 | 57 | 61 | 64 | 67 | 71 | 74 | 78 | 81 | 84 | 88 | 91 | 95 | 98  | 101 | 105 | 108 |
|                     | 100 | 14              | 18 | 21 | 25 | 28 | 36 | 39 | 43 | 46 | 50 | 54 | 57 | 61 | 64 | 68 | 72 | 75 | 79 | 82 | 86 | 90 | 93 | 97 | 100 | 104 | 108 | 111 |

Fatal
Frio severo
Frio leve
Termoneutro
Calor leve
Calor moderado
Calor severo
Fatal



# TechCare: THI y potencial de producción de leche en ovejas de ordeño

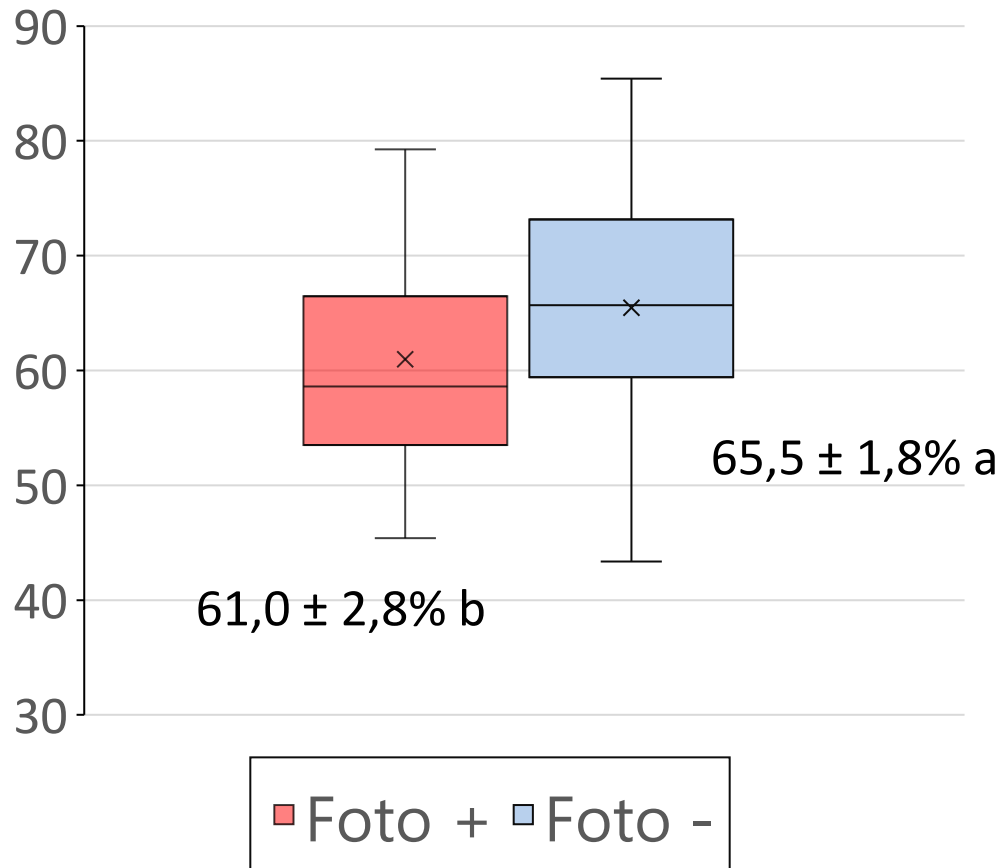
(Caja, 2023)



