

US swine industry productivity analysis, 2005 to 2010

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Summary

Objective: To quantify US swine production trends for sow-farm and grow-finish traits from a large available database.

Materials and methods: Data were provided by a data management company, representing annual production of approximately 1.8 million sows in the United States. Sow-farm traits included pigs per mated female per year, litters per mated female per year, total number born, number born alive, number weaned, preweaning mortality, weaning age, weaning weight, replacement rate, culling rate, sow mortality, lactation-feed intake, and gestation-feed intake. Grow-finish traits included entry age, entry weight, exit age, exit

weight, average daily gain, feed efficiency, caloric efficiency, and mortality.

Results: From 2005 to 2010, pigs per mated female per year, litters per mated female per year, number born alive, number weaned, weaning age, weaning weight, and lactation-feed intake increased ($P < .05$). Sow mortality decreased ($P < .05$) and replacement rate did not change ($P > .05$). Entry age and entry weight increased ($P < .05$) for nursery and wean-to-finish pigs. Average daily gain improved for nursery and finishing production ($P < .05$), but not for wean-to-finish ($P > .05$). No improvements were made for finishing caloric efficiency ($P > .05$), and wean-to-finish caloric efficiency worsened

($P < .05$). Mortality for both finishing and wean-to-finish operations improved ($P < .05$).

Implications: Both scientists and producers can use these results to better understand US sow-farm and grow-finish production levels. Pig industry trends from 2005 to 2010 indicate varied degrees of improvement for pig production traits.

Keywords: swine, grow-finish, sow, production, trend

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Resumen - Análisis de la productividad de la industria porcina de Los Estados Unidos, 2005 a 2010

Objetivo: Cuantificar las tendencias de la producción porcina de los Estados Unidos de las características de la granja de hembras y de crecimiento a finalización de una gran base de datos disponible.

Materiales y métodos: Los datos fueron proporcionados por una compañía de manejo de datos, que representa la producción anual de aproximadamente 1.8 millones de hembras en los Estados Unidos. Las características de las granjas de hembras incluyó los cerdos por hembra cruzada por año, camadas por hembra por año, número total de nacidos, número de nacidos vivos, número de destetados, mortalidad en maternidad, edad de destete, peso de destete, índice de reemplazo, índice de desecho, mortalidad de hembras, consumo de alimento en lactancia, y consumo de alimento en gestación. Las características de crecimiento-finalización incluyeron la

edad de entrada, el peso de entrada, edad de salida, peso de salida, ganancia diaria promedio, eficiencia del alimento, eficiencia calórica, y mortalidad.

Resultados: Entre 2005 y 2010, los cerdos por hembra por año, las camadas por hembra cruzada por año, el número de nacidos vivos, el número de destetados, la edad de destete, el peso de destete, y el consumo de alimento en lactancia aumentaron ($P < .05$). La mortalidad de hembras disminuyó ($P < .05$) y el índice de reemplazo no cambió ($P > .05$). La edad de entrada y el peso aumentaron ($P < .05$) en los cerdos de lactancia y de destete a finalización. La ganancia diaria promedio mejoró en la producción de lactancia y finalización ($P < .05$), pero no de destete a finalización ($P > .05$). No hubo mejoras en la eficiencia calórica de finalización ($P > .05$), y la eficiencia calórica de destete a finalización empeoró ($P < .05$). La mortalidad para las operaciones de finalización y de destete a finalización mejoraron ($P < .05$).

Implicaciones: Tanto científicos como productores pueden utilizar estos resultados para comprender mejor los niveles de producción de crecimiento a finalización y las granjas de hembras de los Estados Unidos. Las tendencias de la industria porcina de 2005 a 2010 indican niveles variados de mejor en las características de producción porcina.

Résumé - Analyse de la productivité de l'industrie porcine américaine, 2005 à 2010

Objectif: Quantifier les tendances des caractéristiques de la production porcine américaine pour les fermes de truies et d'engraissement-finition à partir d'une vaste base de données disponible.

Matériels et méthodes: Les données ont été fournies par une compagnie de gestion de données, représentant la production annuelle d'environ 1,8 millions de truies aux États-Unis. Les caractéristiques des fermes de truies incluait le nombre de porcs par femelle accouplée par année, le nombre de portées par femelle accouplée par année, le nombre total de porcelets nés, le nombre de nés vivants, le nombre de porcs sevrés, le taux de mortalité pré-sevrage, l'âge du sevrage, le poids au sevrage, le taux de remplacement, le taux de réforme, le taux de mortalité des truies, la quantité de moulée de lactation ingérée, ainsi que la quantité de moulée de

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gestation ingérée. Les caractéristiques des élevages d'engraissement-finition incluaient l'âge à l'entrée, le poids à l'entrée, l'âge à la sortie, le poids à la sortie, le gain journalier moyen, l'efficacité alimentaire, l'efficacité calorique, et la mortalité.

