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PHENOTYPIC AND GENETIC ASPECTS OF PRODUCTION IN THE DOHNE MERINO
1. THE INFLUENCE OF NON-GENETIC FACTORS ON PRODUCTION TRAITS*

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OPSOMMING: FENOTIPIESE- EN GENETIESE ASPEKTE VAN PRODUKSIE BY DIE DOHNEMERINO
1. DIE INVLOED VAN NIE-GENETIESE FAKTORE OF PRODUKSIE-EIENSKAPPE

Waarnemings ten opsigte van 5 produksie-eienskappe van 4 000 indiwidue is uit die teelprogram van die Dohnemerino benut vir die berekening van korreksiefaktore vir die invloed van ooi-ouderdom, geboortestatus en geslag op 5 produksie-eienskappe. Vir die beraming van korreksiefaktore is 'n matematiese model op die data gepas volgens die metode van kleinste-kwadrate-variansie-analise.

Die 3 nie-genetiese faktore het die liggaamsmassa by geboorte, 100 dae, 12- en 18-maande ouderdom betekenisvol ($P \leqslant 0,01$) beïnvloed. Ten opsigte van 18-maande rouvagmassa het slegs geboortestatus en geslag 'n betekenisvolle ($P \leqslant 0,01$) invloed gehad. By liggaamsmassakenmerke van die lam, het die grootte van die korreksiefaktore vir ooi-ouderdom en geboortestatus afgeneem met 'n toename in ouderdom. Daarenteen het die korreksiefaktor vir geslag toegeneem met toename in ouderdom. Die omvang van die korreksiefaktore vir die 3 omgewingsfaktore was relatief kleiner vir die 18-maande rouvagmassa as vir liggaamsmassa. Vir meer akkurate seleksie is dit wenslik dat gekorrigeer word vir geboortestatus gevolg deur ooi-ouderdom en dat vir al 3 omgewingsfaktore by die beraming van genetiese parameters gekorrigeer word.

SUMMARY

Observations of 5 production traits on 4 000 individuals in the Dohne Merino Development Programme were used to estimate correction factors for the influence of age of dam, type of birth (single or twin) and sex of lamb on 5 traits. Estimates were based on a mathematical model fitted to the data and analysed by least-squares analysis of variance for data with unequal subclass numbers.

All 3 non-genetic factors had a significant ($P \leqslant 0,01$) influence on body mass at birth, 100 days, and at 12 and 18 months of age. Only type of birth and sex of lamb had a significant influence ($P \leqslant 0,01$) on greasy fleece mass at 18 months of age. Age of dam and type of birth had a diminishing influence on body mass traits as the lambs grew older. The influence of sex of lamb on body mass increased with increase in age. The magnitude of the correction factors for the influence of the 3 non-genetic factors on greasy fleece mass at 18 months of age, was relatively smaller than for their influence on body mass traits. For more accurate selection it is recommended that measurements on body mass and wool production, in growing Dohne Merino sheep, should firstly be corrected for differences in type of birth and then for differences in age of dam. However, data utilised for the estimation of genetic parameters should be corrected also for the influence of sex of lamb on the production traits studied.

The phenotype of animals is the result of their genetic potential as influenced by environmental factors. Therefore, to increase the accuracy of selection it is imperative that any non-genetic factors reducing the correlation between the genotype and phenotype of animals be identified and corrected for by suitable correction factors. Cardillino & Frahm (1971) stressed the fact that environmental factors causing differences between individuals within the same flock, are the most important in this respect. However, the influence of environmental factors cannot be always defined very clearly.

Turner & Young (1969) expressed the opinion that the applicability of correction factors for non-genetic influences depends on the breeder's specific situation. In some cases the farming situation is such that the lambs subjected to the different environmental factors can be easily identified, while in other cases it is not. Furthermore, correction factors can be of practical value only if they are easy and simple to apply (Lax & Brown, 1967). Interactions between environmental

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factors complicate the estimation of correction factors to a considerable extent and should be omitted from the analyses whenever sound reasoning indicates that their influence on phenotypic differences is small (Turner & Young, 1969).

