PRE-WEANING PERFORMANCES OF CROSSBREEDING BETWEEN LOCAL SUMATERA SHEEP AND HAIR SHEEP

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ABSTRACT

Crossbreeding among Sumatera thin tail sheep and the tropical hair sheep breeds (St. Croix and Barbados Blackbelly) have been conducted at the Sungai Putih Research Station, since 1986, in order to create composite breeds with genotype composition of 25% St. Croix, 25% Barbados Blackbelly, 50% Sumatera. Results of the study show that the mean of birth weight of composite genotype (2.45 kg) is higher (P<.05) than that of St. Croix cross (2.23 kg), Barbados cross (2.15 kg) and Sumatera sheep (1.68 kg). The differences in birth weight are continued until weaning. Weaning weight of composite genotype (13.14 kg) is higher than that of Barbados Blackbelly cross (11.73 kg), St. Croix cross (11.67 kg) and Sumatera sheep (8.67 kg). Composite genotype has improved weaning weight around 36.51% as compared to Sumatera sheep. From the analyses of the pre-weaning weight show that breed of ewes, sex of lambs and type of birth influence significantly to the pre-weaning weight. Composite genotype has survival rates (93.12%) higher than that of other parental breeds (85%). Multiple birth tends to have low survival rates. Multiple birth tends to have survival rates similar to twinborn lambs of Sumatera sheep (85%). Growth rates of composite genotype (101.5 g/d) and Barbados cross (108.2 g/d) higher than that of St. Croix cross (97.4 g/d) and Sumatra sheep (81.5 g/d). The higher weight of composite genotype and the St. Croix and Barbados Blackbelly cross indicate that these sheep have adapted to the local environment.

Key words: Sheep, Crossbreeding, Sumatera, St. Croix, Barbados Blackbelly

INTRODUCTION

Systematic crossbreeding is one method of genetic improvement for increasing sheep productivity in short period, by using the effect of heterosis or hybrid vigor (Sakul *et al.*, 1994). Study on crossbreeding between local Sumatera sheep and tropical hair sheep breeds which are St. Croix and Barbados Blackbelly (Fitzhugh and Bradford, 1983) has been conducted since 1986 by Small Ruminant Collaborative Research Support Program in collaboration with the Research Institute for Animal Production at Sungai Putih, North Sumatera Research Station. Evaluation on the ewe productivity of crossing between St. Croix hair sheep and Sumatera thin tail sheep showed that St. Croix cross ewes could produce lamb with litter weight 47% higher than those of Sumatera thin tail ewes (22.4 vs 15.2 kg/year). Productivity per unit metabolic body weight of St. Croix and Barbados Blackbelly cross ewes are 13 and 20 percent higher than that of Sumatera ewes (Gatenby *et al.*, 1993a). However, Barbados Blackbelly cross tend to have less wool cover as compared to St. Croix cross (Gatenby *et al.*, 1993b).

For combining the best traits of St. Croix cross and Barbados Blackbelly cross, crossbreeding between St. Croix cross (50% St. Croix, 50% Sumatera) and Barbados Blackbelly cross (50% Barbados Blackbelly, 50% Sumatera) for producing composite genotype of 25% St. Croix, 25% Barbados Blackbelly, 50% Sumatera. This paper present several pre- and post-weaning performances of Sumatera thin tail, St. Croix hair sheep, St. Croix cross (50% St. Croix and 50% Sumatera) and Barbados Cross (50% Barbados Blackbelly, 50% Sumatera).

MATERIALS AND METHODS

The study have been conducted at the Sungai Putih Research and Asessment

Installation for Agricultural Technology, Galang District, Deli Serdang Regency, North Sumatera, about 60 km from Medan. The location of the study is at the altitude of 50 m from the sea level. The climate of location of study is humid tropics with precipitation of 1800 mm per year. Temperature fluctuation is very low, with minimum temperature of 23 °C and maximum temperature of 32 °C.

The sheep that were used for the study were (1) Sumatera thin tail sheep (S); (2) St. Croix hair sheep (H) which were imported from Virgin Island, U.S.A. in 1986, (3) St. Croix cross which are crossing between St. Croix and Sumatera thin tail sheep to produce genotype of 50% St.Croix, 50% Sumatera (HC); (4) Barbados cross which are crossing between Barbados Blackbelly and Sumatera thin tail to produce genotype of 50% Barbados Blackbelly, 50% Sumatera (BC). Barbados Blackbelly are introduced using frozen semen in 1991; (5) Composite genotype (M) which are crossing between BC rams with HC ewes or between HC rams with BC ewes.

