

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.

SOME ASPECTS OF GROWTH RATE AS IT IS RELATED TO
REPRODUCTIVE EFFICIENCY IN DAIRY CATTLE

A thesis presented in partial fulfilment of the
requirements for the degree of
Master of Philosophy in Veterinary Science
at Massey University

*(Note: This thesis represents a thirty per
cent component of the examinable material).*

TAN Kim Sing

1979

ACKNOWLEDGEMENTS

I am greatly indebted to my supervisor, Professor E.D. Fielden for his guidance and help throughout the course of this study. My thanks go also to Dr K.L. Macmillan who willingly contributed advice and material and to Professor R.E. Munford for his assistance with the statistical analyses. Special thanks are extended to Professor W.J. Pryor for his consideration when I first arrived at Massey University.

Without the willing co-operation of the farm owners, and staff of the Ruakura Number Two Dairy Unit, the study would not have been possible - to them I am grateful.

To Mr R.J. Curnow for his invaluable help when weighing the cattle, the Massey Library Staff for their assistance with obtaining literature, and Mesdames A. Low, V. Darroch and F. Wicherts for typing this thesis I give my thanks.

Finally I would like to acknowledge the financial and moral support given to me by my family and the forbearance shown by my flatmates, especially K.L. Chua, during my stay at this university.

ABSTRACT

The purpose of the study reported in this thesis was to evaluate whether liveweight, measured in Friesian yearlings immediately before the breeding season commenced and in parous cows of the same breed just before calving for the herd began, was related to reproductive performance during the first four weeks of the mating period. Should such a relationship be confirmed 'target weights' which would ensure a high level of reproductive efficiency could be established for animals of this breed under normal husbandry conditions in New Zealand. A pre-requisite to the investigation was that the method(s) used should be easily applied in a commercial farming situation.

Body weight measurements for 184 yearlings (5 herds) and 288 parous cows (4 herds) which were at least three-quarter bred Friesian were taken at the times indicated above and related to submission rates (S.R.) and pregnancy rates (P.R.) during the first four weeks of the following breeding season. The cows were bred by artificial insemination with heat checks being made by experienced stock men; yearlings were mated to young bulls fitted with chin ball mating harnesses. P.R. and the dates of conception were confirmed by both pregnancy examinations at the conclusion of the breeding period and by subsequent calving information.

Reproductive performance in the yearling heifers was high with S.R. averaging 94% (range 88-100%) and P.R. 86% (range 71-100%) for the five herds. The majority of the heifers were judged to be in good body condition with mean body weights for the herds ranging between 231^{+27} and 277^{+22} kg (mean \pm S.D.). Differences in liveweight between herds were probably related to management during rearing although age variation and minor differences in the amount of Friesian 'blood' in each herd could have been contributing factors.

When individual herd effects were removed a positive but non-significant linear relationship between liveweight and S.R. was achieved with the yearlings. From the six points plotted on the regression it was noted that the lightest group of animals had a submission rate of 76%

whereas all other groups had submission rates in excess of 94% thus suggesting a threshold effect. The minimum liveweights for the lightest yearling groups exceeding a 90% submission rate varied from 204-229 kg depending on the herd.

While a positive relationship between liveweight and pregnancy rate was noted in the yearling data this was neither linear nor significant - further investigations seem warranted to resolve this particular issue because of its importance in breeding management. The significant differences noted between herds in yearling pregnancy rates may have been due to differences in fertility of the bulls used.

The reproductive performance of the three year-old and mature age groups of parous cows was satisfactory (S.R. averaged 87 and 86% and P.R. 69 and 65% respectively) but that of the two year-old cattle poor (S.R. 67% and P.R. 56%). Marked differences occurred between herds. Apart from the possible influence of liveweight before calving on these parameters of performance analysis of the reasons for herd differences was beyond the scope of this study and not attempted.

Differences in liveweight of the different age groups of cows both within and between herds was marked and, apart from the relationship with age, could most likely be attributed to management during the late autumn and winter period before calving began. Any association between liveweight and subsequent reproductive performance was however generally poor and inconsistent and in retrospect it was concluded that the method that had been used for investigating any possible relationship was unsatisfactory. A future investigation in which variables are more effectively controlled has been suggested.

Two year-old heifers experiencing their first lactation continue to be a problem group particularly under New Zealand dairy husbandry conditions. Careful management commencing during rearing and extending through first mating, calving and second breeding is required if a high level of reproductive efficiency in this age group is to be achieved.

