

Effect of crossing *FecB* carrier rams of prolific Garole × Malpura halfbreds with *FecB* non- carrier Malpura ewes

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The Garole × Malpura (GM) halfbreds were evolved at the Central Sheep and Wool Research Institute, Avikanagar for increasing prolificacy in sheep. Result on GM showed that it has much higher prolificacy than the Malpura but were having lower body weight (Mishra *et al.* 2007). Having evolved prolific Garole × Malpura (GM) halfbred sheep, there is now scope to exploit the prolific GM sheep for relatively better growth by backcrossing with native Malpura to further propagate the prolificacy of GM sheep and enhance the body weight gains. This study was carried out to evaluate the effect of crossing of *FecB* carrier (*FecB^{BB}* and *FecB^{B+}*) GM rams with non-carrier (*FecB⁺⁺*) Malpura ewes on growth performance and *FecB* status in backcross (GMM) progenies.

The GM halfbreds were evolved by crossing of Garole rams with Malpura sheep. In this experiment only *FecB* carrier (*FecB^{BB}* and *FecB^{B+}*) GM rams were crossed with non-carrier (*FecB⁺⁺*) Malpura ewes to produce progeny having 1/4th Garole × 3/4th Malpura inheritance (GMM). Blood samples were collected from sheep flocks by venipuncture in ACD. The DNA was isolated by standard proteinase K digestion, phenol-chloroform extraction and ethanol precipitation. The mutation Q249R was

assayed using Forced RFLP-PCR with PCR primers F-12 (5′GTCGCTATGGGGAAGTTTGGATG-3′) and R-15 (5′CAAGATGTTTTTCATGCCTCATCA ACACGGTC-3′) as described by Wilson *et al.* (2001). These primers amplified a 140 bp region of the booroola allele. The R-15 primer introduces a point mutation in PCR product amplified from the BMPR-1B gene and the copies having A to G transition at position 746 thus gains *Ava II* restriction site, whereas PCR product from non-carrier (*FecB⁺*) does not complete restriction site and fails to cut by *Ava II*. The *FecB^{BB}* (homozygous carrier) individual showed single 110bp band, *FecB^{B+}* (heterozygous carrier) showed 140 and 110bp bands and the *FecB⁺⁺* animals (homozygous non-carrier) revealed a 140bp band. The growth profile data on birth, 3, 6 and 12 months body weight on animals produced in backcrossing of GM × Malpura (GMM) sheep during 2005 to 2006 and screened for *FecB* gene were analyzed to test the effect of *FecB* gene of rams on body weights of progenies. All the lambs were raised under semi-intensive management system and provided similar grazing/feeding conditions. Least squares procedures (Harvey 1990) were used to analyze the growth data.

Table1. Effect of *FecB* genotypes of GM rams on *FecB* genotype of F1 GMM lambs

<i>FecB</i> genotype of rams	<i>FecB</i> status of progeny of GMM						Total
	2005		2006		Total		
	<i>FecB</i> ^{B+}	<i>FecB</i> ⁺⁺	<i>FecB</i> ^{B+}	<i>FecB</i> ⁺⁺	<i>FecB</i> ^{B+}	<i>FecB</i> ⁺⁺	
<i>FecB</i> ^{B+}	06	17	10	12	16(35.56)	29(64.44)	45
<i>FecB</i> ^{BB}	5	2	18	04	23(79.31)	06(20.69)	29
Total	11	19	28	16	39(52.72)	35(46.61)	74

Figures in parentheses are percentage.

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The genotype of sheep carrying *FecB* mutation in GMM crosses are presented in Table 1. In the present study 74 GMM lambs were genotyped for *FecB*, of which 39 carries *FecB* gene. The results showed that 79.31% progeny of *FecB^{BB}* rams carries *FecB* mutation in heterozygous state while only

Table 2. Least square means of body weight of *FecB*^{BB} and *FecB*⁺⁺ carrier lambs of GMM

Particulars	Body weight of progeny at			
	Birth	3-Month	6-Month	12-Month
Overall	3.05 ± 0.06 (74)	13.79 ± 0.29 (74)	19.61 ± 0.31 (74)	24.93 ± 0.43 (64)
<i>FecB</i> genotype of rams	NS	NS	*	NS
<i>FecB</i> ^{BB}	3.11 ± 0.102 (28)	14.08 ± 13.49 (28)	20.40 ± 0.53 (28)	24.91 ± 0.68 (28)
<i>FecB</i> ^{B+}	2.98 ± 0.07 (46)	13.49 ± 0.31(46)	18.82 ± 0.34 (46)	24.95 ± 0.49 (36)
<i>FecB</i> genotype of lambs	NS	NS	NS	NS
<i>FecB</i> ^{B+}	2.93 ± 0.07 (39)	13.48 ± 0.35 (39)	19.02 ± 0.37 (39)	24.21 ± 0.53 (35)
<i>FecB</i> ⁺⁺	3.17 ± 0.09 (35)	14.09 ± 0.46 (35)	20.20 ± 0.51 (35)	25.64 ± 0.68 (29)
Sex	NS	NS	*	**
Male	3.09 ± 0.08 (38)	14.18 ± 0.39 (38)	20.31 ± 0.43 (38)	26.16 ± 0.65 (29)
Female	2.99 ± 0.08 (36)	13.39 ± 0.36 (36)	18.92 ± 0.37 (36)	23.70 ± 0.49 (35)
Year	*	NS	NS	NS
2005	3.15 ± 0.09 (30)	13.94 ± 0.43 (30)	19.49 ± 0.46 (30)	24.58 ± 0.65 (23)
2006	2.94 ± 0.07 (40)	13.64 ± 0.34 (44)	19.74 ± 0.37 (44)	25.28 ± 0.49 (41)
<i>FecB</i> genotype of rams × <i>FecB</i> genotype of lambs	NS	NS	NS	NS
Regression of ewe's weight	**	NS	*	-