Hand mating are practiced in this study, and the mating periods are within 34 days. Sheep are confined in the night. Ewes, ewe lambs and pre-weaning lambs are grazing from 8:00 a.m. to 16:00 p.m. every day under rubber plantation. All sheep are supplemented with concentrate. Ewes are supplemented with concentrate around 300 g/day. At weaning all the animals are treated with anthelmentic and confined until 6 months of age. Ewe lambs are grazed after age of 6 months, while ram and ram lambs are confined, and the grass are provided by cut and carry. Sheep that are grazed are treated with anthelmentic for every 3 months.

Pre-weaning performances that were observed in this study were birth weight, weight at 4 weeks, weight at 8 weeks, weight at 12 weeks, weaning weight at 90 days, and pre-weaning survival rates. The performances data were analyzed using linear models (SAS, 1987). Factors that were fitted were genotype (S, H, HC, BC, and M), months of birth, age of dam at lambing ($\leq$ 13 months; 13.1-19 months; 19.1-25 months; 25.1-31 months; 31.1-37 months, 37.1-43 months; 43.1-49 months; and > 49 months), sex (male and female), birth type (single, twin and multiple birth), and two way interaction.

Growth rate of lambs each genotype were analyzed using simple regression of weight of lambs (kg) on age of lambs (week). Wool area analyzed using scoring method from zero (0) to nine (9). Hair are given zero (0) score, while heavy wool cover are given score nine (9).

RESULTS AND DISCUSSION

The analysis of variance shows that genotype or breed, month of birth, sex, age of dam at lambing, birth type influence significantly ($P<.01$) on birth weight. However, interaction of breed by sex and breed by birth type do not affect significantly on birth weight. From 1344 birth weight data show that birth weight of St. Croix was the highest (2.74 kg), while the birth weight of Sumatera thin tail sheep was the lowest (1.68 kg). Birth weight of composite genotype (2.45 kg) was higher than the parental breeds (Barbados cross and St. Croix cross) (Table 1). This indicates that hybrid vigor or heterosis has happened in crossing between Barbados cross and St. Croix cross. The birth weight of the composite genotype were about 12% higher than the average of birth weight of parental breeds, and about 46% higher than the birth weight of Sumatera sheep.

Table 2 shows that birth weight of ram lambs were heavier than that of ewe lambs, and the birth weight of singles were heavier than twins and triplets as expected.

Weights at 4 weeks, 8 weeks, 12 weeks and weaning weight are presented at Table 2. Analysis of variance show that the effect of breed, month of birth, age of dam at lambing, sex and type of birth and interaction between breed and birth type were significantly ($P<.01$) affect weight at 4 weeks, while the interaction between breed and sex did not influence significantly on weight at 4 weeks. At age of 4 weeks the highest weight was St. Croix (6.83 kg) followed by composite genotype (6.15 kg), St. Croix cross (5.65 kg), Barbados cross (5.60 kg) and Sumatera thin tail (4.40 kg). The composite genotype consistently higher (9.3%) than those of average of parental breeds, and 39% heavier than that of Sumatera thin

Table 1. Means and standard deviation of birth weight of sheep according to the breed

Breed	N (head)	Birth weight (kg)
Barbados cross	122	$2,15 \pm 0,57^{a}$
St. Croix	119	$2,74 \pm 0,74^{b}$
St, Croix cross	351	$2,23 \pm 0,67^{c}$
Composite	515	$2,45 \pm 0,67^{b}$
Sumatera	237	$1,68 \pm 0,57^{c}$

Within comparison, means followed by the same superscript are not different (P>.05)

tail sheep. At age of 4 weeks, ram lambs were heavier than ewe lambs, and single birth lambs were heavier than twins and triplets in all breeds as expected.

Analysis of variance on weight at 8 weeks show that breed, months of birth, age of dam at lambing, sex and type of birth and interaction between breed and type of birth influenced significantly on weight at 8 weeks (P<.01). Interaction between breed and sex did not affect the weight at 8 weeks. The heaviest weight at 8 weeks was St. Croix (10.19 kg), followed by Composite genotype (9.39 kg), Barbados cross (8.83 kg), St. Croix cross (8.82 kg), and Sumatera thin tail (6.63 kg). The composite genotype at 8 weeks of age were 6.4% heavier than those of mean of parental breeds and 42% heavier than that of Sumatera thin tail sheep. On average, at 8 weeks of age ram lambs were heavier than ewe lambs, and single birth lambs was heavier than those of twins and triplets as expected (Table 2).