Résultats: Entre 2005 et 2010, le nombre de porcs par femelle accouplée par année, le nombre de portées par femelle accouplée par année, le nombre de nés vivants, le nombre de porcs sevrés, l'âge du sevrage, le poids au sevrage et la quantité de moulée de lactation ingérée augmentèrent ($P < .05$). Le taux de mortalité des truies diminua ($P < .05$) et le taux de remplacement ne changea pas ($P > .05$). L'âge et le poids à l'entrée augmentèrent ($P < .05$) pour les porcs en pouponnières ainsi que pour les naisseurs-finisseries. Le gain journalier moyen s'améliora pour les productions de type pouponnière et de finition ($P < .05$), mais pas pour celles de type sevrage-finition ($P > .05$). Aucune amélioration ne fut notée quant à l'efficacité calorique pour les porcs en finition ($P > .05$), et pour le sevrage-finition l'efficacité calorique empira ($P < .05$). Le taux de mortalité pour les opérations de type finition et sevrage-finition s'améliora ($P < .05$).

Implications: Autant les scientifiques que les producteurs peuvent utiliser ces données pour mieux comprendre les niveaux de production des fermes de truies et les élevages engraissement-finition. Les tendances de l'industrie porcine de 2005 à 2010 indiquent des degrés variés d'amélioration des caractéristiques de production de porcs.

Measuring production trends is an important step in validating industry progress. Both scientists and producers can use production benchmarks to better understand performance and trends in the pig industry. While Denmark has reported production changes for both reproduction and finishing traits,¹ limited production trends for only a small number of traits are publically available for pigs in North America. Within the United States, PigCHAMP (Ames, Iowa) has reported benchmarks for reproductive measures.^{2,3} However, no or few production changes for finishing traits in North America are publically available. Therefore, the objective of this study was to quantify US production

trends for sow-farm and grow-finish traits from a large available database.

Materials and methods

Data were provided by a data management company representing approximately 1.8 million sows of annual production in the United States. Records were available from 2005 to 2010, except for records for wean-to-finish producers, that were available from 2007 to 2010. The observational unit for the data set was a producer's production for 1 month. A producer's production included all farms within that production system. Therefore, an observational unit contained multiple farms from one producer. For example, the 2204 records for number weaned from 2005 to 2010 represented approximately 31 producers monthly (2204 records ÷ 6 years ÷ 12 months). Sow-farm traits included pigs per mated female per year, litters per mated female per year, total number born, number born alive, number weaned, preweaning mortality, weaning age, weaning weight, replacement rate, culling rate, sow mortality, lactation-feed intake,

and gestation-feed intake. Grow-finish traits were available for nursery, finishing, and wean-to-finish production phases. These traits included entry age, entry weight, exit age, exit weight, average daily gain (ADG), gain-to-feed ratio, caloric efficiency, and mortality. Caloric efficiency was calculated as the kilocalories per kg of live-weight gain and adjusted to 5.5 to 22.7, 22.7 to 118.2, and 5.5 to 118.2 kg for nursery, finishing, and wean-to-finish phases, respectively. Summary statistics for US sow-farm and grow-finish traits from 2005 to 2010 are shown in Tables 1 and 2, respectively.

Weighted means for each trait were also provided by the data management company. Weighted means were weighted by farm size, thus allowing actual means to be computed. Data were analyzed using PROC MIXED in SAS (SAS Institute, Inc, Cary, North Carolina). The PROC MIXED procedure is an analysis of variance that compares means using an F test. A value of $P < .05$ was considered statistically significant in all tests. All models included year and month as fixed effects.

