Role of genetics in swine inflammation and necrosis syndrome (SINS)

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Introduction | Damage behavior

Skin Damage

Tail/ear/vulva biting

Fighting

https://www.wattagnet.com/articles/10609-tips-for-combating-pig-tail-biting

https://www.pigprogress.net/pigs/detection-of-ear-biting-in-pigs-using-plf/

Welfare and economic concern

- €1.3/pig [55% loss of sales] Naomi, 2016

Country regulations (EU directive 2008/120/EC)

https://www.thepigsite.com/articles/management-and-breeding-strategies-to-reduce-aggression

Not all skin damage results from pig interaction!

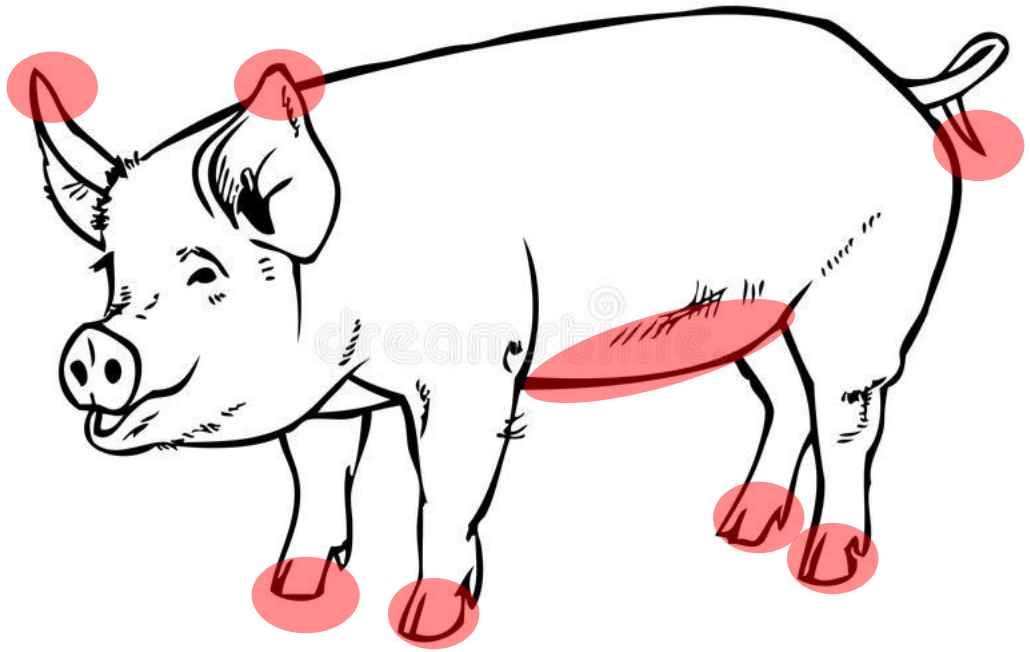
Reiner et al., 2020; Kuehling et al., 2021

Introduction | SINS

Swine inflammation and necrosis syndrome (SINS) Reiner et al., 2019

Centralization/Blood flow constraint of capillaries

- tissue inflammation/necrosis
- loss of skin function



Introduction | SINS

Swine inflammation and necrosis syndrome (SINS) Reiner et al., 2019

Birth to Slaughter

- Piglets (up to 75% of piglets are affected!)
- mostly non-severe

Are affected animals more prone to being bitten?

Reiner et al., 2019

Research questions

- Is SINS heritable?
- Would an animal born with SINS signs be more genetically susceptible of being bitten after weaning?
- How SINS genetically correlates with important pre and post production traits?

Material and methods | population

Dataset

5,960 three-way crossbred piglets
1 farm in Germany
240 females (1 line) and 80 sires
Duroc, Large White, and Pietrain

Pre-weaning:

SINS - tail, ear, teats, and claws (yes/no scores)
Total SINS (yes/no)
Birth and weaning weight

Post-weaning:

2,630 individuals were evaluated
Damage at 9 weeks (yes/no scores)
Carcass back fat thickness and loin depth

Material and Methods | Models

Two-trait models:
Genetic correlation between SINS on different body parts and total SINS

Three-trait models:
Genetic correlation between SINS, DAMAGE, and production traits
SINS, DAMAGE, BF/LD/BW/WW

BW, WW, SINS_x = y = XB + litter + animal + maternal + e
BF, LD, DAMAGE= y = XB + litter + animal + e

BLUF90 (Misztal et al., 2014)

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Results | Population statistics

Information	N	Mean (SD)
EAR_SINS, % affected	5,721	19.0
TAIL_SINS, % affected	5,720	16.9
TEATS_SINS, % affected	5,720	14.0
CLAWS_SINS, % affected	5,720	43.5
TOTAL_SINS, % affected	5,719	62.0
DAMAGE % affected	2,638	20.9

