4.3.3.1. Inbreeding

The inbreeding coefficient of an animal (F) is one half the additive genetic relationship between its parents. If individual k has parents i and j, then

$$F_k = \frac{1}{2} a_{ij} \qquad [4\text{-}2]$$

It is formally defined as the probability that two alleles at any locus are identical by descent.
An inbreeding coefficient (F) was estimated for each purebred sow and purebred litter considered for these analyses using the "Pedigree Viewer" software (Kinghorn, 2003).

Sow and litter inbreeding coefficients were fitted in the mixed model as linear covariables in order to obtain a regression coefficient that indicates the level of inbreeding depression of that trait. The repeatability models used for obtaining these coefficients were the same models described in Chapter 3 for estimating genetic parameters. The only difference is that the repeatability models used in Chapter 3 exclude parity one and in this analysis parity one is included.

4.3.3.2. Direct Piglet Heterosis

In order to estimate direct piglet heterosis, a set of four components of the additive genetic merit were fitted in the model for each reproductive trait, as well as a component of the non-additive genetic merit or 'Heterosis'. This component of the non-additive genetic merit was fitted in the model in order to estimate the amount by which merit in crossbred piglets deviates from the additive genetic component (Dickerson, 1973; Kinghorn, 1987). These components are shown in Table 4-5.

Each set of covariables accounts for the genetic fingerprint of each piglet. For example a purebred Large White piglet will have a value of 1 for the additive component of the Large White breed (LWa) and a 0 for the additive component of the Landrace breed (LRa), it will also have a value of 1 for the additive maternal component of Large White (LWm) due to its mother being Large White and a 0 for the Landrace additive maternal component (LRm). This piglet being purebred will show no heterosis, so this value will be 0. In comparison, a crossbred piglet from a Large White sow and

a Landrace boar will have a value of 0.5 for each additive component (LWa and LRa); a value of 1 for the Large White additive maternal component (LWm) and a value 0 for the Landrace maternal component (LRm). This piglet will have a value of 1 in the non-additive or heterosis component (Het) showing a 100% direct heterosis.

Table 4-5 Matrix of additive and non-additive components of merit fitted as covariables in the mixed model for estimating the reproductive traits (adapted from Dickerson, 1973; Kinghorn, 1987)

Piglet breed Dam x Sire	LWa	LRa	LWm	LRm	Het
LW x LW	1	0	1	0	0
LR x LR	0	1	0	1	0
LW x LR	0.5	0.5	1	0	1
LR x LW	0.5	0.5	0	1	1

For obtaining an overall mean for each combination of litter breed for the different traits a matrix of estimates obtained from the solutions file of ASREML (Table 4-6) was multiplied by an incidence matrix shown in Table 4-5 with the inclusion of an extra column for the overall mean of that trait.

4.4. Results and Discussion

4.4.1. Direct Piglet Heterosis

4.4.1.1. Entire dataset

The adjusted mean (**μ**) of each trait, the additive component for Large White (**LWa**) and Landrace (**LRa**), as well as the maternal component for Large White (**LWm**) and Landrace (**LRm**) for the analyses done in the entire dataset are shown in Table 4-6. The results are constrained for the fixed

direct and maternal breed effects to sum to zero. These results were obtained from the solutions file (.sln) of ASREML.

Table 4-6 Estimates of the adjusted mean (**μ**), Additive component (**a** suffix) and maternal component (**m** suffix) for the LW and LR breed and Heterosis for each reproductive trait using the entire dataset

	TNB (piglets)	NBA (piglets)	NWea (piglets)	AVBW (grams)	AV21dW (grams)	GL (days)
μ	12.45	11.39	7.97	1532.0	6525.0	115.30
LWa	0.24	0.32	-0.06	-16.9	-27.6	-0.02
LRa	-0.24	-0.32	0.06	16.9	27.6	0.02
LWm	0.14	0.11	0.07	-21.6	-155.7	-0.22
LRm	-0.14	-0.11	-0.07	21.6	155.7	0.22
Heterosis (se)	**-0.02 (0.05)**	**0.07 (0.05)**	**-0.09 (0.07)**	**19.3 (5.9)**	**22.5 (15.0)**	**-0.13 (0.02)**

A non-significant (P>0.05) heterosis estimate was shown for TNB (-0.02), NBA (0.07), NWea (-0.09) and Av21dW (22.5) in Table 4-6. In addition, AvBW and GL had significant (P<0.05) levels of heterosis.