Table 1: Summary statistics for US sow-farm traits from 2005 to 2010*

Trait	No. of units†	Mean	SD
Reproductive efficiency			
Piglets/mated female/year	2194	23.2	2.18
Litters/mated female/year	2182	2.36	0.135
Total no. born	2217	12.46	0.706
No. born alive	2202	11.33	0.630
No. weaned	2204	9.83	0.619
Preweaning mortality (%)	2202	13.3	3.28
Piglet weaning			
Weaning age (days)	2186	19.5	1.45
Weaning weight (kg/pig)	2203	5.7	0.50
Sow removal			
Replacement rate (%)	2069	54.8	13.44
Culling rate (%)	2138	45.8	12.25
Sow mortality (%)	2196	9.5	4.04
Feed intake			
Lactation-feed intake (kg/day)	2192	6.5	0.89
Gestation-feed intake (kg/day)	2190	2.34	0.296

* Data were provided by a data management company representing the annual production of approximately 1.8 million sows in the United States, using records available from 2005 to 2010.

† No. of observational units. The observational unit for the data set was a producer's production for 1 month, including all farms within that production system. SD = standard deviation.

Table 2: Summary statistics for US nursery, finishing, and wean-to-finish production traits from 2005 to 2010*

Trait	Production type								
	Nursery			Finishing			Wean-to-finish†		
	No. of units	Mean	SD	No. of units	Mean	SD	No. of units	Mean	SD
Entry age (days)	2170	19.4	1.42	2305	66.4	4.86	633	19.3	1.74
Entry weight (kg)	2188	5.7	0.51	2301	24.0	3.82	633	5.8	0.60
Exit age (days)	2180	65.7	4.96	2311	186	10.6	642	183	10.3
Exit weight (kg)	2186	51.3	7.00	2318	264	11.6	638	262	12.5
ADG (kg)	2188	0.38	.050	2319	0.80	.056	640	0.69	0.045
Gain-to-feed ratio	2187	0.64	.051	2311	0.36	0.026	643	0.39	0.025
Caloric efficiency‡	2192	5111	708	2310	9332	570	645	9431	847
Mortality (%)	2170	3.6	2.12	2311	5.0	2.17	633	7.6	3.47

* Source of data and observational unit described in Table 1.

† Records for wean-to-finish producers were available from 2007 to 2010.

‡ Caloric efficiency = kilocalories/kg of live-weight gain.

SD = standard deviation; ADG = average daily gain.

Table 3: US sow-farm trait means from 2005 to 2010*

Trait	Year						SE	P
	2005	2006	2007	2008	2009	2010		
Reproductive efficiency								
Piglets/mated female/year	21.5 ^a	21.9 ^b	22.4 ^c	22.9 ^d	23.4 ^e	23.6 ^e	0.12	< .01
Litters/mated female/year	2.31 ^a	2.34 ^b	2.34 ^b	2.35 ^b	2.34 ^b	2.34 ^b	0.010	.02
Total no. born	11.82 ^a	12.07 ^b	12.27 ^c	12.52 ^d	12.77 ^e	13.03 ^f	0.029	< .01
No. born alive	10.77 ^a	10.92 ^b	11.11 ^c	11.33 ^d	11.61 ^e	11.83 ^f	0.033	< .01
No. weaned	9.30 ^a	9.39 ^b	9.55 ^c	9.72 ^d	9.98 ^e	10.08 ^f	0.035	< .01
Preweaning mortality (%)	13.7 ^a	14.1 ^a	14.0 ^a	14.2 ^a	14.0 ^a	14.8 ^b	0.27	< .01
Weaning								
Weaning age (days)	18.9 ^a	19.0 ^a	19.2 ^b	19.6 ^c	20.2 ^d	20.6 ^e	0.08	< .01
Weaning weight (kg)	5.46 ^a	5.54 ^b	5.62 ^c	5.63 ^c	5.74 ^d	5.86 ^e	0.015	< .01
Sow removal								
Replacement rate (%)	54.1 ^{ab}	57.8 ^c	56.0 ^{bc}	56.1 ^{bc}	51.4 ^a	52.2 ^a	1.42	< .01
Culling rate (%)	41.9 ^a	44.2 ^b	43.4 ^{ab}	48.2 ^c	48.7 ^c	47.5 ^c	1.17	< .01
Sow mortality (%)	11.2 ^a	10.7 ^b	10.4 ^{cd}	10.3 ^c	9.8 ^d	10.4 ^{cd}	0.15	< .01
Sow feed intake								
Lactation-feed intake (kg)	6.11 ^a	6.29 ^b	6.41 ^c	6.41 ^c	6.70 ^d	6.62 ^d	0.050	< .01
Gestation-feed intake (kg)	2.33 ^a	2.33 ^a	2.30 ^{ab}	2.30 ^{ab}	2.27 ^b	2.27 ^b	0.016	< .01

* Source of data described in Table 1.

