PERFORMANCE OF ONE-QUARTER CHINESE (MEISHAN) AND THREE-BREED CONVENTIONAL CROSSES FOR SOW PRODUCTIVITY AND GROWTH AND CARCASS CHARACTERISTICS OF THE PROGENY.

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Introduction

For many years, crossbreeding programs based on Western pig breeds have been used to improve sow productivity through maximizing maternal heterosis (Kuhlers et al., 1988; McLaren et al., 1987). In the last decade, in both the U.S. and Europe the Machine, a highly prolific Chinese pig breed, has been evaluated for use in commercial crosses (Bidanel et al., 1991; Mercer and Hoste, 1994; Lee and Haley, 1995; Sinclair et al., 1998; Young, 1998). Levels of heterosis between Machine and Western breeds are higher than crosses between Western breeds (Mercer and Hoste, 1994). Therefore, there is an interest in developing crossbreeding programs that utilize the Machine and Western breeds in order to exploit this heterosis and the prolificacy of the Machine.

Machine F1 crossbred females have been found to improve reproductive and litter productivity traits compared to F1 crosses of Western breeds (Lee and Haley, 1995; Young, 1995a). However, growth performance and carcass composition of the progeny is significantly poorer than that of Western breeds. It is therefore of no economic benefit to utilize the Machine F1 in typical commercial pig production.

However, female lines with one-quarter Machine have been developed and the objective of this study was to compare reproductive, litter, and progeny growth and carcass performance of two 1/4 Machine sow lines and a three-breed conventional cross for traits of commercial importance.

Experimental Approach

The study was conducted at the Moorman Swine Research Farm at the University of Illinois. Three dam lines were produced for this study; namely Landrace x (Machine x Yorkshire) (LMeY), Duroc x (Machine x Yorkshire) (DMeY), and Landrace x (Duroc x Yorkshire) (LDY). In addition, a performance test was conducted to evaluate the progeny of the three dam lines mated to terminal Hampshire boars.

At the start of the study, 45 (LMeY), 41 (DMeY), and 50 (LDY) gilts were selected on the basis of dam and sire, with no greater than four gilts being kept from any one dam and at least eight sires being represented in each genotype. Sows were kept for five parities producing a total of 142, 153, 157 litter records for genotypes LMeY, DMeY, and LDY, respectively.

A total of 170 progeny with 60 pigs from both LMeY and DMeY lines, and 50 pigs from the LDY line were evaluate for growth performance and carcass characteristics. Progeny originated from five Hampshire sires and at least 15 dams from each genotype were represented.

Sow and Litter Management and Housing. Gilts selected for this experiment were group-housed in a breeding facility at approximately 220 days of age with fence-line exposure to boars. All matings were to Hampshire boars utilizing artificial insemination. Gilts were pen gestated with eight animals per pen. In subsequent parities sows were housed in gestation stalls. The gestation facilities were environmentally controlled and mechanically ventilated. During breeding and pregnancy sows were subject to standard commercial management practices and were fed approximately 2.2 kg of a corn-soybean meal diet (formulated to contain 12 % CP, 9g/kg of lysine, and 3300 kcal/kg ME) daily.

Sows were weighed and moved to the farrowing accommodation at day 108 of gestation and remained in individual farrowing crates in controlled environment rooms for the entire farrowing and lactation period. Pre-farrowing sows were fed approximately 3.0 kg of a corn-soybean lactation diet (formulated to contain 13% CP, 27g/kg of lysine, and 3400 kcal/kg ME) daily. From immediately post-farrowing, they were fed twice daily to appetite. Within 24 h of farrowing, number of live born, stillborn and number of mummified piglets and piglet weights were recorded, males were castrated, needle teeth were clipped, ears were notched for identification, and piglets were given 1 ml of iron dextran and 1ml penicillin as preventative medication for scours. Cross-fostering occurred when sows farrowed greater than 12 piglets. In those instances, extra pigs were transferred to other sows with smaller litters of similar age and piglet size to try to equalize litters to 10 pigs. Pigs were individually weighed at 21 days and cross fostered pigs were weighed with the recipient sow's litter. Piglets were weaned at 28 days of age into a conventional nursery. Sows were individually weighed and placed in group-housing for re-breeding, and the weaning to farrowing interval was recorded. Death, lameness, illness, and failure to return to estrus resulted in the culling of both gilts and sows. The number of culls were recorded throughout the study and the culling rate was determined by dividing the number of sows culled prior to the fifth parity by the total number of gilts available for breeding at the start of the study.