Table 4-7 Litter breed estimates for the entire dataset, with parental and progeny means for reproductive traits.

Litter Breed	TNB (piglets)	NBA (piglets)	NWea (piglets)	AVBW (grams)	AV21dW (grams)	GL (days)
LW x LW	12.83	11.82	7.98	1494	6342	115.1
LR x LR	12.07	10.96	7.96	1571	6708	115.5
Purebred μ	**12.45**	**11.39**	**7.97**	**1532**	**6525**	**115.3**
LW x LR	12.57	11.57	7.95	1530	6392	115.0
LR x LW	12.29	11.35	7.81	1573	6703	115.4
Crossbred μ	**12.43**	**11.46**	**7.88**	**1551**	**6548**	**115.2**

However most of them non-significant (P>0.05), the levels of direct heterosis expressed in percentage of the purebred mean [TNB (-0.2%), NBA (+0.6%), NWea (-1.1%) AvBW (+1.3%), Av21dW (+0.4%) and GL (-0.1%)] were lower than those found in other studies.

A possible explanation for the lower heterosis effect for litter size (TNB and NBA) in this study in comparison to previous studies is the possible non-linear effect of direct heterosis on these traits. Comparing the adjusted means of the purebred litters and crossbred litters observed at Myora Farm's data (Table 4-7) with those presented by Katoele et al. (2002) and Baas et al. (1992) we can observe a considerable higher performance in litter size at Myora Farm compared with the mentioned studies. Katoele (2002) presented raw means for TNB for both purebred lines of 11.20 and 10.26 piglets and Baas et al. (1992) presented least square means for both purebred lines of 10.35 and 11.22 for TNB. Least square means from Myora Farm's data for TNB were 13.06 and 12.32 (approximately 18% higher). The same occurred for NBA in the purebred lines being 10.57 and 9.87 piglets and 10.68 and 9.71 piglets for the mentioned studies while Myora Farm's least square means for NBA were 12.10 and 11.30 (approximately 15% higher).

Using a more extreme example the performances of the Large White and Landrace purebred sows in the study done by Ikeobi (1994) in Nigeria, showed an average litter size in the purebred litters of 8.47 and 8.48 piglets respectively. The reciprocal crosses had on average 9.02 piglets born. These levels of reproductive performance on the purebred lines were 50% lower in the Nigerian study than at Myora Farm.

The difference between the average of the purebred litters and the average of the crossbred litters for the trait AvBW was approximately 19 grams. This means that the average of the crossbred piglets were 1.25% heavier than the average of the purebred litters. This level of heterosis is smaller than the 4.0% level observed by Katoele et al. (2002) for an individual birth weight trial in The Netherlands. In addition, Roehe (1998) found a 70 grams heterosis for individual birth weight. On the other hand the results of this study were much higher than the results obtained by Ikeobi (1994) in a study made in Nigeria, under hot and humid environments where a negative direct heterosis of 2.34% was found.

Gestation length had a significant (P<0.05) negative level of heterosis of -0.13 days. This difference represents a decrease in the gestation length of 0.1 % relative to the purebred mean. Katoele et al. (2002) presented a decrease of 0.24 days from crossbred litters to purebred litters, equivalent to a direct heterosis of -0.2%.