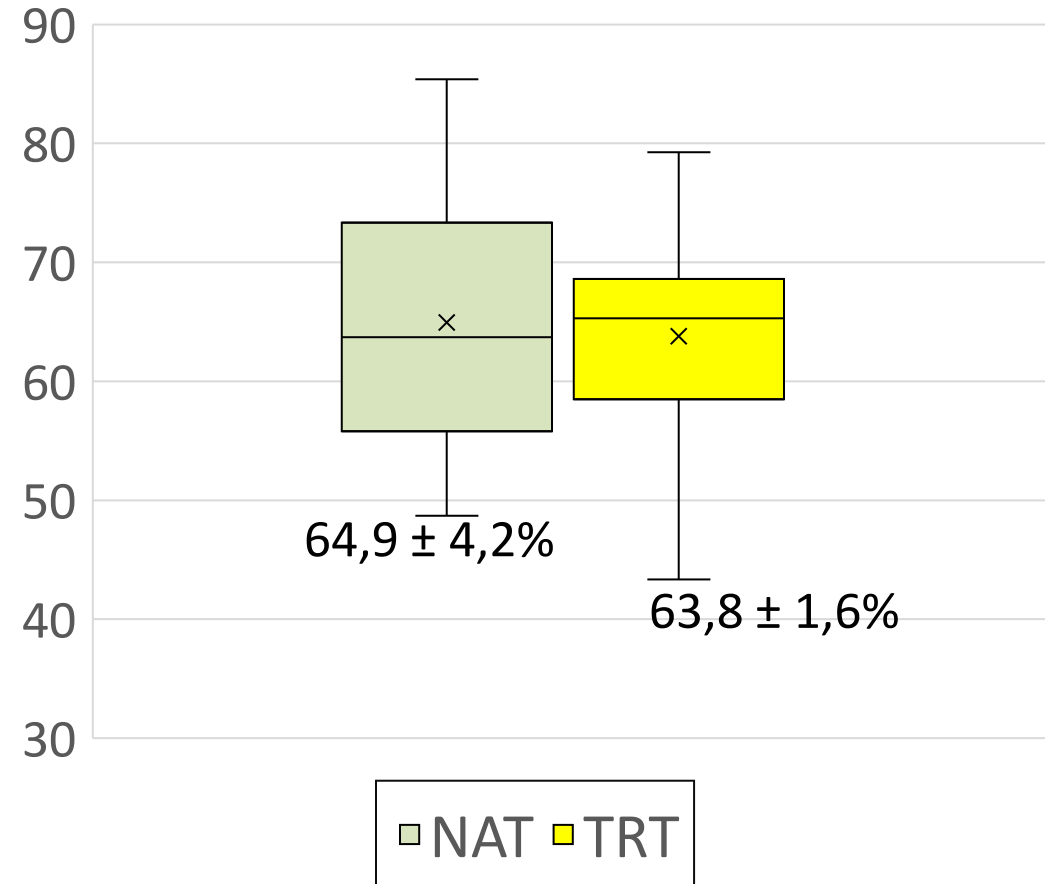
# TechCare: THI y fertilidad en ovejas de ordeño (Granjas GEO, Castilla y León, 2022-24)

Fertilidad (**64,1 ± 1,5%**; n = 42; 17.035 ovejas )

Fotoperiodo ( $P < 0,05$ )