Grow-Finish Management and Housing. Animals were allotted on the basis of weight to like-genotype, like-sex pens of five pigs at an average start weight of 40 kg and taken off test at an average live-weight of 110 kg. During the study, pigs were housed in two different environmentally controlled finishing houses with partially slatted flooring and a pen space allocation of 1.2 m^2/pig. Pigs were given ad libitum access to feed from a two hole feeder. A two-phase dietary program was used with diets being based on corn and soybean meal and formulated to meet or exceed NRC (1988) nutrient requirements. Pigs were given ad libitum access to water via a nipple waterer in each pen. Live weight and feed consumption were recorded at 14-d intervals. In addition, pigs were ultrasonically scanned to measure backfat and loin depth anterior to the last rib, 5 cm off of the midline at the start and at 28-d intervals throughout the trial.

Statistical analysis. All results were analyzed using the GLM procedure of SAS (1990). The model used for reproductive and litter productivity traits (traits of the dam) included the effects of genotype, farrowing season, litter sire, parity of dam, genotype x season interaction, genotype x parity interaction, and dam nested in genotype. Dam nested within genotype was used as the error term to test genotype effects.

For progeny performance test data, the pen was used as the experimental unit for feed intake, growth and feed efficiency, and the individual animal was used as the experimental unit for carcass data. Analysis of growth performance and feed efficiency was performed using a model that included the effects of genotype, sex, finishing house, genotype x sex interaction, finishing house x sex interaction, finishing house x genotype interaction.

Results and Discussion

Reproductive performance is summarized in Table 1. Gestation length was similar for all three genotypes. However, LMeY had a shorter farrowing interval than LDY, with DMeY being similar and intermediate to the other two lines. This suggest that LMeY either had a shorter return to estrus interval from weaning and/or fewer returns to estrus after breeding than LDY. European research (Mercer and Hoste, 1994), reported that sows containing Machine had shorter return to estrus than conventional white-cross sows. In contrast, Young (1998a) reported no significant differences for weaning to first estrus interval for a (1/4 Machine, 3/4 White) composite line compared to a (1/4 Duroc, 3/4 White) composite line. However, Young (1995a) comparing (½ Machine, ½ White) composite verses (½ Duroc, ½ White) composite females, found that the Machine line had a significantly shorter weaning to estrus interval. The shorter interval to estrus exhibited by the LMeY line would result in fewer non-productive days, increasing the efficiency of production compared to the DMeY and LDY lines. Additionally, the culling rate or the percentage of sows removed before parity five was lower for DMeY than for LDY, with LMeY being intermediate. Female replacement rate has been shown to have a substantial impact on the efficiency of a swine crossbreeding system (McLaren et al., 1987). Therefore, the sow genotypes containing Meishan in this study would have a significant advantage over the conventional three-breed cross in this respect.