Analysis of variance on weight at 12 weeks and weaning weight at 90 days show that the effect of two factors interaction between breed and sex, and breed and type of birth were not significant. The effect of breed, month of birth, sex and type of birth were significant (P<.01). While the effect of age of dam at lambing were significant (P<.05) for weaning weight, but there were not significant for weight at 12 weeks. Reducing the effect age of dam, indicate that the lambs become independent from the dam.

As on other pre-weaning weight, most of the ram lambs were heavier than those of ewe lambs, and single born lambs were heavier than those of twins and triplets. The order of weight at 12 weeks and weaning weight at 90 days, respectively, are similar to other pre-weaning weights which were St. Croix the heaviest (12.67 and 13.32 kg), followed by composite genotype (12.30 and 13.14 kg), Barbados cross (11.35 and 11.73 kg), St. Croix cross (11.34 and 11.67 kg) and Sumatera thin tail (9.02 and 8.67 kg) (Table 2). At 12 weeks of age the Composite genotype were 8.4% heavier than those of average parental breeds and about 36.4% heavier than those of Sumatera thin tail sheep. At weaning, the composite genotype were 12.3% heavier than those of average weaning weight of parental breeds, and 51.6% heavier than that of Sumatera thin tail sheep.

Analysis of growth rate by simple regression of weight (kg) on age of lambs (week) from birth to 6 months, show that growth rate significantly affected by age of lambs from birth up to 6 months of age (P<.01). Table 4, shows that St. Croix has higher body weight than other breeds to be studied, but the Barbados Blackbelly has the higher growth rate (0.76 kg/week), followed by Composite genotype (0.711 kg/week), St Croix (0.696 kg/week), St. Croix cross (0.682 kg/week) and Sumatera thin tail (0.571 kg/week). If the growth rate converted into gram/day, the growth rate of Barbados cross, Composite genotype, St. Croix, St. Croix cross and Sumatera thin tail are 108.8; 101.5; 99.0; 97.4; and 81.5 g/day. The different growth rate between Composite genotype and Sumatera thin tail is 20 g/day, thus it means that using Composite genotype will get an additional

Table 2. Mean and standard deviation of weight at 4-,8-,12-week, and weaning weight of sheep according to the breed, sex and birth type

