

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

STUDIES OF THE FLOCK MATING PERFORMANCE
OF
BOORoola MERINO CROSSBRED RAM LAMBS,
AND THE
FOOT "CONDITIONS" IN BOORoola MERINO CROSSBREDS
AND
PERENDALE SHEEP
GRAZED ON HILL COUNTRY

A THESIS PRESENTED IN PARTIAL
FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF AGRICULTURAL SCIENCE
IN ANIMAL SCIENCE AT
MASSEY UNIVERSITY

MOHAMMED TAHA ALWAN
1983
MASSEY UNIVERSITY
PALMERSTON NORTH, NEW ZEALAND

62380-68

MASSEY UNIVERSITY

- 1.* (a) I give permission for my thesis, entitled
"STUDIES OF THE FLOCK MATING PERFORMANCE OF BOORoola MERINO
CROSSBRED RAM LAMBS, AND THE FOOT "CONDITIONS" IN BOORoola
MERINO CROSSBREDS AND PERENDALE SHEEP GRAZED ON HILL COUNTRY"
to be made available to readers in the Library under the conditions
determined by the Librarian.
- (b) I agree to my thesis, if asked for by another institution, being sent
away on temporary loan under conditions determined by the Librarian.
- (c) I also agree that my thesis may be copied for Library use.

2. * ~~I do not wish my thesis, entitled~~
~~.....~~
~~.....~~
~~.....~~
~~to be made available to readers or to be sent to other institutions~~
~~without my written consent within the next two years.~~

Signed MTA
Date 1/2-1982

* Strike out the sentence or phrase which does not apply.

The Library
Massey University
Palmerston North, N.Z.

The copyright of this thesis belongs to the author. Readers must sign their name in
the space below to show that they recognise this. They are asked to add their
permanent address.

Name and Address	Date
.....	
.....	
.....	
.....	
.....	

ABSTRACT

Two studies using the Booroola Merino crossbred animals were conducted. In the first, the flock mating performance of Booroola Merino-Romney crossbred ram lambs mated to Perendale ewes was examined. The second study comprised observations on the incidence of foot "conditions" in young Booroola Merino crossbreds and Perendale sheep grazed on hill country.

MATING PERFORMANCE

Eighteen Booroola Merino x Romney ram lambs^b (6 control, 12 mating group) were selected according to weaning weight, fleece characteristics and general body condition. Nine ram lambs were exposed to ewes prior to mating for two weeks (trained) and nine kept separate from any ewes (untrained). The ram lambs of the mating group (6 trained, 6 untrained) were allocated to six groups of ewes which were "single-sire" mated. Groups 1, 2, 3, 4 comprised 140 ewes each and Groups 5 and 6 comprised 100 ewes each. The ram lambs were changed after eight, eight, seven and seven days of mating, Periods P₁, P₂, P₃ and P₄ respectively, and a total of 12 "single-sire" mating groups generated. All ram lambs produced a satisfactory semen sample before joining with the flocks. Mating commenced on 30 March 1981.

The flock mating performance of each ram lamb was assessed by recording the percentage of ewes raddled, percentage of ewes returning to service, percentage of pregnant ewes, percentage of ewes lambing, docking rate and weaning rate. Differences among each of these parameters were attributed to various factors. Trained and un-

trained ram lambs were similar in most of the observed parameters of flock mating performance. There were no differences between individual ram lambs within each sire-group (trained or untrained) in mating performance. There were differences in the percentage of ewes raddled between first and second oestrous cycle of mating ($P < 0.001$).

Live weights of the ram lambs were measured from weaning (December 1980) until the end of the trial (December 1981), at weekly intervals during the mating periods and at monthly intervals during the post-mating and post-shearing periods. There was little loss in the mean live weight of the mating group ram lambs after P_1 . Overall the live weights of both groups increased consistently throughout the trial.

Semen samples (collected by electro-ejaculation) from the ram lambs of the mating group were microscopically examined for general motility after each mating period at least for three days. Recovery from mating exhaustion occurred four and six days after P_1 and P_2 respectively, while three and two days were required after P_3 and P_4 respectively.

Semen samples were also collected on two occasions from the rams (only 15) as two-tooths and examined for general motility, sperm concentration and percentage of live sperm. There were no differences in semen characteristics between rams of the mated and control groups.