The high influence of cross-fostering and management practices on the trait number of piglets weaned as well as average piglet weight at 21 days might be influencing the estimates of direct heterosis. The absence of heterosis at this level disagrees with the findings of Ikeobi (1994) and Bass (1992) of 2.8 % and 3.7 % respectively.

4.4.1.2. Dataset excluding records from parity 1

A dataset excluding the first parity records was analysed to try to exclude the bias that could be introduced to the dataset due to 97% of the first parity records being crossbred litters. The results obtained showed that there were no significant (P>0.05) differences observed between the analysis with the entire dataset and this one excluding parity 1 for all the traits. However for the trait average piglet birth weight the heterosis increased to 25.2 grams, representing a 1.63 % heterosis with respect to the parental mean. This difference came basically from the slight change (8.71 grams) that occurred in the Large White purebred litters, after removing the first parity records, compared with the changes occurred in the purebred Landrace litters (21.3 grams), LW x LR (22.6 grams) and LR x LW (19.1 grams). Although not significant (P>0.05) the direct heterosis for the gestation length in the entire dataset presented a slight decrease from -0.13 to -0.11 once the 1st parity records were removed.

4.4.2. Inbreeding

4.4.2.1. Inbreeding Coefficient Estimations

The mean inbreeding coefficient (F) values of purebred sows sorted by their year of birth for both breeds are presented in Appendix 1 and are shown graphically in Figure 4-1. The mean F values of

purebred litters are presented in Appendix 2 for both breeds sorted by the year of birth and are shown graphically in Figure 4-2.

The average inbreeding coefficient increased steadily from 0 in 1994 for both breeds to 5.74 and 2.70 in 2003 for Large White and Landrace sows respectively. The difference in population size between breeds is not reflected by a higher inbreeding coefficient in the Landrace breed due to higher importation of animals. The average inbreeding level of Large White sows born in 2003 increased by 1.2%. Landrace sows born in 2003 had a 1.3% increase in average inbreeding coefficient from the ones born the previous year.

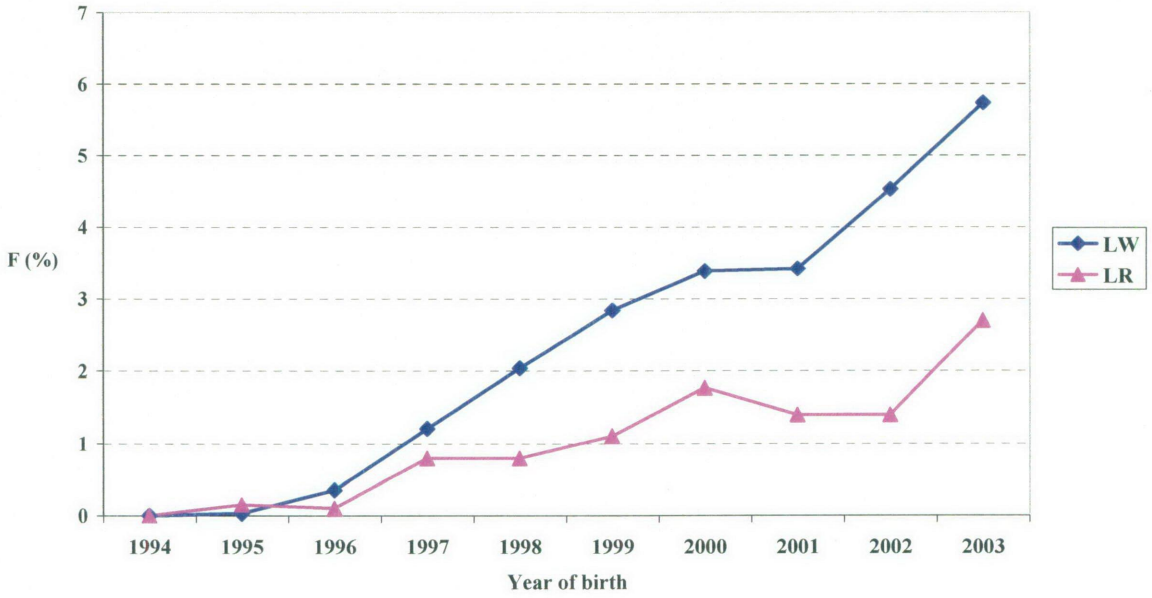

Figure 4-1 Mean inbreeding coefficients (F %) of Large White (LW) and Landrace (LR) sows across year of birth