Results | SINS on different body parts

	SINS_TAIL	SINS_EAR	SINS_TEATS	SINS_CLAWS	TOTAL_SINS
SINS_TAIL	0.24 (0.04)				
SINS_EAR		0.08 (0.05)			
SINS_TEATS			0.33 (0.07)		
SINS_CLAWS				0.34 (0.07)	
TOTAL_SIN					0.26 (0.05)

Results | SINS on different body parts

	SINS_TAIL	SINS_EAR	SINS_TEATS	SINS_CLAWS	TOTAL_SINS*
SINS_TAIL		0.80 (0.13)	-0.12 (0.11)	0.28 (0.15)	**0.22 (0.12)**
SINS_EAR			0.13 (0.30)	0.99 (0.25)	**0.99 (0.06)**
SINS_TEATS				0.40 (0.14)	**0.43 (0.12)**
SINS_CLAWS					**0.94 (0.05)**
TOTAL_SIN					

*Practical advantage!

Results | SINS, DAMAGE, and production traits

BW

	BW_a	SINS_a	DAMAGE_a
BW_a			
SINS_a			
DAMAGE_a			

WW

	WW_a	SINS_a	DAMAGE_a
WW_a			
SINS_a			
DAMAGE_a			

BF

	BF_a	SINS_a	DAMAGE_a
BF_a			
SINS_a			
DAMAGE_a			

LD

	LD_a	SINS_a	DAMAGE_a
LOIN_a			
SINS_a			
DAMAGE_a			

Results | SINS, DAMAGE, and production traits

BW

	BW_a	SINS_a	DAMAGE_a
BW_a	0.07 (0.01)		
SINS_a		0.21 (0.02)	
DAMAGE_a			0.05 (0.01)

WW

	WW_a	SINS_a	DAMAGE_a
WW_a	0.11 (0.02)		
SINS_a		0.23 (0.03)	
DAMAGE_a			0.05 (0.01)

BF

	BF_a	SINS_a	DAMAGE_a
BF_a	0.63 (0.07)		
SINS_a		0.24 (0.03)	
DAMAGE_a			0.06 (0.01)

LD

	LD_a	SINS_a	DAMAGE_a
LOIN_a	0.42 (0.06)		
SINS_a		0.15 (0.02)	
DAMAGE_a			0.05 (0.01)

SINS direct heritability ranged from 0.15 to 0.24 (direct) and from 0.07 to 0.12 (maternal)

Results | SINS, DAMAGE, and production traits

BW

	BW_a	SINS_a	DAMAGE_a
BW_a		-0.30 (0.08)	-0.11 (0.09)
SINS_a			0.19 (0.08)
DAMAGE_a			

WW

	WW_a	SINS_a	DAMAGE_a
WW_a		-0.40 (0.08)	-0.61 (0.06)
SINS_a			0.23 (0.09)
DAMAGE_a			

BF

	BF_a	SINS_a	DAMAGE_a
BF_a		0.05 (0.05)	-0.84 (0.04)
SINS_a			0.43 (0.07)
DAMAGE_a			

LD

	LD_a	SINS_a	DAMAGE_a
LOIN_a		-0.16 (0.07)	0.76 (0.06)
SINS_a			0.50 (0.09)
DAMAGE_a			

SINS and damage are positively correlated (0.19-0.50)

Results | SINS, DAMAGE, and production traits

BW

	BW_a	SINS_a	DAMAGE_a
BW_a		-0.30 (0.08)	-0.11 (0.09)
SINS_a			0.19 (0.08)
DAMAGE_a			

WW

	WW_a	SINS_a	DAMAGE_a
WW_a		-0.40 (0.08)	-0.61 (0.06)
SINS_a			0.23 (0.09)
DAMAGE_a			

BF

	BF_a	SINS_a	DAMAGE_a
BF_a		0.05 (0.05)	-0.84 (0.04)
SINS_a			0.43 (0.07)
DAMAGE_a			

LD

	LD_a	SINS_a	DAMAGE_a
LOIN_a		-0.16 (0.07)	0.76 (0.06)
SINS_a			0.50 (0.09)
DAMAGE_a			

SINS is negatively correlated with pre-weaning production traits but weakly correlated with post-weaning traits

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Conclusions

1. SINS is heritable for all evaluated piglet body parts
2. SINS_TOTAL is heritable, positively correlated with SINS on different body parts, and influenced by piglets (0.15-0.20) and dams (0.07-0.12)
3. Selection against SINS will favor BW and WW (-0.30 to -0.40), but should not affect BF and LD
4. At the piglet genetic level, SINS animals are more predisposed to being bitten (0.19-0.50) after weaning

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Thank you

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