Digital Evaluation of Structural Phenotypes Common among Higher Parity Crossbred Sows

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Summary and Implications

Two independent, commercial, crossbred sow populations were selected to compare feet and leg structure in order to identify commonalities among them that may contribute to their long herd life. Digital imagery was used to measure the angle of the knee, pasterns and hock joints as well as the overall rear stance in sows ranging from parity 5 to 14. Parity and population effects were evaluated for each angle analyzed. Significant population effects ($P < 0.05$) were observed for the angle of the knee. Significant parity effects ($P<0.05$) were observed for the angle of rear leg stance. Similar leg conformation values across populations and parities for the front and rear pasterns and the hock may suggest that these values are within an acceptable range to allow for long herd life.

Introduction

Evaluation of structural traits has relied on subjective scoring and is subject to bias and error among and between individual scorers. Modern advances in digital imagery have made it possible to capture large quantities of high resolution images. Similar advances in digital image evaluation software can be used to measure the high resolution images. This creates opportunity for an objective collection and measurement method of visually observable feet and leg soundness and body conformation phenotypes in swine. By objectively measuring structural phenotypes, bias and error could be reduced or eliminated, making the replacement gilt selection process for feet and leg soundness highly efficient. Sows that have remained in a population past the average parity of their contemporaries may possess the desirable feet and leg soundness traits that are needed in order for that female to have a long and productive herd life. The objective of this study was to evaluate the feet and leg soundness traits from sows from two independent, commercial, crossbred populations to identify commonalities across sows that may contribute to their long and productive herd life.

Materials and Methods

Twenty-one sows from population one (5th and 6th parity) and twenty-four sows from population two (5th - 9th and 11th - 14th parities) were digitally photographed from several views in order to capture a variety of front and rear leg conformation traits and evaluated using digital image software. Both populations were from commercial, crossbred breed-to-wean operations. A Samsung PL20 camera was used (Samsung Electronics Co., Ltd. Yongin-City, Gyeonggi-Do, Korea) on the portrait setting with no zoom. Fifty-eight side and 50 rear images were used from population one and 189 side images and 76 rear images were used from population two. The angle measurement tool in ImageJ (ImageJ, National Institute of Health, Bethesda, MD) was used. The joints measured were the knee, front and rear pasterns and the hock. Angles were measured on opposite sides of each joint and then averaged for the specific joint angle. Rear stance was also measured by averaging left and right rear legs angles. Angles were compared using population and parity as fixed effects and individual sow id as a random effect. PROC MIXED of SAS (SAS Inst. Inc., Cary, NC) was used to analyze the data.

Results and Discussion

The population effect results are displayed in Table 1. The only significant effect ($P<0.05$) from the evaluation of the two populations was observed in the knee joint, with population one having a greater angle than population two. The parity effect results are displayed in Table 2. The only significant effect ($P<0.05$) from the analyses of the parity affects was observed in the rear leg stance. The present findings indicate that the sows from the different sow populations evaluated show similar leg conformational values. The similarity in joint angles across populations may suggest that these values are within some yet unknown acceptable kinematic range of motion to allow for a long herd life. Further work is needed to determine if these associations hold true in other commercial sow and gestation system types. Furthermore, the value for these digital joint angles should be validated using a large gilt population.

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Table 1. Comparison of populations by angles.

		Knee	Front Pastern	Rear Pastern	Hock	Rear Stance
Population 1	LSMEANS	159.86[a]	57.05[a]	49.6[a]	143.06[a]	87.45[a]
	SE	2.85	4.56	4.49	3.33	2.61
Population 2	LSMEANS	153.49[b]	54.95[a]	52.08[a]	142.32[a]	86.76[a]
	SE	1.21	2.01	1.97	1.49	1.18

[a,b] Values in a column without common superscript are significantly different (P<0.05)

Table 2. Comparison of angles by parity.

		Knee	Front Pastern	Rear Pastern	Hock	Rear Stance
Parity 5	LSMEANS	156.82[a]	56.06[a]	53.38[a]	148.93[a]	89.89[a,c,d,e]
	SE	1.97	4.56	3.08	2.28	1.77
Parity 6	LSMEANS	157.97[a]	54.31[a]	51.81[a]	148.95[a]	88.09[c,d,e]
	SE	1.51	2.39	2.36	1.74	1.36
Parity 7	LSMEANS	153.74[a]	57.16[a]	48.55[a]	142.63[a,b]	87.15[b,c,d,e]
	SE	3.04	5.04	4.92	3.71	2.89
Parity 8	LSMEANS	156.84[a]	54.63[a]	56.80[a]	143.59[a,b]	96.37[a]
	SE	3.59	5.95	5.82	4.39	3.48
Parity 9	LSMEANS	156.59[a]	56.60[a]	46.04[a]	142.51[a,b]	84.35[b,c,d,e]
	SE	4.83	8.05	7.86	5.94	4.84
Parity 11	LSMEANS	152.24[a]	54.94[a]	48.68[a]	142.04[a,b]	84.07[a,b,c,d,e]
	SE	3.59	5.95	5.82	4.39	3.5
Parity 12	LSMEANS	157.56[a]	54.82[a]	49.66[a]	144.60[a,b]	83.16[a,b,c,d,e]
	SE	4.88	8.09	7.9	5.97	4.62
Parity 13	LSMEANS	158.03[a]	61.81[a]	55.23[a]	129.91[b]	78.52[b]
	SE	4.83	8.05	7.86	5.94	4.69
Parity 14	LSMEANS	160.29[a]	53.64[a]	47.42[a]	141.09[a,b]	92.34[a,c,d,e]
	SE	3.58	5.94	5.83	4.39	3.48

[a, b, c, d, e] Values in a column without common superscript are significantly different (P<0.05)