The mean inbreeding coefficient of litters has increased steadily for Large White litters since 1995. In Landrace litters inbreeding coefficient decreased from 0.8 % in 1995 to 0.2 % in 1996, and then increased the following year to 1.2 %. Since then a slight decrease has occurred with 2003's level being 2.2 %. A considerable increase in the average inbreeding coefficients of the sows and litters for both breeds were observed for the period 2002 – 2003.

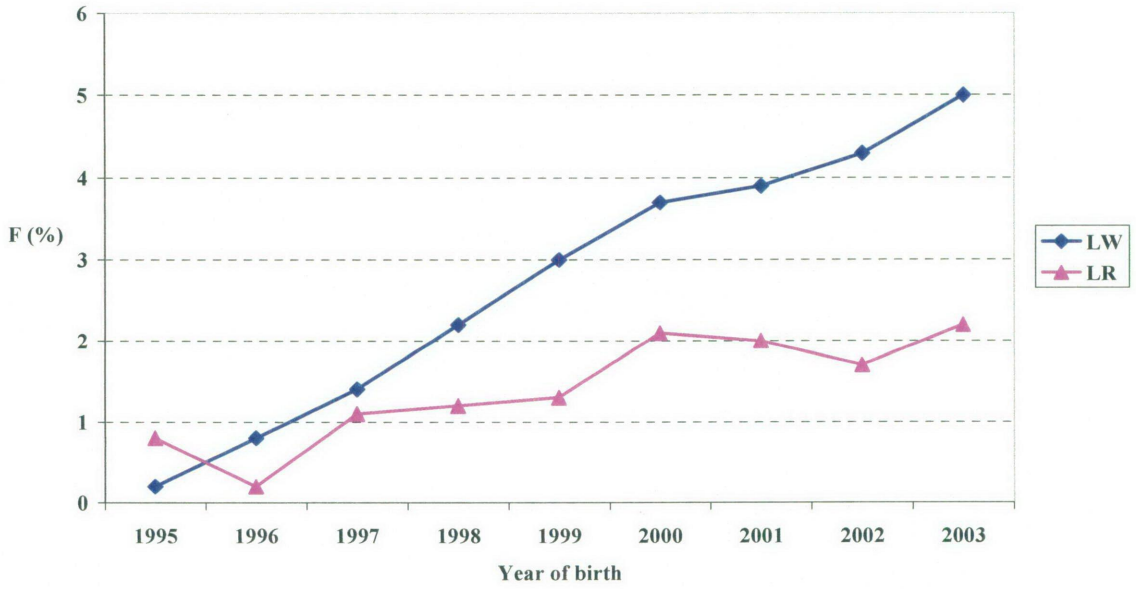

Figure 4-2 Mean inbreeding coefficients (F %) of Large White (LW) and Landrace (LR) litters across year of birth

4.4.2.2. Effects of Inbreeding on Reproductive Performance

In order to analyze the inbreeding coefficients of the sow and litter for the different datasets as class effects, the sows and litters were sorted in 3% ranges for their inbreeding coefficients. Nine levels were created for each class. The frequencies of these classes are shown in Appendix 3 for the Large White breed and in Appendix 4 for the Landrace breed. A high frequency of sows and litters were concentrated in the first two classes (0-3% and 3-6%). These frequencies illustrate the difficulties that will arise trying to analyze the data by fitting the inbreeding coefficients as classes, so it was decided to analyze the data using linear regression.

