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Title: Noninvasive thermographic evaluation of the thermal condition of piglets the first month of life

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INTRODUCTION

Neonatal mortality is frequent in piglets as they do not have a hair cover, and their subcutaneal fat is scarce in the first days of life.

Rectal thermometry is a common assessment of the thermal condition of pigs, but this method could influence the pig performance, and its thermoregulation may be affected. (Kammersgaard *et al.*, 2001).

A non-invasive accurate method to evaluate the pigs' thermal condition, without individual handling of animals, is of great potential in research and in farm conditions (Montero-Lopez *et al.*, 2018).

Justification. Survival until weaning is highly related with hypothermia between one or two hours after birth.

At birth piglets are in a colder environment than in the uterus.

Piglets that cannot quickly overcome hypothermia, die because of it and of hunger.

Hypothesis. Image thermographic analysis will make possible to establish the heat source effect in the response of the piglets the first month of life.

Objectives. Evaluate the thermic condition of piglets in the first twenty eight days of life, using thermography.

Analyze the thermographic images of the litters in the maternity area.

Measure the regulatory capacity of the litter.

METHODOLOGY

Location: The study was carried out in December 2017 to January 2018, in a commercial farm in the Zacoalco de Torres County, state of Jalisco.

Animals: Thirteen litters of (York x Landrace) x Pietrain crosses.

Treatments: Four types of temperatures around the litters during the first 28 days of life: maximum, minimum, average and midpoint.

Studied variables: Piglet mortality, number of weaned piglets, litter weight at weaning, and lactating days.

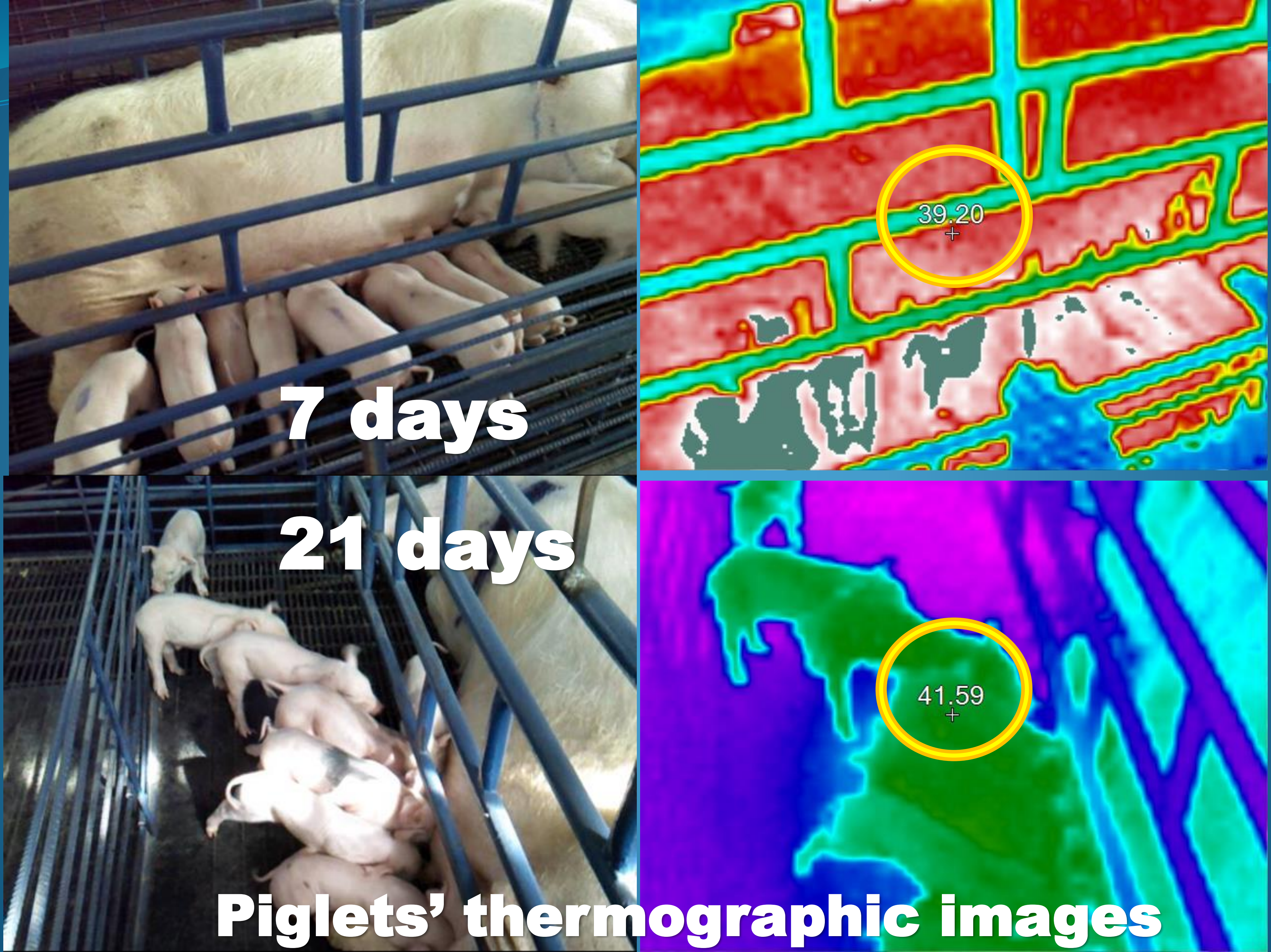
Experimental methodology: A Fluke® thermograph provided thermographic images of the environment around the piglets, from birth to the twenty-eighth day. Images were recorded in three daily periods. The Fluke® software was used for image analysis.