Variables	Birth weight (kg)		Weight at 4 weeks (kg)		Weight at 8 weeks (kg)		Weight at 12 weeks (kg)		Weaning weight (kg)	
	N	Mean±SD	N	Mean±SD	N	Mean±SD	N	Mean±SD	N	Mean±SD
Barbados Cross	122	2,15 ± 0,57	133	5,60 ± 1,66	108	8,83 ± 2,43	106	11,35 ± 2,88	109	11,73 ± 2,94
Male	57	2,12 ± 0,54	52	5,58 ± 1,66	52	8,62 ± 2,50	50	11,33 ± 3,03	50	11,83 ± 3,13
Female	65	2,17 ± 0,54	61	5,62 ± 1,67	56	9,02 ± 2,37	56	11,37 ± 2,78	59	11,65 ± 2,79
Single	48	2,50 ± 0,51	45	6,95 ± 1,26	43	10,49 ± 1,85	43	13,11 ± 2,12	45	13,36 ± 2,34
Twin	49	2,07 ± 0,47	46	4,91 ± 1,21	44	8,17 ± 2,16	43	10,65 ± 2,80	44	11,04 ± 2,82
Triplet	25	1,67 ± 0,38	22	4,30 ± 1,22	21	6,81 ± 1,80	20	9,08 ± 2,27	20	9,57 ± 2,45
St. Croix	119	2,74 ± 0,74	95	6,83 ± 1,68	87	10,19 ± 2,30	83	12,67 ± 2,51	100	13,32 ± 2,60
Male	61	2,86 ± 0,75	50	6,79 ± 1,71	46	10,24 ± 2,40	43	12,81 ± 2,52	48	13,66 ± 2,76
Female	58	2,60 ± 0,69	45	6,87 ± 1,67	41	10,13 ± 2,21	40	12,51 ± 2,52	52	13,01 ± 2,43
Single	73	3,07 ± 0,52	63	7,75 ± 1,16	56	11,50 ± 1,43	53	13,89 ± 1,70	64	14,36 ± 2,16
Twin	34	2,24 ± 0,81	22	5,33 ± 0,77	22	8,19 ± 4,61	21	10,77 ± 2,47	27	11,71 ± 2,42
Triplet	12	2,13 ± 0,48	10	4,33 ± 0,79	9	6,97 ± 1,20	9	9,92 ± 1,68	9	10,81 ± 1,82
St. Croix Cross	351	2,23 ± 0,67	299	5,65 ± 1,58	286	8,82 ± 2,33	282	11,34 ± 2,70	293	11,67 ± 2,83
Male	168	2,31 ± 0,67	138	5,92 ± 1,57	133	9,34 ± 2,34	132	12,10 ± 2,67	135	12,47 ± 2,89
Female	183	2,17 ± 0,66	161	5,42 ± 1,55	153	8,36 ± 2,22	150	10,67 ± 2,55	158	10,99 ± 2,59
Single	152	2,66 ± 0,59	136	6,79 ± 1,25	132	10,25 ± 1,87	131	12,78 ± 2,05	132	13,17 ± 2,15
Twin	147	2,01 ± 0,47	129	4,75 ± 1,12	122	7,67 ± 1,83	121	10,18 ± 2,35	127	10,53 ± 2,64
Triplet	52	1,67 ± 0,56	34	4,51 ± 1,20	32	7,26 ± 2,32	30	9,75 ± 3,34	34	10,13 ± 3,11
Composite	515	2,45 ± 0,67	400	6,15 ± 1,74	363	9,39 ± 2,49	336	12,30 ± 3,07	473	13,14 ± 3,16
Male	277	2,52 ± 0,64	208	6,37 ± 1,73	189	9,88 ± 2,45	180	13,07 ± 2,85	254	13,87 ± 2,94
Female	238	2,35 ± 0,69	192	5,91 ± 1,71	174	8,85 ± 2,43	156	11,41 ± 3,09	219	12,30 ± 3,21
Single	202	2,91 ± 0,57	173	7,45 ± 1,43	153	11,29 ± 1,90	142	14,41 ± 2,41	190	15,10 ± 2,55
Twin	214	2,29 ± 0,52	170	5,39 ± 1,20	156	8,30 ± 1,87	14450	11,12 ± 2,49	200	12,39 ± 2,82
Triplet	99	1,84 ± 0,47	57	4,47 ± 1,04	54	7,12 ± 1,59	144	9,66 ± 2,37	83	10,46 ± 2,41
Sumatera	237	1,68 ± 0,57	198	4,40 ± 1,95	166	6,63 ± 1,87	74	9,02 ± 1,03	154	8,67 ± 2,27
Male	119	1,71 ± 0,57	97	4,25 ± 1,37	86	6,90 ± 1,92	75	10,02 ± 1,71	74	9,25 ± 2,34
Female	118	1,64 ± 0,57	101	4,35 ± 2,38	80	6,35 ± 1,70	62	8,03 ± 1,99	80	8,14 ± 2,08
Single	94	2,12 ± 0,48	85	5,36 ± 0,92	70	7,95 ± 1,55	67	9,97 ± 1,83	65	10,16 ± 1,87
Twin	106	1,46 ± 0,39	88	3,76 ± 2,46	72	5,70 ± 1,43	20	8,67 ± 1,25	69	7,61 ± 1,91
Triplet	37	1,19 ± 0,38	25	3,40 ± 0,66	24	5,57 ± 1,20		7,20 ± 1,72	20	7,53 ± 1,94

Table 3. Mean and standard deviation of weight at 6 months and pre-weaning survival rate of sheep according to the breed, sex and birth type

Breed: Sex / Birth type	Pre-weaning survival rates (%)	
	N	Mean ± SD
Barbados Cross	121	90,91 ± 28,87
Male	56	91,07 ± 28,77
Female	65	90,77 ± 29,57
Single	48	95,83 ± 20,19
Twin	48	91,67 ± 27,93
Triplet	25	80,00 ± 40,82
St. Croix	117	85,47 ± 35,39
Male	59	81,35 ± 39,28
Female	58	89,65 ± 30,72
Single	71	90,14 ± 30,02
Twin	34	71,41 ± 41,04
Triplet	12	75,00 ± 45,23
St. Croix Cross	348	84,75 ± 35,98
Male	167	82,03 ± 38,50
Female	181	87,29 ± 33,39
Tunggal	150	89,33 ± 30,97
Twin	146	86,99 ± 33,76
Triplet	52	65,38 ± 48,04
Composite	509	93,12 ± 25,33
Male	276	92,39 ± 26,56
Female	233	93,99 ± 23,81
Single	199	95,98 ± 19,69
Twin	213	93,89 ± 23,99
Triplet	97	85,57 ± 35,32
Sumatera	183	85,24 ± 35,56
Male	90	84,44 ± 36,45
Female	93	86,02 ± 34,86
Single	67	97,01 ± 17,14
Twin	85	83,53 ± 37,31
Triplet	31	64,52 ± 48,64