The effects of inbreeding on the reproductive performance will be presented as regression coefficients (b) of the inbreeding coefficients of the sow and/or the litter on each reproductive trait. For interpreting these regression coefficients (b), we should consider that this will show how much the dependant variable (reproductive trait) will change (in units of the trait) for an increase of 10% in the level of the inbreeding coefficient. In order to describe the effects of the inbreeding in each

reproductive trait, a 10% inbreeding will be considered as a standard for comparisons with other studies.

4.4.2.2.1. Nucleus Herd

The first analysis was made separately for each breed on datasets containing the nucleus herds, with a sow and litter inbreeding record for each litter. The results are shown in Table 4-8 for the Large White breed and in Table 4-9 for the Landrace breed. The average inbreeding of the 3,531 LW sows was 1.4% with a 2.6% standard deviation, and for the 2,821 LR sows it was 0.5% with a 1.5% standard deviation. The average litter inbreeding of the LW herd was 2.9 % with a standard deviation of 3.5 % while for the LR herd it was 1.5% with a standard deviation of 2.9%. It is clear that the LW nucleus herd is more inbred than the LR nucleus herd.

In LW, a reduction of 0.46 NBA was observed for each increase of 10% in the inbreeding coefficient of the sow; a reduction of 0.20 NBA was observed for the LR sows. The inbreeding of the litter decreased NBA by 0.16 and 0.15 piglets for LW and LR respectively.

Table 4-8 Number of litters (N), regression coefficient (b) of the sow and litter inbreeding coefficient (F) on the reproductive traits, and the adjusted mean (μ) of the trait for the nucleus of the Large White breed with standard errors in brackets

	Large White				
	Units	**N**	**μ**	**b of Sow F**	**B of Litter F**
NBA	Piglets	3,531	12.62 (0.31)	-0.46 (0.3)	-0.16 (0.2)
TNB	Piglets	3,531	13.95 (0.33)	-0.49 (0.3)	-0.09 (0.2)
NWea	piglets	3,531	7.86 (0.38)	-0.58 (0.3)	-0.39 (0.2)
Av21dW	Grams	2,878	6512.5 (96.1)	-65.6 (85.3)	-8.4 (53.0)
AvBW	Grams	1,681	1445.4 (55.7)	6.4 (27.9)	-19.7 (18.1)
GL	Days	3,527	115.17 (0.13)	-0.02 (0.2)	0.04 (0.1)

(b) is the regression coefficient of regressing the trait on the inbreeding level x 10 (F)

These results are in line with the review by (Rothschild and Bidanel, 1998) where they found a decrease of 0.4 of a piglet for a 10% increase in the inbreeding of the sow and a 0.29 of a piglet for an increase in the inbreeding of the litter. Culbertson (1998) and Falconer (1981) found similar results. However these results do not agree with Katoele et al. (2002) and Brandt et al. (2002) who found no effect on NBA for the inbreeding of the sow.

In the nucleus herd of the Landrace breed a significant decrease in Av21dW was observed for a 10% inbreeding level of the sow (412 grams) and of the litter (135 grams). These differences were 66 and 8 grams in the nucleus of the Large White breed. Rothschild and Bidanel (1998) reported in their review of 6 studies a decrease of 2,180 grams for the entire litter weight at 21 days for a 10% increase in the sow inbreeding and 1,720 grams for a 10% increase in the litter inbreeding. Estimates of the inbreeding depression from this review varied, starting at 4,330 grams for sow inbreeding and at 3,350 grams for the litter inbreeding, for the entire litter weight at 21 days.

A 10% inbreeding of the litter will increase the gestation length by 0.14 of a day. Inbred piglets will also be lighter and this will delay the occurrence of farrowing, prolonging the gestation length for a few hours.