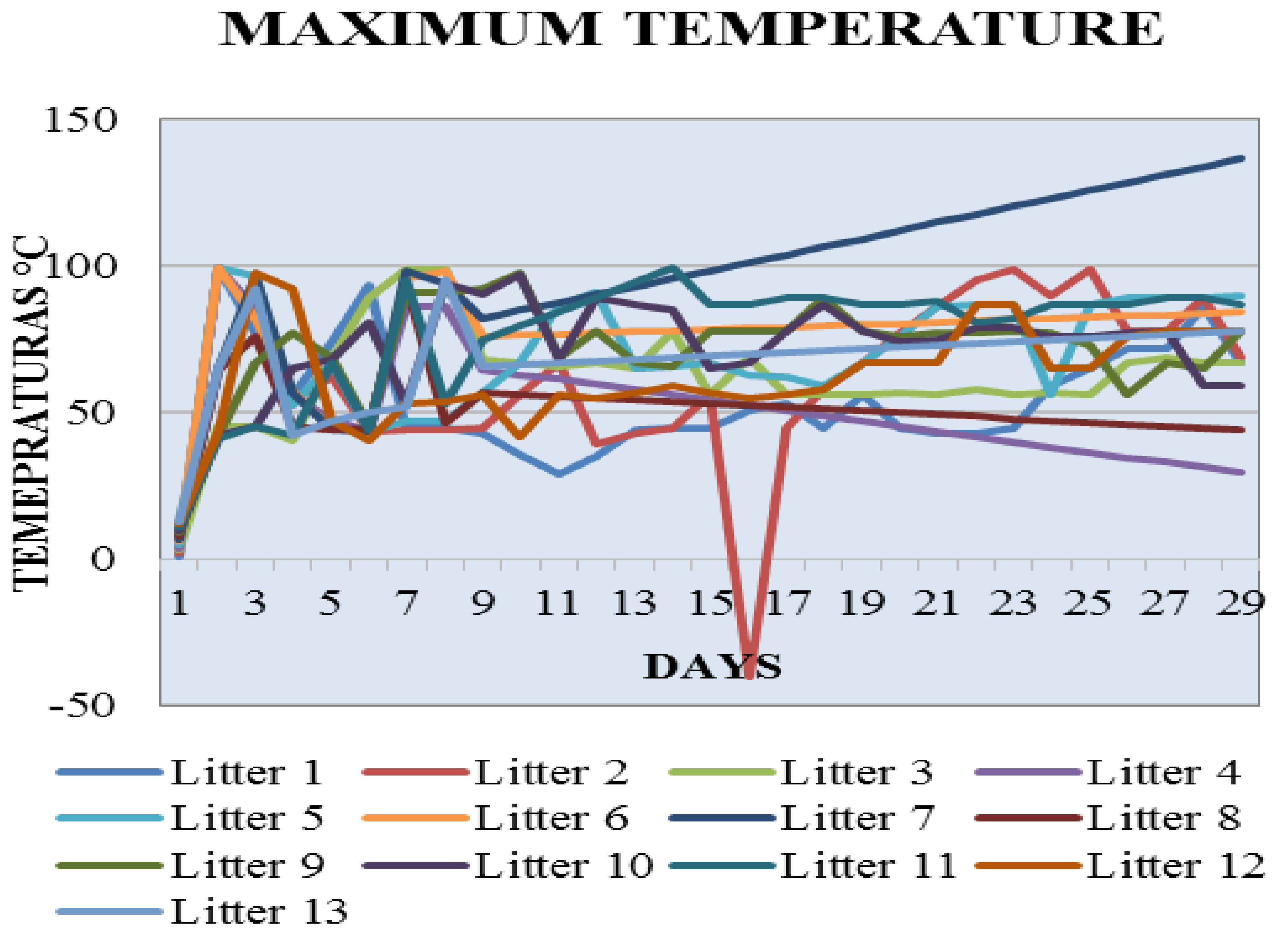
Experimental design: Randomized complete blocks.