Farrowing performance was generally similar between the three genotypes. Total pigs born and number of live born pigs did not differ between genotypes. U.S. studies (Young 1998), found no significant differences between (1/4 Meishan, 3/4 White) composite and (1/4 Duroc, 3/4 White) composite lines for number born alive. However, Mercer and Hoste (1994) suggested that there is a significant advantage in number born alive in a synthetic sow line containing 1/4 Meishan relative to a conventional White sow line. Other studies have also indicated an advantage in number born alive for the Meishan crosses over Western breed crosses (Bidanel et al., 1989; Haley et al., 1995). Individual pig birth weights in the current study were similar for all genotypes, however, LMeY had significantly higher live born litter birth weights than either DMeY or LDY. Young (1998) also reported no difference in piglet birth weights between (1/4 Meishan, 3/4 White) composite and (1/4 Duroc, 3/4 White) composite genotypes. In contrast, most research has found sows containing 1/4 Meishan to produce lighter piglets at birth (Mercer and Hoste, 1994; Sinclair et. al, 1998; Van Der Steen and De Groot, 1992).

Pre-weaning mortality was significantly lower for the Meishan lines than for the LDY. Therefore, numbers weaned were higher for LMeY than LDY with DMeY being intermediate for this trait. This may have resulted from behavioral differences between the genotypes. There is evidence (Sinclair et al., 1998) that ½ Meiahan sows spend less time standing with fewer posture changes during lactation when compared to sows of a synthetic white line genotype. Furthermore, van der Steen and de Groot (1992) found that Meishan sows possess good maternal characteristics with a resulting lower piglet mortality and even heavier piglets at weaning, and Haley and Lee (1994) have shown that at a constant birth weight Meishan cross piglets have an advantage in survivability.

The LMeY sows were significantly lighter pre-farrowing than the other two dam lines. In addition, the two Meishan genotypes lost significantly more body weight during lactation than LDY. LMeY had a higher percentage of body weight loss than both DMeY and LDY, losing 21.7 percent of pre-farrowing body weight compared to 18.5 and 14.9 for DMeY and LDY, respectively. These results are similar to those of Sinclair et al. (1996) who showed that ½ Meishan sows had a lower live weight pre-partum and higher total live weight loss post-partum compared to White line sows. Additionally, the sows of Meishan genotype also suffered a higher backfat loss over the tenth rib during lactation and had a higher litter growth rate than the White line sows (Sinclair et al., 1996).

Growth performance and carcass measurements for genotype. Performance and carcass composition data for the progeny from the three crossbred lines are presented in Table 2. Average daily gain, daily feed intake, and gain to feed ratio did not differ between the three genotypes. Young (1998b) also reported no differences in the growth performance and feed efficiency between (1/8 Meishan, 7/8 White) and (1/8 Duroc, 7/8 White) pigs. Both European and U.S. studies, however, have reported that purebred Meishan and Meishan crossbred pigs containing at least 1/4 Meishan have reduced growth rates with poorer feed efficiency than Western breeds of pigs (Bidanel et al., 1993; Haley et al., 1992; Mercer and Hoste, 1994; White et al., 1994; Young, 1995b). While Meishans generally exhibit lower growth performance traits than Western breeds, 1/8 Meishan pigs appear to have similar growth performance compared to other commercial Western breed crosses.

Ultrasound fat and loin eye measurements were corrected to an average end of test live weight of 114 kg. There were no differences for either backfat or loin depth at the last rib between genotypes. These findings are in agreement with data reported by Young (1998b) where no differences were found between pigs with 1/8 Meishan compared to conventional genotypes for level of backfat at slaughter. However, Young (1998b) found that (1/8 Duroc, and 7/8 White) composite line pigs did have higher yield of lean cuts than those of the 1/8 Meishan line.

Conclusions

1. The LMeY dam line had improved reproductive performance compared to the conventional three-breed cross.

2. The lower overall body weight in addition to the lower culling rate of the LMeY female line may correspond to a reduction in the cost of maintaining this genotype in commercial swine operations.

3. Growth performance and carcass composition to typical U.S. slaughter weights was not significantly different for the progeny of 1/4 Meishan sows compared to those of a conventional three-breed cross in this study.

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Table 1. Least square means for reproductive and litter productivity traits in the crossbred female lines.