Table 4-9 Number of litters (N), regression coefficient (b) of the sow and litter inbreeding coefficient (F) on the reproductive traits, and the adjusted mean (μ) of the trait for the nucleus of the Landrace breed with standard errors in brackets

	Landrace				
	Units	**N**	**μ**	**b of Sow F**	**b of Litter F**
NBA	Piglets	2,821	11.53 (0.29)	-0.20 (0.4)	-0.15 (0.2)
TNB	Piglets	2,821	12.96 (0.31)	-0.29 (0.5)	-0.23 (0.2)
NWea	Piglets	2,821	8.26 (0.39)	-0.30 (0.5)	-0.43 (0.3)
Av21dW	Grams	2,248	6860.8 (81.3)	-412.2 (124.2)	-135.2 (59.0)
AvBW	Grams	1,447	1577.5 (48.2)	-35.4 (53.9)	-12.1 (25.3)
GL	Days	2,817	115.53 (0.14)	-0.14 (0.2)	0.14 (0.1)

(b) represents the regression coefficient of the inbreeding level (F) x 10 on the reproductive trait

4.4.2.2.2. Multiplier Herd

The second analysis was based on the multiplier herd of each breed. The results are shown in Table 4-10 for the Large White breed and in Table 4-11 for the Landrace breed. Only sow inbreeding levels were used, due to litters being 100% crossbred.

The average sow inbreeding of the Large White multiplier herd was 1.81 % with a 2.86 % standard deviation, and for the Landrace multiplier herd it was 1.04 % with a 2.25 % standard deviation. Sows with more than one litter will have more than one record.

There is a decline of 0.25 of a piglet in the NBA and 0.36 of a piglet decline in the TNB for an increase of 10% in the inbreeding level in the Large White breed. This represented a non-significant (P>0.05) difference from what occurred in the nucleus herd due to the size of the standard errors. However, a smaller inbreeding depression was observed for the Large White sows and a considerable decrease occurred in the Landrace sows of 0.71 NBA for a 10% increase in the sow inbreeding.

Table 4-10 Number of litters (N), regression coefficient (b) of the sow inbreeding coefficient (F) on the reproductive traits, and the adjusted mean (μ) of the trait for the multiplier herd of the Large White breed with standard errors in brackets

		Large White		
	Units	**N**	**μ**	**b of Sow F**
NBA	Piglets	7,500	11.5 (0.2)	-0.25 (0.2)
TNB	Piglets	7,500	12.42 (0.2)	-0.36 (0.2)
NWea	Piglets	7,500	7.99 (0.24)	-0.27 (0.2)
Av21dW	Grams	6,084	6428.8 (56)	-125.4 (53.0)
AvBW	Grams	3,649	1533.6 (50)	2.8 (18.6)
GL	Days	7,494	115.1 (0.1)	0.05 (0.1)

(b) represents the regression coefficient of the inbreeding level (F) x 10 on the reproductive trait

The average piglet weight at 21 days was reduced by 125 grams in Large White and 190 grams in Landrace for a 10% increase in inbreeding levels. This represents a decline of 2% in Large White and 2.8% in Landrace compared to the overall mean. These results are in line with the 1.2% and 3.6% decline obtained by Silio et al. (1994) in different lines of Iberian pigs.

Table 4-11 Number of litters (N), regression coefficient (b) of the sow inbreeding coefficient (F) on the reproductive traits, and the adjusted mean (μ) of the trait for the multiplier herd of the Landrace breed with standard errors in brackets

		Landrace		
	Units	**N**	**μ**	**b of Sow F**
NBA	Piglets	4,472	10.93 (0.2)	-0.71 (0.2)
TNB	Piglets	4,472	11.88 (0.2)	-0.61 (0.2)
NWea	Piglets	4,472	7.55 (0.3)	-0.37 (0.3)
Av21dW	Grams	3,577	6,629 (63)	-185.2 (66.4)
AvBW	Grams	2,707	1,625 (32)	-20.5 (25.1)
GL	Days	4,466	115.1 (0.1)	0.1 (0.1)

(b) represents the regression coefficient of the inbreeding level (F) x 10 on the reproductive trait

Inbreeding levels of the sow or the litter did not affect average birth weight and gestation length significantly ($P>0.05$). No significant ($P>0.05$) differences were obtained between sows at the multiplier and the nucleus analysis either.