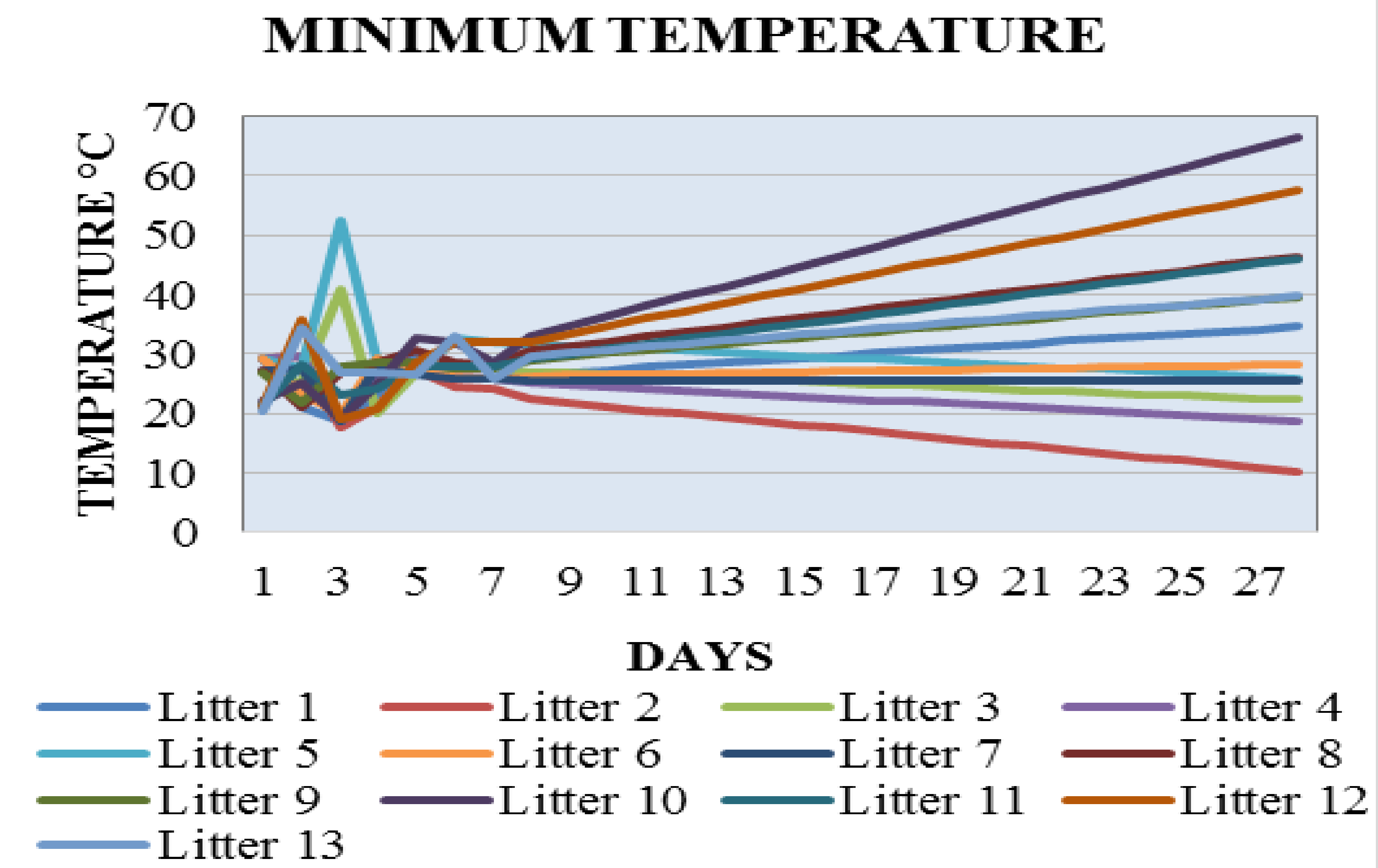
RESULTS

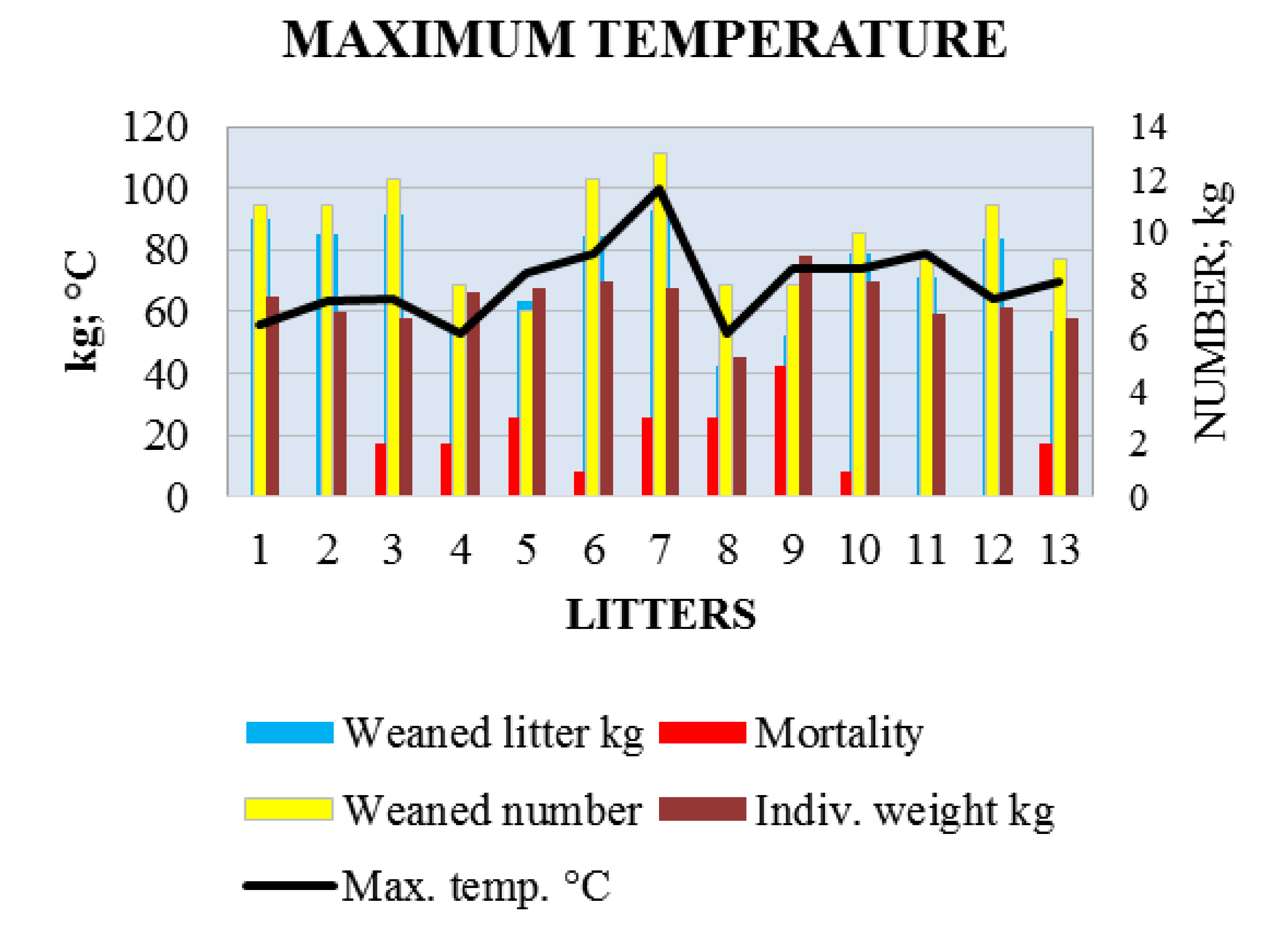
SOURCE OF VARIATION	MEAN SQUARE MINIMUM TEMPERATURE	MEAN SQUARE MEAN TEMPERATURE
Litters	1384.35*	5003.47*
Days	116.06*	598.69*
VC%	24.13	20.68