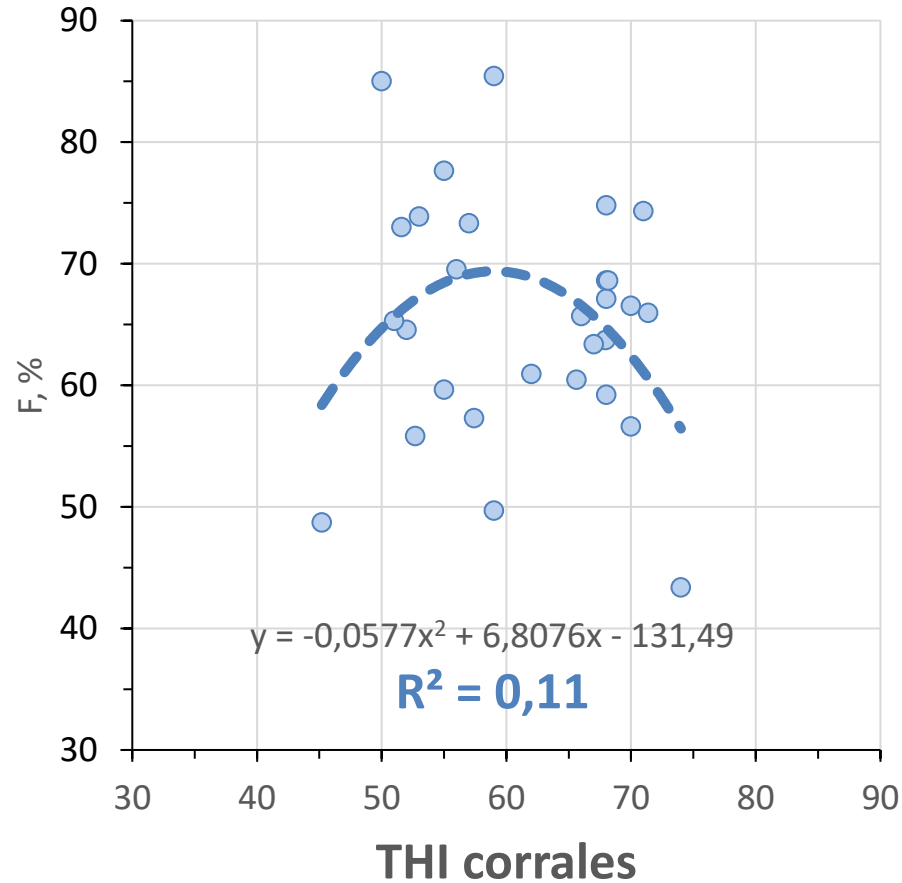
Tratamiento (NS)



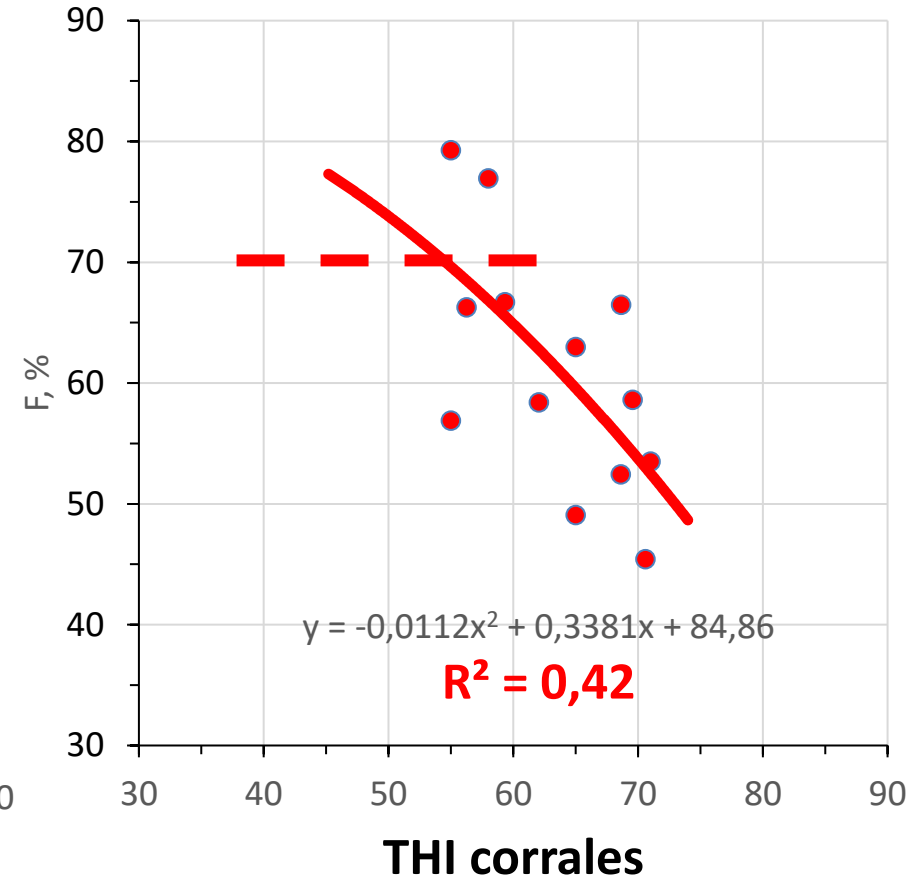
# TechCare: THI y fertilidad en ovejas de ordeño