^{a-f} Values within a row with no common superscript are statistically different ($P < .05$; F test for homogeneity of variances).

SE = standard error.

Table 4: US nursery production means from 2005 to 2010*

Trait	Year						SE	P
	2005	2006	2007	2008	2009	2010		
Entry age (days)	19.2 ^a	19.0 ^a	19.2 ^a	19.6 ^b	20.1 ^c	20.5 ^d	0.11	< .01
Entry weight (kg)	5.53 ^a	5.56 ^a	5.58 ^a	5.58 ^a	5.70 ^b	5.85 ^c	0.026	< .01
Exit age (days)	68.3 ^a	66.1 ^b	66.2 ^b	67.0 ^c	66.4 ^b	67.1 ^c	0.2	< .01
Exit weight (kg)	22.71 ^a	22.43 ^a	22.21 ^c	22.62 ^a	22.79 ^a	23.42 ^d	0.09	< .01
ADG (kg)	0.367 ^{ab}	0.362 ^a	0.359 ^a	0.364 ^a	0.374 ^b	0.382 ^c	0.0041	< .01
Gain-to-feed ratio	0.637 ^a	0.645 ^a	0.644 ^b	0.632 ^a	0.652 ^c	0.655 ^c	0.0031	< .01
Caloric efficiency†	5183 ^a	5267 ^a	5218 ^{ab}	5227 ^{ab}	5042 ^c	4903 ^d	38.6	< .01
Mortality (%)	4.6 ^a	4.4 ^a	4.4 ^a	5.9 ^b	5.2 ^c	5.0 ^c	0.19	< .01

* Source of data described in Table 1.

† Caloric efficiency = kilocalories/kg of live-weight gain.

^{a-d} Values within a row with no common superscript are statistically different ($P < .05$; F test for homogeneity of variances).

SE = standard error; ADG = average daily gain.

Results

Sow-farm trait means from 2005 to 2010 are shown in Table 3. Pigs per mated female per year, litters per mated female per year, total number born, number born alive, number weaned, preweaning mortality, weaning age, weaning weight, culling rate, and lactation-feed intake were greater ($P < .05$) in 2010 than in 2005. Sow mortality and gestation-feed intake were lower ($P < .01$) and replacement rate did not differ ($P > .05$) in 2005 compared to 2010.

Nursery production means from 2005 to 2010 are shown in Table 4. Nursery entry age, entry weight, exit weight, ADG, gain-to-feed ratio, and mortality were greater ($P < .01$) and caloric efficiency was lower ($P < .01$) in 2005 than in 2010.

Finishing production means from 2005 to 2010 are shown in Table 5. Entry age, entry weight, exit weight, ADG, and gain-to-feed ratio were greater ($P < .01$) in 2010 than in 2005. Exit age and mortality were lower ($P < .01$) and caloric efficiency did not differ ($P > .05$) in 2010 compared to 2005.

Wean-to-finish production means from 2007 to 2010 are shown in Table 6. Entry age, exit age, exit weight, and caloric efficiency were greater ($P < .05$) in 2010 than in 2007. Mortality was lower ($P < .01$) in 2010 than in 2007. Entry weight, ADG, and gain-to-feed ratio did not differ ($P > .05$) between years.

Discussion

The authors acknowledge that the data set does not represent all producers in the

United States. However, the study does characterize a major portion of the pigs in the United States and can be construed as such.

The United States continues to show improvements in sow productivity. Number weaned per litter increased from 9.30 in 2005 to 10.08 in 2010. This improvement is in agreement with reports from other US databases.²⁻⁵ In 2006 and 2007, Pig-CHAMP^{2,3} reported numbers weaned in the United States were 9.30 and 9.60 pigs per litter, respectively. The United States Department of Agriculture's Quarterly Hogs and Pigs^{4,5} reported numbers weaned in 2005 and 2010 were 9.02 and 9.78, respectively. Collectively, these studies document increases in sow productivity for US pig farms. These improvements can be attributed to both improved management and genetics.

Results from the current study showed that 86% of the improvement in pigs per mated female per year was due to an increase in number weaned per litter, and 14% of the improvement was due to an increase in litters per mated female per year. In agreement, Denmark¹ reported number weaned increased from 9.9 in 1996 to 11.6 in 2006, while litters per sow per year decreased from 2.27 in 1996 to 2.23 in 2006. Thus, producers have predominantly focused on increasing pigs per mated female per year by increasing number weaned.