The two-tooth rams were also subjected individually and randomly

on three occasions to pen-libido tests, each with two oestrous ewes. Mating ability was assessed by recording the number of mounts attempted on the oestrous ewes, the number of services, the reaction time to mount (in seconds) and the reaction time to service. There were no differences between the mating and control groups in the number of mounts and number of services performed on each occasion of the libido test. Significant differences were found between both groups in reaction time to mount ($P < 0.01$) and in reaction time to service ($P < 0.05$) but only at the first libido test.

It was concluded that the Booroola Merino x Romney ram lambs had achieved satisfactory levels of flock mating performance under the conditions of the trial. No adverse effects of mating on the post-mating body development of the ram lamb could be detected. Semen quality from the ram lambs deteriorated during mating but recovered shortly after mating. The use of ram lambs as sires had no adverse effects on their semen characteristics and libido performance at the two-tooth age.

FOOT "CONDITIONS"

The incidence of abnormal foot shape, foot scald and footrot was observed in Perendale and Booroola Merino crossbreds. The animals were generated in 1980 and 1981. Observations on foot "conditions" were made at the lamb, hogget and two-tooth ages for animals born in 1980, and at the lamb and hogget ages for those born in 1981. A scoring system was used to rank the various foot "conditions" (shape; scald; footrot) which were assessed separately.

Booroola Merino crossbreds showed significantly a higher incidence of abnormal foot shape, foot scald and footrot than did Perendale sheep. Significant differences in foot "conditions" were also found between (Booroola x Romney) x Perendale and Booroola x Romney sheep. Sires of the progeny generated in 1980 and 1981 provided a major source for the variation in the incidence of these foot "conditions".

Estimates of heritability of each of the observed foot "conditions" were calculated at different ages (lamb, hogget and two-tooth).

Sex of the lamb caused significant effects on the incidence of abnormal foot shape ($P < 0.05$) and foot scald ($P < 0.001$) between ram lambs and ewe lambs, but not on the incidence of footrot.

Differences in the incidence of abnormal foot shape and foot scald occurred between 1980- and 1981-born sheep. These differences were attributed partly to the particular climatic conditions in each year (notably the annual rainfall).

It was concluded that under environmental conditions similar to that of the present trial, long-term selection programmes could be applied to enhance the natural resistance of sheep against foot diseases.

ACKNOWLEDGEMENTS

I would like to acknowledge my gratitude to my supervisor Dr M.F. McDonald, Animal Science Department, Massey University, who suggested some of the aspects included in this study and offered guidance and criticism during the course of the study and writing of the manuscript.

Special thanks are due to staff of the Animal Science Department, particularly Dr G.A. Wickham for his valuable advice and discussion.

I am indebted to my fellow graduate student Mr A.R. Gilmour, who offered very useful assistance for the statistical analyses.

Acknowledgement is made also to Messrs M.G. Divehall, M. Wycherley, B. Thatcher and W.R. Fairhall for their skilled technical assistance, and to Mr A.L. Harwood (Tuapaka Sheep Farm) for his co-operation.

I am grateful to the Government of IRAQ for financial assistance and support.

Finally, I would like to thank Mrs E.V. Oram for her skilful and careful typing of this manuscript.

MOHAMMED TAHA ALWAN

TABLE OF CONTENTS

	<u>PAGE</u>
ABSTRACT	ii
ACKNOWLEDGEMENTS	vi
LIST OF TABLES	xiv
LIST OF FIGURES	xvii
LIST OF PLATES	xix
LIST OF APPENDICES	xx
CHAPTER ONE	
GENERAL INTRODUCTION	1
SECTION I	
A STUDY OF THE FLOCK MATING PERFORMANCE OF BOORoola MERINO CROSSBRED RAM LAMBS	
CHAPTER TWO	
REVIEW OF LITERATURE	4
A - PUBERTY IN THE RAM LAMB	4
1 - Introduction	4
2 - Anatomical Changes	5
3 - Factors Affecting the Attainment of Puberty	7
(a) Age and body weight	8
(b) Genetic	11
(c) Nutrition	12
(d) Date of Birth	14
(e) Daylight and temperature	15
4 - Semen Production	16
5 - Mating Behaviour	17
6 - Use of Ram Lambs as Sires	19

TABLE OF CONTENTS (CONTD)