(Granjas GEO, Castilla y León, 2022-24)

## Fotoperiodo -



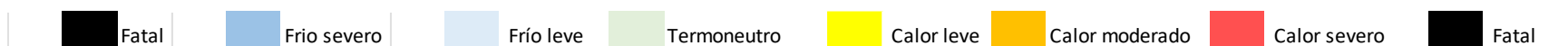
## Fotoperiodo +



# TechCare – Índice termohigrométrico (THI) en ovino (Caja et al., 2024)

**2. RIESGOS TERMICOS EN OVINO (Caja, 2023): Producción de LECHE**

|                     |     | Temperatura, °C |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |     |     |     |
|---------------------|-----|-----------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
|                     |     | -10             | -8 | -6 | -4 | -2 | 2  | 4  | 6  | 8  | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38  | 40  | 42  | 44  |
| Humedad relativa, % | 10  | 36              | 38 | 40 | 41 | 43 | 47 | 49 | 50 | 52 | 54 | 56 | 58 | 59 | 61 | 63 | 65 | 67 | 68 | 70 | 72 | 74 | 76 | 77 | 79  | 81  | 83  | 85  |
|                     | 20  | 34              | 36 | 38 | 40 | 42 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82  | 84  | 86  | 88  |
|                     | 30  | 31              | 33 | 35 | 38 | 40 | 44 | 46 | 49 | 51 | 53 | 55 | 57 | 60 | 62 | 64 | 66 | 68 | 71 | 73 | 75 | 77 | 79 | 82 | 84  | 86  | 88  | 90  |
|                     | 40  | 29              | 31 | 33 | 36 | 38 | 43 | 45 | 48 | 50 | 53 | 55 | 57 | 60 | 62 | 65 | 67 | 69 | 72 | 74 | 77 | 79 | 81 | 84 | 86  | 89  | 91  | 93  |
|                     | 50  | 26              | 29 | 31 | 34 | 37 | 42 | 44 | 47 | 50 | 52 | 55 | 57 | 60 | 63 | 65 | 68 | 70 | 73 | 76 | 78 | 81 | 83 | 86 | 89  | 91  | 94  | 96  |
|                     | 60  | 24              | 27 | 29 | 32 | 35 | 41 | 43 | 46 | 49 | 52 | 55 | 57 | 60 | 63 | 66 | 69 | 71 | 74 | 77 | 80 | 83 | 85 | 88 | 91  | 94  | 97  | 99  |
|                     | 70  | 21              | 24 | 27 | 30 | 33 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 72 | 75 | 78 | 81 | 84 | 87 | 90 | 93  | 96  | 99  | 102 |
|                     | 80  | 19              | 22 | 25 | 28 | 32 | 38 | 41 | 44 | 48 | 51 | 54 | 57 | 60 | 64 | 67 | 70 | 73 | 76 | 80 | 83 | 86 | 89 | 92 | 96  | 99  | 102 | 105 |
|                     | 90  | 16              | 20 | 23 | 27 | 30 | 37 | 40 | 44 | 47 | 50 | 54 | 57 | 61 | 64 | 67 | 71 | 74 | 78 | 81 | 84 | 88 | 91 | 95 | 98  | 101 | 105 | 108 |
|                     | 100 | 14              | 18 | 21 | 25 | 28 | 36 | 39 | 43 | 46 | 50 | 54 | 57 | 61 | 64 | 68 | 72 | 75 | 79 | 82 | 86 | 90 | 93 | 97 | 100 | 104 | 108 | 111 |