Van der Merwe (1976) considers year of birth, age of dam, type of birth and sex of lamb to be the 4 most important non-genetic factors in sheep. According to Heydenrych (1975) the omission of year of birth and sex of lamb is justified as only lambs born in the same year are normally compared, while differences between the sexes are irrelevant in selection. At a very early stage in the development of correction factors, Warwick (1958) concluded that the size of correction factors may differ from herd to herd in the same breed of cattle. Correction factors for non-genetic factors have not to date been estimated for, or been included in breeding plans for the South African developed Dohne Merino sheep. Therefore, the estimation of the applicable correction factors in Dohne Merino sheep is an important step towards the refinement of the breeding policy for the breed. This breed was developed mainly for semi-intensive grassland farming. For this purpose S.A. Mutton Merino rams were crossed with Merino ewes with *inter se* matings of the subsequent generations. From 1939 onwards, these crossings were made mainly for the purpose of fat lamb production. The major thrust in the development of the breed occurred from 1946 onwards (Kotzé, 1951). In the development programme at the Dohne experimental farm approximately 15 rams and 300 ewes were used.

Procedure

Production data covering the period from 1955 to 1976 were used for this investigation. These data were extracted from the Dohne Merino Development Programme undertaken at the Dohne Research Institute, Stutterheim. Observations included in the data were body mass at birth, 100 days, and at 12 and 18 months of age as well as greasy fleece mass at 18 months of age. The environmental factors studied were age of dam, type of birth (single or twin) and sex of lamb. The data were analysed by least-squares variance analyses techniques for data with unequal subclass numbers, as developed by Harvey (1960).

Results and discussion

The correction factors for the effects of age of ewe, type of birth and sex on the production traits studied, are given in Table 1. The correction factors are expressed as deviations from the mean in both absolute and relative terms. To make a correction for a specific environmental influence, the sign of the correction factor concerned, is changed and the result added to the measured phenotypic value of the specific production trait of the individual.

In the present study birth mass increased with age of dam up to an age of 7 years. Lambs from 2 year old ewes were 0,32 kg lighter and those from 7 years old ewes 0,47 kg heavier than average. This pattern of change in birth mass with age is in agreement with the results obtained with other breeds. Vosloo (1967) demonstrated an increase in birth mass up to an age of 4 years in S.A. Mutton Merino ewes, Chopra & Acharya (1971) up to 5 years in Bikaneri ewes, Heydenrych (1975) and Van der Merwe (1976) up to 6 years of age in Merino and Dormer ewes, respectively. The necessity for correcting the birth mass of their lambs, in the evaluation of ewes, is obvious.

Single lambs had a 0,98 kg higher birth mass than twins. This was in agreement with the findings of Vosloo (1976) and Heydenrych (1975). At this stage, however, the influence of sex was considerably smaller than that of type of birth. The superiority of ram lambs being only 0,26 kg. On the other hand, Vosloo (1967) found ram lambs of the S.A. Mutton Merino to be 0,45 kg heavier at birth than ewe lambs, while the difference of 0,24 kg found by Heydenrych (1965) in Merino sheep, compared very well with the present result. Therefore, it appears that the Dohne Merino resembles the Merino in this respect, if it is assumed that the environments in which these 2 studies were undertaken are comparable.

The ewe's age influences not only the birth mass of her lamb, but also its post-natal growth. The 100 day body mass of lambs from 2 year old ewes was 0,78 kg lower and lambs from 6 year old ewes 0,48 kg heavier than average (Table 1). This was in agreement with the results of other workers who showed that maximum growth rate is obtained with lambs from 5 to 6 year old ewes (Smith & Lidvall, 1964; Trail & Sacker, 1966).

At 100 days of age single lambs outweighed twins by 2,64 kg. This difference is of the same magnitude as that found by Heydenrych (1975) for Merinos. Blackwell & Henderson (1955) and Campbell (1962) also reported on the considerable influence of type of birth at this stage of development.

Ram lambs were 1,98 kg heavier than ewe lambs at a 100 days of age. The influence of sex increased very rapidly up to 100 days of age. Most probably this phenomenon can be explained by the increasing secretion of testosterone by the growing ram lambs.

The obvious environmental factors which cause non-genetic differences between sheep at 12 and 18 months of age, i.e. age of dam, type of birth and sex, have been investigated by several workers (Veseley & Peters, 1964; Vosloo, 1967; Turner & Young, 1969; Heydenrych, 1975; Van der Merwe, 1976). As one or the other of these ages is an important stage for selection in practice, it is of interest to compare the present results for the Dohne Merino with that of the 2 parental breeds.