	<u>PAGE</u>
B - LIBIDO AND MATING PERFORMANCE	21
1 - Introduction	21
2 - Hormonal Control of Male Sexual Activity	22
3 - Measurement of Mating Ability of Rams	24
4 - Factors Affecting Mating Ability	24
(a) Genetic	24
(b) Nutrition	26
(c) Season	27
(d) Social ranking	28
(e) Early rearing management	29
(f) Senses	30
(g) Hormonal	31
(h) Other factors	32
5 - Mating Efficiency of Rams	34
C - SEMEN PRODUCTION AND EVALUATION	38
1 - Semen Production and Testes Measurements	38
2 - Semen Evaluation	40
3 - Factors Affecting the Quantity and Quality of Semen	42
(a) Genetic	42
(b) Age of the ram	43
(c) Nutrition	43
(d) Season	44
(e) Frequency of ejaculation	46
CHAPTER THREE	
MATERIALS AND METHODS	48
A - TUAPAKA FARM	48
B - THE ANIMALS AND GENERAL MANAGEMENT	48
1 - Ram Lambs	48
2 - Ewes	50

TABLE OF CONTENTS (CONTD)

	<u>PAGE</u>
C - LIVE WEIGHT OF RAM LAMBS	50
D - MATING PROCEDURES	51
1 - Training of Ram Lambs	51
2 - Flock Mating	51
E - RECORDING OF LAMBING DATA	52
F - SEMEN COLLECTION AND EXAMINATION	52
G - LIBIDO TEST	54
H - ANALYSIS OF DATA	55
CHAPTER FOUR	
RESULTS	59
A - LIVE WEIGHTS	59
B - EXHAUSTION TEST	59
C - FLOCK MATING PERFORMANCE	59
1 - Percentage of Raddled Ewes	62
2 - Percentage of Ewes Returning to Service	67
3 - Percentage of Pregnant Ewes	71
4 - Percentage of Ewes Lambing	72
5 - Docking Rate	72
6 - Weaning Rate	79
D - SEMEN CHARACTERISTICS	80

TABLE OF CONTENTS (CONTD)

	<u>PAGE</u>
E - LIBIDO TEST	80
1 - Number of Mounts	80
2 - Number of Services	85
3 - Reaction Time to Mount	85
4 - Reaction Time to Service	86
CHAPTER FIVE DISCUSSION AND CONCLUSIONS	91
A - EFFECT OF MATING ON BODY WEIGHT	91
B - EFFECT OF MATING ON SEMEN QUALITY	92
C - FLOCK MATING PERFORMANCE	94
1 - Effect of Training	94
2 - Effect of Periods of Sire-Groups	95
3 - Effect of Oestrous Cycle	95
D - SEMEN CHARACTERISTICS	97
E - LIBIDO TEST	98
1 - Number of Mounts	98
2 - Number of Services	99
3 - Reaction Time to Mount	99
4 - Reaction Time to Service	100
F - GENERAL CONCLUSION	100

TABLE OF CONTENTS (CONTD)

	<u>PAGE</u>
SECTION II	
A STUDY OF THE FOOT "CONDITIONS" IN BOORoola MERINO CROSSBRED AND PERENDALE SHEEP	
CHAPTER SIX	REVIEW OF LITERATURE
	103
A - INTRODUCTION	103
B - DEFINITION	104
Footrot	104
Scald	105
Abnormal shape of the hoof	107
C - PREDISPOSING FACTORS	107
D - TREATMENT AND CONTROL	111
CHAPTER SEVEN	MATERIALS AND METHODS
	112
A - OUTLINE	112
B - SCORING SYSTEM	112
1 - Foot Shape	112
2 - Foot Scald and Footrot	115
3 - Reading the Scores	115
C - ANALYSIS OF DATA	115
D - HERITABILITY ESTIMATION	117
E - REPEATABILITY ESTIMATION	117

TABLE OF CONTENTS (CONTD)