**2. RIESGOS TERMICOS EN OVINO (Caja, 2024): FERTILIDAD a la MONTA en ovejás**

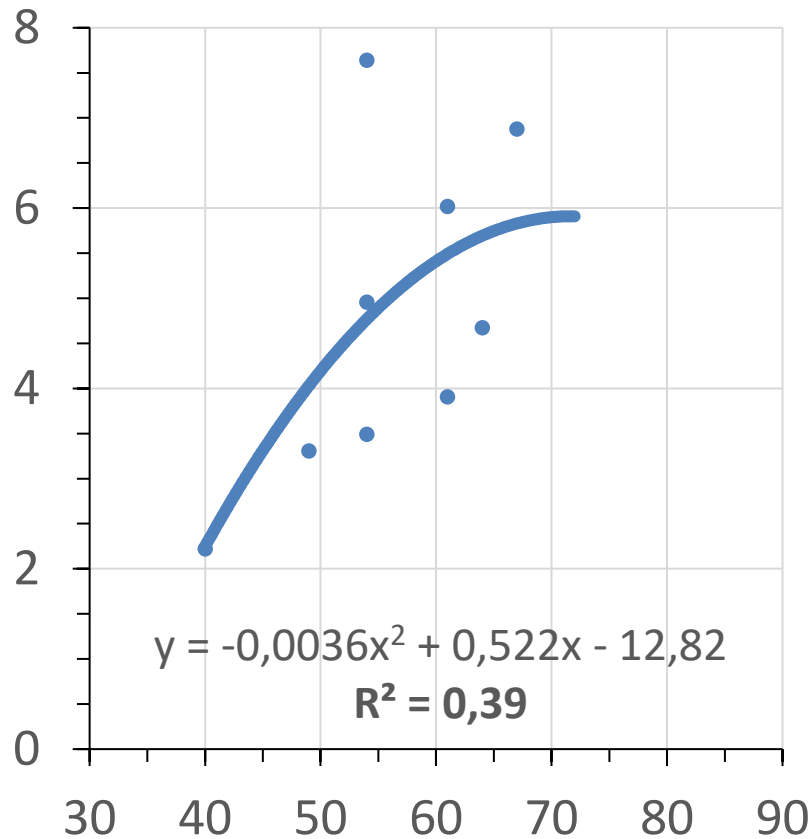
|                     |     | Temperatura, °C |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |     |     |     |
|---------------------|-----|-----------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
|                     |     | -10             | -8 | -6 | -4 | -2 | 2  | 4  | 6  | 8  | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38  | 40  | 42  | 44  |
| Humedad relativa, % | 10  | 36              | 38 | 40 | 41 | 43 | 47 | 49 | 50 | 52 | 54 | 56 | 58 | 59 | 61 | 63 | 65 | 67 | 68 | 70 | 72 | 74 | 76 | 77 | 79  | 81  | 83  | 85  |
|                     | 20  | 34              | 36 | 38 | 40 | 42 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82  | 84  | 86  | 88  |
|                     | 30  | 31              | 33 | 35 | 38 | 40 | 44 | 46 | 49 | 51 | 53 | 55 | 57 | 60 | 62 | 64 | 66 | 68 | 71 | 73 | 75 | 77 | 79 | 82 | 84  | 86  | 88  | 90  |
|                     | 40  | 29              | 31 | 33 | 36 | 38 | 43 | 45 | 48 | 50 | 53 | 55 | 57 | 60 | 62 | 65 | 67 | 69 | 72 | 74 | 77 | 79 | 81 | 84 | 86  | 89  | 91  | 93  |
|                     | 50  | 26              | 29 | 31 | 34 | 37 | 42 | 44 | 47 | 50 | 52 | 55 | 57 | 60 | 63 | 65 | 68 | 70 | 73 | 76 | 78 | 81 | 83 | 86 | 89  | 91  | 94  | 96  |
|                     | 60  | 24              | 27 | 29 | 32 | 35 | 41 | 43 | 46 | 49 | 52 | 55 | 57 | 60 | 63 | 66 | 69 | 71 | 74 | 77 | 80 | 83 | 85 | 88 | 91  | 94  | 97  | 99  |
|                     | 70  | 21              | 24 | 27 | 30 | 33 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 72 | 75 | 78 | 81 | 84 | 87 | 90 | 93  | 96  | 99  | 102 |
|                     | 80  | 19              | 22 | 25 | 28 | 32 | 38 | 41 | 44 | 48 | 51 | 54 | 57 | 60 | 64 | 67 | 70 | 73 | 76 | 80 | 83 | 86 | 89 | 92 | 96  | 99  | 102 | 105 |
|                     | 90  | 16              | 20 | 23 | 27 | 30 | 37 | 40 | 44 | 47 | 50 | 54 | 57 | 61 | 64 | 67 | 71 | 74 | 78 | 81 | 84 | 88 | 91 | 95 | 98  | 101 | 105 | 108 |
|                     | 100 | 14              | 18 | 21 | 25 | 28 | 36 | 39 | 43 | 46 | 50 | 54 | 57 | 61 | 64 | 68 | 72 | 75 | 79 | 82 | 86 | 90 | 93 | 97 | 100 | 104 | 108 | 111 |