4.4.2.2.3. Multiplier herd excluding parity one

After excluding parity one from the dataset containing the multiplier herd information, a new analysis was run and the results are presented in Table 4-12 and Table 4-13 for Large White and Landrace respectively.

The average sow inbreeding for the Large White multiplier decreased significantly ($P<0.05$) to 1.69% with 2.76% standard deviation after excluding the first parity records from the dataset; the

average inbreeding coefficient of the sow increased slightly to 1.05 % on the Landrace multiplier with a 2.27 % standard deviation.

Table 4-12 Number of litters (N), regression coefficient (b) of the sow inbreeding coefficient (F) on the reproductive trait, and adjusted average (μ) for the Large White multiplier excluding parity one, with standard errors in brackets

		Large White		
	Units	**N**	**μ**	**b of Sow F**
NBA	Piglets	4,918	11.85 (0.24)	-0.11 (0.2)
TNB	Piglets	4,918	12.82 (0.26)	-0.25 (0.3)
NWea	Piglets	4,918	8.07 (0.3)	-0.36 (0.3)
Av21dW	Grams	3,992	6,613 (69)	-100.1 (66.3)
AvBW	Grams	2,564	1,573 (61)	9.9 (22.8)
GL	Days	4,914	115.1 (0.1)	-0.10 (0.1)

(b) represents the regression coefficient of the inbreeding level (F) x 10 on the reproductive trait

A non significant (P>0.05) increase was observed for the Large White multiplier herd, after excluding parity one, in the adjusted mean for NBA (0.35 of a piglet), TNB (0.4 of a piglet), NWea (0.08 of a piglet) and AvBW (39 grams). Similarly a non significant (P>0.05) increase was observed for the Landrace breed with 0.39 NBA, 0.41 TNB, 0.09 NWea, 22 grams in AvBW and 0.5 of a day in GL. In contrast, a significant (P<0.05) difference was observed between the overall mean of the trait Av21dW at the multiplier with and without the first parity records; increasing in the latter 184 grams for the Large White and 314 grams for the Landrace sows.

No significant differences were obtained in the regression coefficients after excluding the first parity records, from the multiplier herds in both breeds. However the magnitude of the inbreeding depression for litter size decreased in this analysis for both breeds.

Table 4-13 Number of litters (N), Regression coefficient (b) of the Inbreeding coefficient (F) on the reproductive trait, and adjusted average (μ) for the Landrace multiplier excluding parity one

	Landrace			
	Units	**N**	**μ**	**b of Sow F**
NBA	Piglets	2,775	11.32 (0.31)	-0.59 (0.3)
TNB	Piglets	2,775	12.29 (0.32)	-0.37 (0.3)
NWea	Piglets	2,775	7.46 (0.41)	-0.16 (0.3)
Av21dW	Grams	2,240	6,943 (81)	-218.5 (77.0)
AvBW	Grams	1,818	1,647 (41.2)	-43.6 (32.0)
GL	Days	2,770	115.6 (0.13)	0.12 (0.2)

(b) represents the regression coefficient of the inbreeding level (F) x 10 on the reproductive trait

4.5. Discussion and Conclusions

The higher prolificacy of the purebred Large White lines compared to the Landrace lines is apparent from Tables 4-3 and 4-4. In contrast, Landrace had better average piglet weights at birth and at 21 days, as well as higher number of piglets weaned showing the maternal ability of the Landrace line in comparison to the Large White line.