Items	*Dam Genotype*[d]			*Ave SE*	*Sig*
	LMeY	DMeY	LDY		
Number of Sows	45	41	50	-	-
Reproductive Performance					
Gestation Length, day	114.5	114.3	115.0	0.43	NS
Farrowing Interval, day	143.5[a]	145.0[ab]	149.1[b]	3.07	*
Culling Rate, %	53.0	41.0	60.0	-	-
Farrowing Performance					
Total Number Born	11.82	11.35	11.25	0.762	NS
Number Born Alive	10.67	10.19	9.92	0.640	NS
Number Still Born	0.99	0.98	1.22	0.294	NS
Number Mummified	0.17	0.19	0.12	0.158	NS
Average Piglet Weight, kg	1.88	1.89	1.83	0.010	NS
Total Litter Weight, kg	20.28[a]	18.45[b]	17.54[b]	1.085	**
Weaning Performance					
Pigs Weaned/Litter	10.44[a]	9.80[ab]	9.28[b]	0.620	*
Pre-weaning Mortality, %	3.1[a]	4.2[a]	6.4[b]	1.59	**
Total Litter 21 d Weight, kg	52.95	51.25	53.29	2.992	NS
Sow Weights					
Pre-Farrowing, kg	235.16[a]	247.79[b]	247.06[b]	7.020	*
Post-weaning, kg	190.05[a]	206.72[b]	213.35[b]	6.916	**
Lactation Weight Loss, kg	51.30[a]	45.38[b]	37.20[c]	4.198	*
Lactation Weight Loss, %	21.7[a]	18.5[b]	14.9[c]	0.016	**

1 kg = 2.2046 lbs
[a, b, c] Means within row with differing superscripts differ (P<.05).
NS, *,**, *** = not significant, P<.05, P<.01, P<.001 respectively.
[d] LMeY = Landrace x (Machine x Yorkshire), DMeY = Duroc x (Machine x Yorkshire), and LMY = Landrace x (Duroc x Yorkshire)

Table 2. Least square means for genotype and sex for progeny growth performance traits.

	Dam Genotype					Sex			
Variable	*LMeY*	*DMeY*	*LDY*	*Avg SE*	*P value*	*Barrow*	*Gilt*	*Avg SE*	*P value*
Growth performance traits									
Start of test weight, kg.	40.0	40.6	40.6	0.92	NS	40.2	40.5	0.75	**
End of test weight, kg.	107.8	107.6	109.1	1.51	NS	109.5	106.8	1.23	NS
Days on test	82	80	82	1.5	NS	80	83	1.2	NS
Average daily gain, g									
40 - 80 kg	816	815	857	24.5	NS	860	799	19.8	**
80 - 110 kg	921	960	985	34.0	NS	995	916	27.5	**
40 - 110 kg	868	888	921	18.3	NS	927	858	14.8	***
Gain:feed									
40 - 80 kg	0.37	0.36	0.36	0.014	NS	0.36	0.36	0.012	NS
80 - 110 kg	0.29	0.30	0.31	0.010	NS	0.29	0.30	0.008	NS
40 - 110 kg	0.33	0.33	0.34	0.010	NS	0.33	0.33	0.008	NS
Average daily feed intake, g									
40 - 80 kg	2315	2346	2394	68.1	NS	2470	2234	55.0	***
80 - 110 kg	3276	3285	3178	85.9	NS	3433	3060	69.4	***
40 - 110 kg	2795	2816	2786	57.7	NS	2951	2647	46.6	***
Carcass traits[a], last rib, mm									
Fat depth	20.74	19.01	18.72	0.852	NS	20.94	18.04	0.442	***
Loin eye depth	52.16	52.63	54.30	0.764	NS	51.95	54.09	0.595	***

1 kg = 2.2046 lbs; 1 mm = 0.039 in.

[a] All measurements corrected to a live weight of 114.37 kg using covariate analysis.

NS, **, *** = not significant, P<.05, P<.01, respectively.