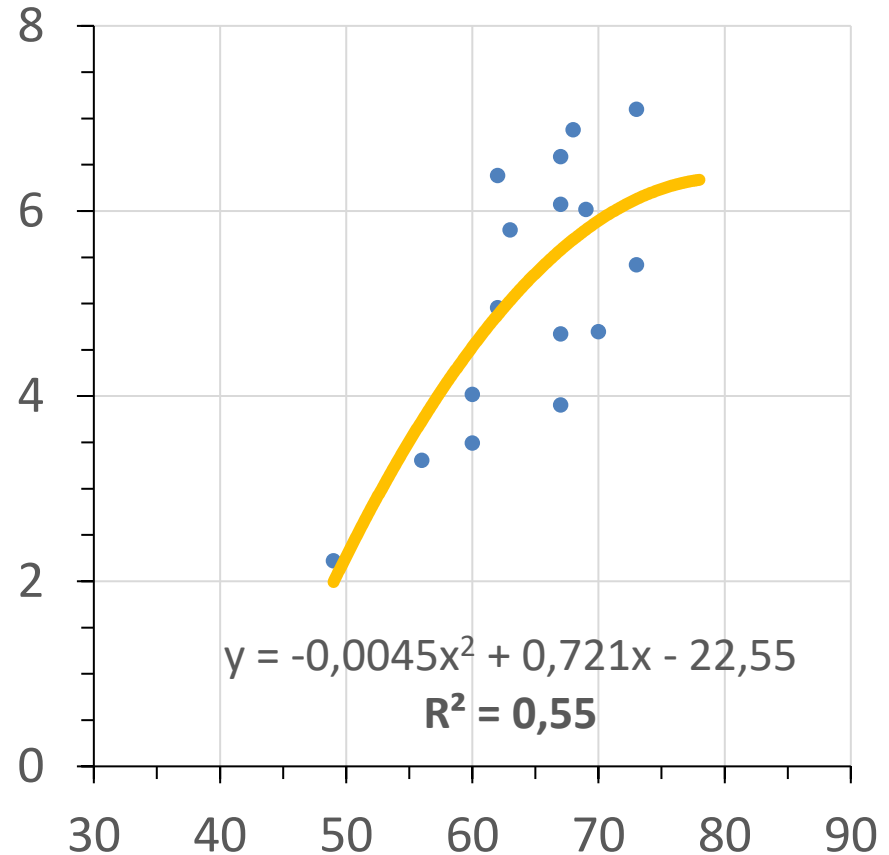
# TechCare: THI y mortalidad periparto en ovejas de ordeño

(Granjas GEO, Castilla y León, 2022-24)