	<u>PAGE</u>
CHAPTER EIGHT RESULTS	119
A - REPEATABILITY AND HERITABILITY	119
B - FOOT SHAPE	119
1 - Year	122
2 - Breed	122
3 - Sex	123
4 - Sire Effect	123
C - FOOT SCALD	130
1 - Year	130
2 - Breed	130
3 - Sex	131
4 - Sire Effect	131
D - FOOTROT	136
1 - Year	136
2 - Breed	136
3 - Sex	137
4 - Sire Effect	137
CHAPTER NINE DISCUSSION AND CONCLUSIONS	143
A - REPEATABILITY	143
B - EFFECT OF BREED	143
C - EFFECT OF YEAR	144
D - EFFECT OF SEX	144

TABLE OF CONTENTS (CONTD)

	<u>PAGE</u>
E - EFFECT OF SIRE	146
F - HERITABILITY	147
G - GENERAL CONCLUSION	148
APPENDICES	150
REFERENCES	164

LIST OF TABLES

<u>TABLE</u>		<u>PAGE</u>
2.1	A COMPARISON BETWEEN 28 EARLY AND 26 LATE-BORN RAM LAMBS (MEAN DATA).	10
4.1	NUMBER OF DAYS REQUIRED FOR RECOVERY FROM EXHAUSTION AS MEASURED BY SEMEN MOTILITY SCORES AFTER THE RAM LAMBS WERE REMOVED FROM THE FLOCKS.	61
4.2	ANALYSIS OF VARIANCE OF PERCENTAGE OF RADDLED EWES (ANGULAR TRANSFORMED DATA) AND MEAN \pm SE PERCENTAGE OF RADDLED EWES ATTRIBUTED TO DIFFERENT VARIABLES.	63
4.3	ANALYSIS OF VARIANCE OF PERCENTAGE OF EWES RETURNING TO SERVICE (ANGULAR TRANSFORMED DATA) AND MEAN \pm SE PERCENTAGE OF EWES RETURNING TO SERVICE ATTRIBUTED TO DIFFERENT VARIABLES.	68
4.4	ANALYSIS OF VARIANCE OF PERCENTAGE OF PREGNANT EWES (ANGULAR TRANSFORMED DATA) AND MEAN \pm SE PERCENTAGE OF PREGNANT EWES ATTRIBUTED TO DIFFERENT VARIABLES.	73
4.5	ANALYSIS OF VARIANCE OF PERCENTAGE OF EWES LAMBING (ANGULAR TRANSFORMED DATA) AND MEAN \pm SE PERCENTAGE OF EWES LAMBING ATTRIBUTED TO DIFFERENT VARIABLES.	74
4.6	ANALYSIS OF VARIANCE OF DOCKING RATE AND MEAN \pm SE DOCKING RATE ATTRIBUTED TO DIFFERENT VARIABLES.	75
4.7	ANALYSIS OF VARIANCE OF WEANING RATE AND MEAN \pm SE WEANING RATE ATTRIBUTED TO DIFFERENT VARIABLES.	81
4.8	ANALYSIS OF VARIANCE OF SEMEN MOTILITY SCORES.	83
4.9	ANALYSIS OF VARIANCE OF SEMEN DENSITY (NO. OF SPERM/ML).	83
4.10	ANALYSIS OF VARIANCE OF PERCENTAGE OF LIVE SPERM.	83
4.11	MEANS \pm SE OF SEMEN CHARACTERISTICS FROM THE TWO-TOOTH RAMS.	84

LIST OF TABLES (CONTD)

<u>TABLE</u>		<u>PAGE</u>
7.1	DETAILS OF THE YEAR OF BIRTH OF ANIMALS, NUMBER OF SIRES, NUMBER OF ANIMALS AND DATE OF OBSERVATIONS.	113
7.2	DETAILS OF THE ORIGIN AND NUMBER OF SIRES USED.	114
8.1	ANALYSIS OF DEVIANCE OF FOOT SHAPE SCORE ON WHICH ESTIMATION OF REPEATABILITY WAS BASED.	120
8.2	ANALYSIS OF VARIANCE OF FOOT SHAPE SCORE ON WHICH ESTIMATION OF REPEATABILITY WAS BASED.	120
8.3	ESTIMATES OF HERITABILITY OF SHEEP FOOT CHARACTERISTICS AT DIFFERENT AGES.	121
8.4	ANALYSIS OF DEVIANCE OF LAMB FOOT SHAPE SCORE (5, 4 AND <4-TYPE OF SCORES).	124
8.5	ANALYSIS OF DEVIANCE OF LAMB FOOT SHAPE SCORE (5 AND 4-TYPE OF SCORES).	125
8.6	ANALYSIS OF DEVIANCE OF HOGGET FOOT SHAPE SCORE (5, 4 AND <4-TYPE OF SCORES).	126
8.7	ANALYSIS OF DEVIANCE OF HOGGET FOOT SHAPE SCORE (5 AND 4-TYPE OF SCORES).	126
8.8	ANALYSIS OF DEVIANCE OF TWO-TOOTH RAM FOOT SHAPE SCORE (5, 4 AND <4-TYPE OF SCORES).	127
8.9	ANALYSIS OF DEVIANCE OF TWO-TOOTH RAM FOOT SHAPE SCORE (5 AND 4-TYPE OF SCORES).	127
8.10	ANALYSIS OF DEVIANCE OF LAMB FOOT SCALD SCORE.	132
8.11	ANALYSIS OF DEVIANCE OF HOGGET FOOT SCALD SCORE.	133
8.12	ANALYSIS OF DEVIANCE OF TWO-TOOTH RAM FOOT SCALD SCORE.	133