The sows used for purebred matings (nucleus sows) had higher prolificacy than the sows used for crossbred matings (multiplier sows), showing that the sows at the nucleus have higher selection differential for litter size than the sows at the multiplier. This can be observed by comparing the adjusted means of Table 4-8 to Table 4-11. Adding to this, gilts are almost all (97%) allocated to the multiplier in their first parity. This high proportion of first parity sows, which have inferior performance than multiparous sows, in the multiplier has increased the difference observed between the nucleus and the multiplier. This can be observed in Table 4-4 comparing the mean value for NBA for parities two and three. In addition, parity two had a significant ($P>0.05$) increase from crossbred to purebred mating and no significant ($P>0.05$) difference in parity three.

Landrace sows have a higher maternal ability, reflected in the better performance for traits such as NWea and Av21dW. These traits reflect a combination of maternal ability, piglet performance and cross-fostering practices. Assuming that the cross-fostering practices are exactly the same for Large White and Landrace sows and for the nucleus and multiplier sows, comparing these traits between breeds and herds is a useful way to differentiate maternal ability and piglet performance.

A significantly ($P<0.05$) higher litter size at weaning was observed for Landrace and Large White sows with crossbred litters, than with purebred litters, 0.18 and 0.14 of a piglet respectively. In contrast, a significant decrease in Av21dW was observed for both breeds at the multiplier level, compared with the nucleus herds. In summary, there is an indication that sows with crossbred litters tend to wean more piglets than sows with purebred litters. The decrease in Av21dW might be an indication of the negative correlation that exists between this trait and NWea.

Direct piglet heterosis did not have an influence on reproductive performance at the multiplier level at Myora Farm. However, a small increase in the AvBW and a slight shortening of the GL were observed. The expression of AvBW heterosis was driven by a higher performance of the Large White sow, Landrace boar combination.

The lack of direct heterosis in litter size could be the consequence of the performance levels of the purebred lines at Myora Farm. At such high levels of performance 13.77 and 12.85 for TNB in Large White and Landrace nucleus' sows respectively with 12.52 and 11.44 of those piglets born alive, an increase in performance after mating the sows with a reciprocal breed boar is not occurring. This could be due to sows used at the nucleus level that have been selected for their higher genetic merit for litter size than their multiplier's counterparts, hence their performance is much higher. With such high levels of litter size observed at Myora Farm, direct heterosis might not be expressed. There was an indication of this with Myora Farm's dataset. A separate analysis was done sorting the extremes of the data regarding their litter size (NBA) in three groups, with litters smaller than 9 in one group, litters larger than 9 and smaller than 14 in another group, and a third group with litters larger than 14. These three groups were compared and descendant levels of heterosis were expressed in the three groups; however the effects were non-significant ($P>0.05$).

Inbreeding levels for litter size, birth weight and gestation length were in agreement with the majority of earlier published results. On the other hand traits measured at 21days post-farrowing and hence influenced by cross-fostering, were not in line with previous studies. A high level of inbreeding depression was observed for the trait Av21dW particularly for the inbreeding of the Landrace sow as well as for the inbreeding of the litter.

Inbreeding, in addition to selection, is a tool that the animal breeder may use for the improvement of farm animals (Rönningen, 1977). Restrictions placed on selection decisions based on the inbreeding of the possible litter should consider that production largely occurred at the crossbred level. Acknowledging this issue will avoid any unnecessary reduction in the rate of genetic response caused by the excessive caution placed when mating related individuals. In large populations, inbreeding depression seems to be less important then previously indicated (Gama and Smith, 1993).

In this study the inbreeding levels of the sows from the maternal lines were very low at the nucleus as well as at the multiplier herds in both breeds. In addition there is no direct piglet heterosis in traits such as NBA, TNB and NWea and very small levels in traits such as AvBW, AvWW and GL. It was shown by Falconer (1981) that inbreeding can increase the difference in gene frequency between two lines and, as such, increases the heterosis at the crossbred generation.

Further studies need to be done in order to determine if F1 sows, from highly inbred parents express maternal heterosis and hence improve their reproductive performance. If that is the case increasing levels of inbreeding will contribute in the short term to increase the production at the commercial level, where the majority of the sows are performing.