NS, Nonsignificant; * P < 0.05; ** P < 0.01; within parentheses are number of observations.

35.56% progeny of *FecB*^{B+} rams carries *FecB* mutation. The results are similar with Kumar *et al.* (2006) who reported that about 68% GM sheep carried the *FecB* mutation. The 20.69% progenies of *FecB*^{BB} rams did not show mutation for *FecB* which might be due to non expression of *FecB* mutation in first generation of back crossing. Davis *et al.* (2002) also found that the *FecB* gene has been fixed at a high frequency in Garole sheep. However, few *FecB*⁺⁺ individuals were found in the population. The results indicated that the *FecB* gene is segregating in backcross progeny; however the frequency is about 52.72%. The reason for low frequency of the *FecB* gene in GMM was due to use of *FecB*^{B+} rams in backcrossing programme. Knowledge that fecundity gene is present in GM and GMM sheep will allow breeding strategies to be developed that maximize the benefits of *FecB* gene. Though above results are based on only 2 years data and hence further work needs to be conducted to reach definite conclusion.

The least square means of body weight of carriers (*FecB*^{B+}) and non-carrier (*FecB*⁺⁺) lambs from birth to 12-months of age for GMM back cross progenies are summarized in Table 2. There were only 2 genotypes (*FecB*^{B+} and *FecB*⁺⁺) available in the backcross progeny. The non-significant effect of *FecB* genotype of rams was observed from birth to 12-months of age except at 6-month body weight. The average body weight of progenies of *FecB*^{BB} carriers ram was higher than *FecB*^{B+} from birth to 6-month age; however it was slightly lower at 12 month. The *FecB* genotype of lambs did not affect the body weight at birth, 3, 6 and 12 months of age. The body weight of non-carrier (*FecB*⁺⁺) was nonsignificantly higher than the carrier lambs (*FecB*^{B+}). This is in accordance with the study of Kolte *et*

al. (2005) and Gootwine *et al.* (2006). Walling *et al.* (2000) hypothesized that 80% of animals inheriting the Booroola allele (*FecB*) also inherit the low growth allele. The year of births nonsignificantly affect body weight from weaning to 12 months age.

The interaction between *FecB* genotypes of rams and *FecB* genotype of lambs was nonsignificant. The result suggested that *FecB* genotype status of rams used in breeding programme and also the *FecB* genotype of lambs had no significant effect on body weights and growth traits from birth to 12-month of age, except significant (P<0.05) effect of *FecB* genotype of sire on 6-month body weight in GMM crosses and carriers are lighter than non-carriers.

The result clearly indicates that GMM crosses may be propagated as a new crossbred sheep having *FecB* gene towards evolving new prolific strain for enhancing overall productivity of sheep. Since the effect of *FecB* gene on body weight is nonsignificant, the useful character can be introduced into other breeds without compromising body weight. The mutation-screening test can be used as molecular marker for early selection of the animals and that will be helpful for designing breeding strategies.

SUMMARY

This study was carried out to evaluate the effect of crossing of *FecB* carrier (*FecB*^{BB} and *FecB*^{B+}) GM rams with non-carrier (*FecB*⁺⁺) Malpura ewes on growth performance and *FecB* status in backcross (GMM) progenies. The results showed that 79.31% progeny of *FecB*^{BB} rams carries *FecB* mutation in heterozygous state while only 35.56% progeny of *FecB*^{B+} rams carries *FecB* mutation. There were only 2 genotypes (*FecB*^{B+} and *FecB*⁺⁺) available in the backcross

progeny. The nonsignificant effect of *FecB* genotype of rams was observed from birth to 12-months of age except at 6-month body weight. The body weight of non-carrier (*FecB*⁺⁺) was nonsignificantly higher than the carrier lambs (*FecB*^{B+}). The interaction between *FecB* genotypes of rams and *FecB* genotype of lambs was nonsignificant. The result clearly indicates that GMM crosses may be propagated as a new crossbred sheep having *FecB* gene towards evolving new prolific strain.

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