LIST OF TABLES (CONTD)

<u>TABLE</u>		<u>PAGE</u>
8.13	ANALYSIS OF DEVIANCE OF LAMB FOOTROT SCORE.	139
8.14	ANALYSIS OF DEVIANCE OF HOGGET FOOTROT SCORE.	140
8.15	ANALYSIS OF DEVIANCE OF TWO-TOOTH RAM FOOTROT SCORE.	140

LIST OF FIGURES

<u>FIGURE</u>		<u>PAGE</u>
2.1	MEAN GROWTH RATES OF EARLY AND LATE-BORN RAM LAMBS FROM BIRTH TO 160 DAYS OF AGE.	10
2.2	SEXUAL BEHAVIOURAL SEQUENCES AND FACTORS INFLUENCING LIBIDO.	25
4.1	MEAN LIVE WEIGHT OF RAM LAMBS IN MATING AND CONTROL GROUPS OVER THE TRIAL PERIOD.	60
4.2	PERCENTAGE OF RADDLED EWES FOR EACH TRAINED AND UNTRAINED RAM LAMB IN EACH FLOCK OF EWES.	64
4.3	PERCENTAGE OF RADDLED EWES DURING EACH PERIOD OF MATING BY EACH SIRE-GROUP.	65
4.4	MEAN PERCENTAGE OF RADDLED EWES DURING EACH OESTROUS CYCLE BY TRAINED AND UNTRAINED SIRES.	66
4.5	PERCENTAGE OF EWES RETURNING TO SERVICE FROM THOSE WHICH WERE RADDLED BY EACH TRAINED OR UNTRAINED RAM LAMB IN EACH FLOCK OF EWES.	69
4.6	PERCENTAGE OF EWES RETURNING TO SERVICE FROM THOSE WHICH WERE RADDLED DURING EACH PERIOD OF MATING BY EACH SIRE-GROUP.	70
4.7	MEAN PERCENTAGE OF EWES RETURNING TO SERVICE FROM THOSE WHICH WERE RADDLED DURING EACH OESTROUS CYCLE BY TRAINED AND UNTRAINED SIRES.	70
4.8	PERCENTAGE OF PREGNANT EWES OF THOSE WHICH WERE RADDLED BY EACH TRAINED OR UNTRAINED RAM LAMB IN EACH FLOCK OF EWES.	76
4.9	PERCENTAGE OF EWES LAMBING OF THOSE WHICH WERE PREGNANT AS BEING MATED BY EACH TRAINED OR UNTRAINED RAM LAMB IN EACH FLOCK OF EWES.	77

LIST OF FIGURES (CONTD)