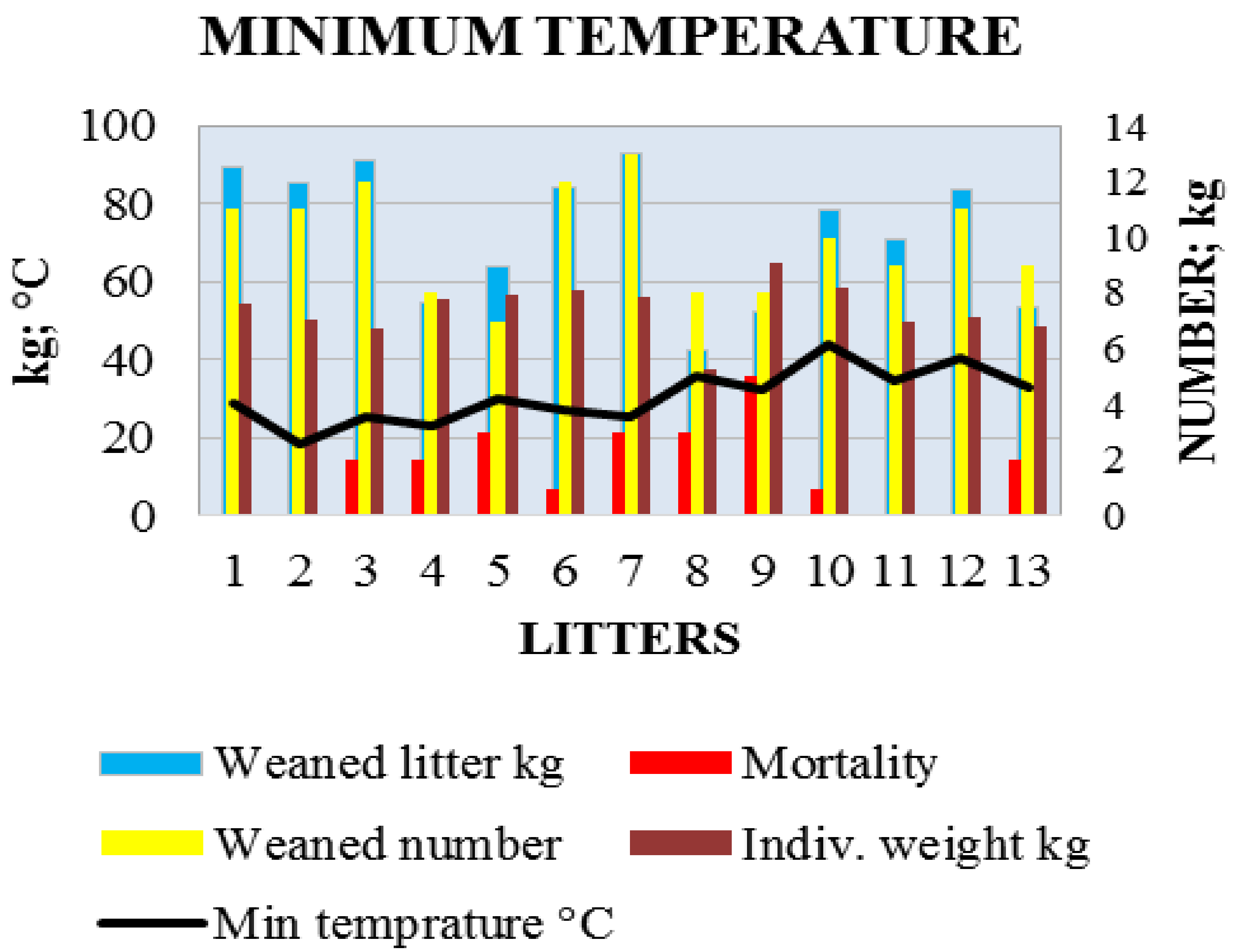
SOURCE OF VARIATION	MEAN SQUARE MAXIMUM TEMPERATURE	MEAN SQUARE MIDPOINT TEMPERATURE
Litters	4585.60*	1642.47*
Days	465.52*	7.43*
VC%	19.31	15.6