Single born sheep were 2,04 and 1,92 kg heavier than twins at 12 and 18 months of age respectively (Table 1). Turner & Young (1969), working with Merino sheep,

Table 1

The influence of age of dam, type of birth and difference in sex on 5 production traits expressed in absolute (correction factors) and relative terms

Non-genetic factor	Production trait									
	Birth mass		100 day body mass		12 month body mass		18 month body mass		18 month grease fleece mass	
	kg	%	kg	%	kg	%	kg	%	kg	%
Average	4,52	100	24,48	100	49,17	100	55,44	100	4,37	100
Age of dam:	**		**		**		**			
2 years	−0,32	−7,07	−0,78	−3,17	−1,27	−2,69	−1,30	−2,34	−0,14	−3,20
3 years	−0,12	−2,65	0,18	0,73	0,28	0,59	0,55	0,99	−0,02	−0,45
4 years	0,04	0,88	0,16	0,65	0,05	0,01	0,35	0,63	0,01	0,23
5 years	0,09	1,99	0,39	1,59	−0,47	−0,99	−0,39	−0,70	0,00	0,00
6 years	0,14	3,09	0,48	1,95	0,19	0,40	0,06	0,11	0,02	0,45
7 years	0,47	10,39	0,11	0,45	−0,21	−0,44	−1,00	−1,80	−0,06	−1,37
8 years	−0,01	−0,22	−0,29	−1,18	0,38	0,81	0,07	0,11	0,04	0,91
9 years	0,12	2,65	−0,25	−1,02	1,14	2,42	1,67	3,01	0,16	3,66
Type of birth:	**		**		**		**		**	
Single	0,49	10,84	1,32	5,37	1,02	2,16	0,96	1,73	0,09	2,06
Twin	−0,49	−10,84	−1,32	−5,37	−1,02	−2,16	−0,96	−1,73	−0,09	−2,06
Sex of lamb:	**		**		**		**		**	
Ram	0,13	2,87	0,99	4,03	4,08	8,64	6,12	11,03	0,15	3,43
Ewe	−0,13	−2,87	−0,99	−4,03	−4,08	−8,64	−6,12	−11,03	−0,15	−3,43

Significance: ** $P \leqslant 0,01$

found differences of 1,09 and 2,73 kg between singles and twins at 12 and 16 months of age respectively. Vosloo (1967) and Heydenrych (1975) demonstrated differences of 1,23 and 1,42 kg for S.A. Mutton Merino and Merinos respectively, at 18 months of age. According to Turner & Young (1969) age of dam has a smaller influence on 12 and 16 month body mass than type of birth. Furthermore, Heydenrych (1975) found the influence of age of dam on the 18-month body mass of her lamb to be insignificant. In the present study the progeny of 2 year old ewes had a 1.27 and 1,30 kg lower body mass than the average at 12 and 18 months of age, respectively. The differences for lambs from ewes of the other age groups were considerably smaller. However, they were still significant ($P \leqslant 0,01$). This is in contrast with the results for Merino sheep (Heydenrych, 1975).

The effect of difference in sex is of no consequence in the practical selection of young sheep based on their own performance. However, it may be of importance in nutritional studies where the sexes are to be compared. Ram lambs outweighed ewe lambs by 8,16 and 12,24 kg at 12 and 18 months of age, respectively. Of the non-genetic factors investigated, difference in sex made the largest contribution to the variance in body mass at these 2 ages.

As far as greasy fleece mass at 18 months of age is concerned, only type of birth had a significant effect ($P \leqslant 0,01$). The difference between single and twin born lambs was 0,18 kg of greasy wool in this study compared to a difference of 0,42 kg in Merino sheep (Heydenrych, 1975). Lax & Brown (1967) pointed out that the differences between singles and twins tended to increase with an improvement in environmental conditions. This might explain the large difference for Merinos demonstrated by Heydenrych (1975) in the South Western Districts.

Conclusions

Should weaning mass (at 100 days of age) be considered as a future selection criterion for Dohne Merino sheep, observations will have to be corrected, firstly, for type of birth and secondly, for age of dam. If selection of breeding ewes for increased milk production is based on the growth rate or the weaning mass of their lambs, correction for the sex of the lambs will also be necessary. Selection based on the 12 or 18 month body mass of Dohne Merino sheep will require corrections for type of birth and age of dam. With regard to greasy fleece mass at 18 months of age, correction for type of birth only will be necessary.

For increased accuracy in the estimation of genetic parameters for this newly developed sheep breed, corrections for all 3 non-genetic factors are suggested.

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