<u>FIGURE</u>		<u>PAGE</u>
4.10	DOCKING RATE OF LAMBS SIREDBY EACH TRAINED OR UNTRAINED RAM LAMB IN EACH FLOCK OF EWES.	78
4.11	WEANING RATE OF LAMBS SIREDBY EACH TRAINED OR UNTRAINED RAM LAMB IN EACH FLOCK OF EWES.	82
4.12	THE MEAN NUMBER OF MOUNTS FOR THE TWO-TOOTH RAMS FOR EACH TEST OF LIBIDO.	87
4.13	THE MEAN NUMBER OF SERVICES FOR THE TWO-TOOTH RAMS FOR EACH TEST OF LIBIDO.	88
4.14	THE MEAN REACTION TIME TO MOUNT FOR THE TWO-TOOTH RAMS FOR EACH TEST OF LIBIDO.	89
4.15	THE MEAN REACTION TIME TO SERVICE FOR THE TWO-TOOTH RAMS FOR EACH TEST OF LIBIDO.	90
8.1	PREDICTED BREEDING VALUES OF SIRESBASED ON FOOT SHAPE SCORES OF PROGENY BORN IN 1980.	128
8.2	PREDICTED BREEDING VALUES OF SIRESBASED ON FOOT SHAPE SCORES OF PROGENY BORN IN 1981.	129
8.3	PREDICTED BREEDING VALUES OF SIRESBASED ON FOOT SCALD SCORES OF PROGENY BORN IN 1980.	134
8.4	PREDICTED BREEDING VALUES OF SIRESBASED ON FOOT SCALD SCORES OF PROGENY BORN IN 1981.	135
8.5	PREDICTED BREEDING VALUES OF SIRESBASED ON FOOTROT SCORES OF PROGENY BORN IN 1980.	141
8.6	PREDICTED BREEDING VALUES OF SIRESBASED ON FOOTROT SCORES OF PROGENY BORN IN 1981.	142

LIST OF PLATES

<u>PLATE</u>		<u>PAGE</u>
3.1	TOPOGRAPHICAL VIEW OF "TUAPAKA" FARM.	49
3.2	TOPOGRAPHICAL VIEW OF "TUAPAKA" FARM.	49
3.3	THE "RUAKURA RAM PROBE" FOR COLLECTION OF SEMEN.	53
3.4	COLLECTION OF SEMEN FROM THE RAM BY ELECTRICAL STIMULATION USING "RUAKURA RAM PROBE".	53

LIST OF APPENDICES

<u>APPENDIX</u>		<u>PAGE</u>
I	SUMMARY OF FOOT CHARACTERISTICS DATA OF SHEEP BORN IN 1980.	150
II	SUMMARY OF FOOT CHARACTERISTICS DATA OF SHEEP BORN IN 1981.	153
III	CLASSIFICATION OF ABNORMAL FOOT SHAPE INCIDENCE IN 97 (BOORoola X ROMNEY) X PERENDALE RAMS.	154
IV	CLASSIFICATION OF FOOT SCALD INCIDENCE IN 97 (BOORoola X ROMNEY) X PERENDALE RAMS.	155
V	CLASSIFICATION OF FOOTROT INCIDENCE IN 97 (BOORoola X ROMNEY) X PERENDALE RAMS.	155
VI	COMPARATIVE RESULTS OF FOOT SCORES OF BOORoola CROSS AND PERENDALE LAMBS AT TUAPAKA (9/12/1980) (ANIMALS TAG 1980).	156
VII	COMPARATIVE RESULTS OF FOOT SCORES OF BOORoola CROSS AND PERENDALE EWE HOGGETS AT TUAPAKA (2/7/1981) (ANIMALS TAG 1980).	157
VIII	COMPARATIVE RESULTS OF FOOT SCORES OF BOORoola CROSS AND PERENDALE TWO-TOOTH EWES AT TUAPAKA (23/3/1982) (ANIMALS TAG 1980).	158
IX	COMPARATIVE RESULTS OF FOOT SCORES OF BOORoola CROSS AND PERENDALE LAMBS AT TUAPAKA (9/12/1981) (ANIMALS TAG 1981).	159
X	COMPARATIVE RESULTS OF FOOT SCORES OF BOORoola CROSS AND PERENDALE RAM HOGGETS AT TUAPAKA (11/3/1982) (ANIMALS TAG 1981).	160
XI	TOTAL MONTHLY RAINFALL IN TUAPAKA FARM OVER THE TRIAL PERIOD.	161

LIST OF APPENDICES (CONTD)

<u>APPENDIX</u>		<u>PAGE</u>
XII	DETAILS OF THE FLOCK MATING PERFORMANCE OF THE BOORoola X ROMNEY CROSSBRED RAM LAMBS.	162
XIII	NUMBER OF EWES RETURNING TO SERVICE AFTER EACH MATING PERIOD (P) AND FOR EACH RAM LAMB SIRE.	163