Table 4. Simple regression of weight (kg) on age of lambs (week) from birth to 6 months of age

Breeds	Simple regression			Simple regression Equation
	a (kg)	b (kg/week)	R^2	
Barbados Cross	2,399	0,762	0,99	Weight = 2,399 + 0,762 Age
St. Croix	3,929	0,696	0,98	Weight = 3,929 + 0,696 Age
St. Croix Cross	2,905	0,682	0,99	Weight = 2,905 + 0,682 Age
Composite	3,291	0,711	0,98	Weight = 3,291 + 0,711 Age
Sumatera	1,907	0,571	0,99	Weight = 1,907 + 0,571 Age

Table 5. Mean and standard deviation of wool cover area according to breed of sheep

Breed	N	Wool cover (score)*
Barbados Cross	44	6,84 ± 1,82
St. Croix	58	4,40 ± 2,86
St. Croix Cross	69	7,07 ± 1,74
Composite	228	6,67 ± 1,76
Sumatera	23	8,69 ± 0,47

* Six months of age

value around 25%. The superiority of Barbados Blackbelly growth from birth to Croix sheep has been also observed in Tobago, which has a similar climate to North Sumatera (Rastogi *et al.*, 1993).

Pre-weaning survival rates are presented at Table 3. The mean of pre-weaning survival rates of all breeds is 88.81 ± 0.30%. This figure indicates that the pre-weaning mortality is around 12%. In general there indicates that the management is very good, weaning as compared to St. since the pre-weaning mortality rates is less than 20%.

Analysis of variance show that age of dam at lambing and birth type influenced highly significantly (P<.01) on pre-weaning survival rates, and breed affected significantly (p<.05) on pre-weaning survival rates. Sex did not affect significantly on pre-weaning survival rates. The pre-weaning survival rates increase from 89.28% to 92.62% when the age of dam increases from 1.5 to 3 year. Improving pre-weaning survival rates with increasing age of dam, probably due to improvement of milk yield and mothering ability to raise the lambs. Multiple birth lambs were significantly (P<.01) lower the pre-weaning survival rates. Multiple birth lambs usually have low birth weight in which related to low survival ability (Shelton, 1964). Among the breed that are compared, the composite genotype show the highest survival rates (93.12%), followed by Barbados cross (90.91%), St. Croix (85.47%), Sumatera thin tail (85.24%) and St. Croix cross (84.75%). Better survival rate and heavier weaning weight of Composite genotypes will result higher weight of lambs per ewe.

Wool cover that are evaluated by scoring in which if there were covered by hair the score is zero (0), and if there were covered by heavy wool area there were score to nine (9). Evaluation on wool cover at age around 6 months was presented at Table 5. Analysis of variance showed that breed and breed by sex interaction effect on wool cover were significant (P<.01). Sumatera thin tail had the highest score (P<.01) for wool cover as compared to other breeds that were studied, and the St. Croix had the lowest score (4.40) as expected from the hair sheep. The effect of crossbreeding as shown by Barbados cross, St. Croix cross and Composite genotype were reducing wool cover, and the Composite genotype tend to have lower score than the other crossing (Table 5). Also there are observed variability within the crossbred groups, therefore suggest that selection in the crossbred and composite genotype groups should lead to a reduction in wool cover, although the heritability is very low. Odenya (1982) obtained an estimate of 0.26 for heritability of wool cover in Dorper sheep

CONCLUSION

The pre-weaning performances on weight show that composite genotype was consistently heavier than those of the average of parental breeds (Barbados cross and St. Croix cross). The pre-weaning performances were higher for each crossbred group as compared to Sumatera thin tail sheep as expected from crossing with breeds with higher mature weight. Composite breeds tended to have better survival rates and heavier pre-weaning weight than those of other crossbred group resulted in higher weight of lamb per ewe. The use of hair sheep for crossbreeding resulted in lambs with less wool

cover at 6 months, especially for the Composite genotype.

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