## Mortalidad ovejas (%)



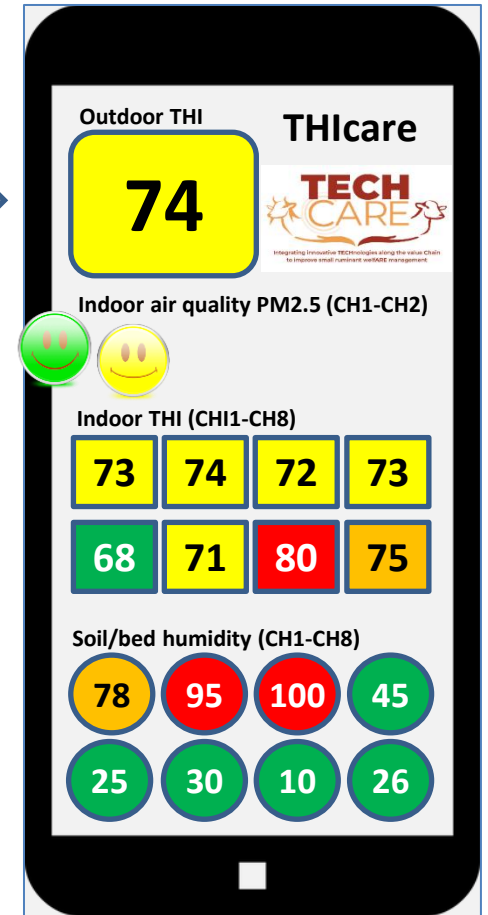
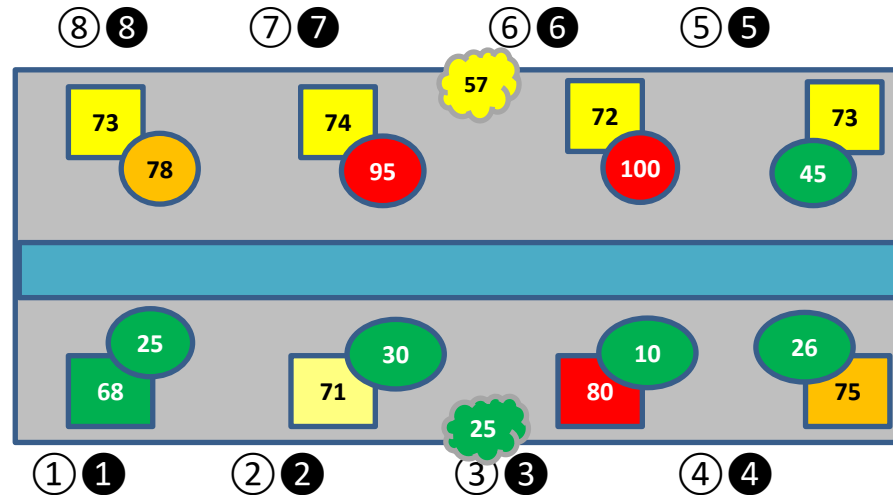
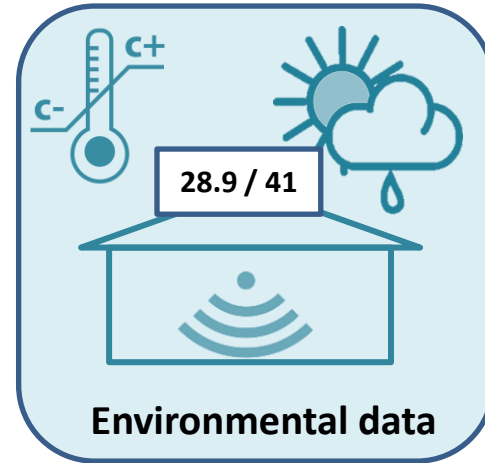
THI exterior



THI corrales



# TechCare: Propuesta de sistema de acceso sencillo y alarma temprana en App (THIcare en desarrollo)





## Conclusiones:

- **Facilidad de implementar** un sistema de medida de las condiciones ambientales internas en granjas de ovejas y cabras lecheras.
- Equipos disponibles a coste reducido, fiables y durables con bajo mantenimiento (>1,5 años).
- Valoración del **riesgo térmico** mediante medidas de temperatura y humedad (**THI**) en ovejas lecheras.
- Diferencias en **THI crítico** según la **función productiva** (mortalidad < fertilidad < leche), estado fisiológico, especie..., raza, individuos?.
- Necesidad de disponer de **herramientas de fácil interpretación** y reacción (EWS, sistemas de alarma temprana).
- Necesidad de validación y ampliación de estudios en ovejas y cabras lecheras.



Gracias por la atención!



**Información complementaria:**

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**<https://techcare-project.eu/>**



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(Contrato No 862050)*