The current analysis found varied levels of improvement for grow-finish throughput traits (growth rate, mortality) and cost traits (feed efficiency, caloric efficiency) across

production types. Mixed levels of improvement have also been reported in Denmark.¹ From 1996 to 2007, the Danes reported ADG for nursery and finisher pigs improved from 0.420 to 0.434 kg and 0.762 to 0.866 kg, respectively, while gain-to-feed ratio for finishers improved from 0.341 to 0.358.¹ However, the same study reported mortality for nursery and finisher pigs increased from 2.8% to 3.1% and 3.2% to 4.3%, respectively. Perhaps improvements in ADG and gain-to-feed ratio can be explained by improvements in genetics and nutrition. A study by Fix et al⁶ reported that changes in both genetics and feeding programs between 1980 and 2005 resulted in improvements for both growth rate and feed efficiency.

Cost-effective improvements in production metrics will enable pig producers to maximize profitability. Scientists from multiple disciplines (engineering, genetics, immunology, nutrition, physiology, veterinary medicine, etc) should work together to solve complex problems that impact cost of production and pig performance. The trends outlined in the current study will help educate scientists on how the pig industry has improved and where there are opportunities to improve.

Implications

- Scientists and producers can apply the annual production data from approximately 1.8 million sows, in this study used to represent the US swine industry, to better understand US sow-farm and grow-finish production data.

Table 5: US finishing production means from 2005 to 2010*

Trait	Year						SE	P
	2005	2006	2007	2008	2009	2010		
Entry age (days)	66 ^a	65 ^b	66 ^{ac}	67 ^c	66 ^{ac}	68 ^d	0.4	< .01
Entry weight (kg)	23.0 ^a	23.4 ^{ab}	23.0 ^a	22.9 ^a	23.0 ^a	24.0 ^b	0.29	< .01
Exit age (days)	191 ^a	185 ^b	188 ^c	190 ^d	188 ^c	190 ^d	0.5	< .01
Exit weight (kg)	117.7 ^a	116.9 ^b	117.8 ^a	117.9 ^a	118.8 ^c	119.9 ^d	0.41	< .01
ADG (kg)	0.735 ^a	0.763 ^b	0.800 ^c	0.786 ^c	0.798 ^c	0.797 ^c	0.0070	< .01
Gain-to-feed ratio	0.354 ^a	0.361 ^b	0.361 ^{bc}	0.357 ^d	0.364 ^c	0.364 ^{bc}	0.0015	< .01
Caloric efficiency†	9399 ^{ab}	9358 ^{abc}	9231 ^c	9216 ^c	9257 ^{bc}	9464 ^a	79.4	< .01
Mortality (%)	6.7 ^{ab}	6.3 ^{bc}	7.1 ^a	5.9 ^{cd}	5.4 ^d	5.2 ^e	0.34	< .01

* Source of data described in Table 1.

† Caloric efficiency = kilocalories/kg of live-weight gain.

^{a-d} Values within a row with no common superscript are statistically different ($P < .05$; F test for homogeneity of variances).

SE = standard error; ADG = average daily gain.

Table 6: US wean-to-finish production means from 2007 to 2010*

Trait	Year				SE	P
	2007	2008	2009	2010		
Entry age (days)	18.5 ^a	19.4 ^{ab}	19.3 ^{ab}	20.0 ^b	0.45	.02
Entry weight (kg)	5.68	5.95	5.95	6.23	0.209	.10
Exit age (days)	182 ^a	182 ^a	183 ^a	186 ^b	0.9	< .01
Exit weight (kg)	119.1 ^a	119.1 ^a	120.0 ^a	121.8 ^b	0.91	< .01
ADG (kg)	0.686	0.695	0.695	0.691	0.0050	.16
Gain-to-feed ratio	0.394	0.395	0.392	0.391	0.0018	.17
Caloric efficiency†	9247 ^a	9057 ^a	9559 ^{ab}	9942 ^b	299.9	.03
Mortality (%)	8.3 ^a	8.2 ^a	8.0 ^a	6.6 ^b	0.4	< .01

* Source of data described in Table 1.

† Caloric efficiency = kilocalories/kg of live-weight gain.

^{ab} Values within a row with no common superscript are statistically different ($P < .05$; F test for homogeneity of variances).

ADG = average daily gain.

- Pig industry trends from 2005 to 2010 indicate varied degrees of improvement for production traits.

Conflict of interest

None reported.

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