7 days
39.20
21 days
41.59
Piglets’ thermographic images


MAXIMUM TEMPERATURE
150
100
50
0
-50
TEMEPRATURAS °C
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
DAYS
Litter 1
Litter 2
Litter 3
Litter 4
Litter 5
Litter 6
Litter 7
Litter 8
Litter 9
Litter 10
Litter 11
Litter 12
Litter 13


MINIMUM TEMPERATURE
TEMPERATURE °C
70
60
50
40
30
20
10
0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
DAYS
Litter 1
Litter 2
Litter 3
Litter 4
Litter 5
Litter 6
Litter 7
Litter 8
Litter 9
Litter 10
Litter 11
Litter 12
Litter 13


MAXIMUM TEMPERATURE
120
100
80
60
40
20
0
kg; °C
14
12
10
8
6
4
2
0
NUMBER; kg
1
2
3
4
5
6
7
8
9
10
11
12
13
LITTERS
Weaned litter kg
Mortality
Weaned number
Indiv. weight kg
Max. temp. °C


MINIMUM TEMPERATURE
kg; °C
100
80
60
40
20
0
NUMBER; kg
14
12
10
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12 13
LITTERS
Weaned litter kg
Mortality
Weaned number
Indiv. weight kg
Min temprature °C

MULTIPLE REGRESSION EQUATIONS

$\hat{y} = a+b1(x)+b2(x)+b3(x)+b4(x)$

Mortality number: $R^2 = 0.2332$
$\hat{y} = 0.7980-0.0349-0.0349-0.0615+0.0513$
Weaned litter weight: $R^2 = 0.0672$
$\hat{y} = 55.5328-0.0673+0.0101+0.0648-0.0460$
Weaned piglets' number: $R^2 = 0.0167$
$\hat{y} = 10.8418-0.0083+0.0270-0.0369+0.0002$
Lactating days: $R^2 = 0.2193$
$\hat{y} = 34.1419-0.0486+0.0101+0.0648-0.0460$
Individual weight of weaned piglets: $R^2 = 0.0167$
$\hat{y} = 2.3572+0.0100+0.0478-0.0162+0.0533$

Productive traits of 13 litters.

Litters	Individual weight at weaning kg	Lactating days	Litter weight at weaning	Mortality number
1	7.9	30	93	3
12	6.7	36	91	2
11	7.6	30	90	0
2	7.0	30	85	0
13	8.1	30	84	1
9	7.2	31	84	0
5	8.2	29	79	1
3	7.0	30	71	0
10	7.9	31	64	3
8	7.8	34	55	2
6	6.8	30	54	2
7	9.1	34	52	5
4	5.3	34	42	3
Average	7.4	31.5	72.6	1.7

CONCLUSIONS

- **Values found in this work allow us to recognize that some litters were under temperatures below the low critical temperature.**
- **It is clear there is a positive relation between environmental temperature and heat production with the calostrum intake.**
- **The thermography used made possible to verify the importance of the piglet microclimate.**
- **The heat source can provide varied temperature areas in the beds.**

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Kammersgaard TS, Pedersen LJ and Jørgensen E. 2001. Hypothermia in neonatal piglets: interactions and causes of individual differences. Journal of AnimalScience; 89, 2073–2085.

Montero López, Eva María; Roberto Gustavo Martínez Gamba; Marco Antonio Herradora Lozano; Gerardo Ramírez Hernández; Susana Espinosa Hernández; Mónica Sánchez Hernández; Roberto Martínez Rodríguez. 2018. Alternativas para la producción porcina a pequeña escala. Edit. UNAM p37.

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