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENTS	ii
ABSTRACT	iii
LIST OF TABLES	vii
LIST OF FIGURES	ix
INTRODUCTION	1
LITERATURE REVIEW	3
REPRODUCTIVE EFFICIENCY AND PARAMETERS USED IN ITS ASSESSMENT	3
i. Calving Interval	3
ii. Days Open	3
iii. Services Per Conception	4
iv. Non-Return Rate	4
GROWTH RATE OF DAIRY YOUNG STOCK	5
i. Body Weight and Puberty	6
ii. Conception Rate and Dystocia	7
iii. Milk Yield and Composition	8
iv. Longevity	9
SUBMISSION RATE	11
i. The Significance of Submission Rate	11
ii. Body Weight and Submission Rate	12
iii. Factors affecting Submission Rate	13
a. Efficiency of oestrus detection	13
b. Anoestrous syndrome	14
c. Post-calving interval	15
d. Multiple suckling	16
e. Management factors	17
BODY WEIGHT AND FERTILITY	17
i. Physiological Basis of Nutritional Infertility	17
ii. Partition of Nutrients	19
iii. Pattern of Liveweight Change	20
iv. The Relationship Between Body Condition and Fertility	22

v.	The Relationship Between Body Weight Change and Fertility	23
vi.	Factors Which May Influence The Relationship Between Liveweight And Fertility	25
	a. Protein-energy relationships	25
	b. Yield level and fertility	26
	c. Pre- and post-calving feeding	26
	d. Level of feeding immediately around the time of service	27
	TARGET BODY WEIGHTS	27
i.	Target Body Weights For Maiden Heifers	27
ii.	Target Pre-Calving Weights For Cows	31
	MATERIALS AND METHODS	34
i.	Location And Animals	34
ii.	Records And Measurement	35
iii.	Method Of Analysis	36
	RESULTS	39
	DISCUSSION	55
	CONCLUSIONS	64
	REFERENCES	66
	APPENDICES	76
I.	Coefficients and Divisors for Sets of Ortho- gonal Comparisons in Regression	76
IIa.	Submission Rate and Pregnancy Rate Responses for the Different Age Groups of Cattle within each Weight Classification	78
IIb.	F Values for Linear and Quadratic Components of the Response to Regression (Herd Effects Ignored)	79
IIc.	Submission and Pregnancy Rates for Yearling Friesian Cattle According to Body Weight Before Breeding in Five Dairy Herds (Herd Effects Ignored)	81
IIId.	Submission and Pregnancy Rates for Two Year-Old Friesian Cattle According to Body Weight Before Calving in Four Dairy Herds (Herd Effects Ignored)	83
IIe.	Submission and Pregnancy Rates for Three Year-Old Friesian Cattle According to Body Weight Before Calving in Four Dairy Herds (Herd Effects Ignored)	85
IIIf.	Submission and Pregnancy Rates for Mature Friesian Cattle According to Body Weight Before Calving in Four Dairy Herds (Herd Effects Ignored)	87

LIST OF TABLES

Table	Page
I. Liveweights at various stages of development of Jersey and Friesian Cattle (kg)	6
II. General effects of underfeeding on productivity of young dairy cattle	10
III. The importance of C.R. and S.R. on subsequent calving performance	11
IV. Relationship between body weight and 28-day submission rate (S.R.)	13
V. Ovarian status of cows showing 'pre-service anoestrous syndrome'	15
VI. The influence of interval from calving to mating on conception rates	16
VII. Effect of change in body weight on fertility of dairy cows	24
VIII. Effects of weight at breeding age on reproductive performance of heifers	29
IX. Target weights immediately prior to calving (kg)	32
Xa. Mean body weights of the yearling heifers immediately before mating in five herds (kg)	41
Xb. Analysis of variance for herd effects on body weight of the yearling heifers	41
XIa. Mean body weights of the different age groups of parous cows measured before the first cow calved in each herd (kg)	42
XIb. Analysis of variance for herd and age effects on body weight of the parous cows	42
XIIa. Submission rates (S.R.) and pregnancy rates (P.R.) for a four-week breeding period for yearling heifers in five dairy herds	43
XIIb. Chi-square test of independence for herd differences in submission rate and pregnancy rate for yearling heifers using R x C method	43
XIIIa. Submission rates and pregnancy rates for a four-week breeding period for three age groups of parous cows in four dairy herds	44

Table	Page
XIIIb. Chi-square test of independence for herd differences in submission rate and pregnancy rate within each age classification using R x C method	44
XIV. Submission rate and pregnancy rate responses for the different age groups of cattle within each weight classification	45
XV. F values for linear and quadratic components of the response to regression (herd effects removed)	46
XVI. Relationship between the post-calving interval and submission rates for three age groups of cows in four dairy herds	60
XVII. Weighing, calving and joining dates and weighing to calving interval for three age groups of cows in four dairy herds.	60

LIST OF FIGURES

Figure		Page
1.	The Effects of Nutrition on Reproduction	18
2.	Simplified Model to Describe the Relationship of Food to Milk and Liveweight in Dairy Cows According to Responses to Level of Intake	20
3.	Recommended Target Liveweights for Jersey and Friesian Cattle Between Birth and Mating	30
4.	Recommended Target Liveweights for Jersey and Friesian Cattle Between Mating and Calving	30
5a.	Submission Rate for Yearling Friesian Cattle According to Body Weight Before Breeding in Five Dairy Herds	48
5b.	Pregnancy Rate for Yearling Friesian Cattle According to Body Weight Before breeding in Five Dairy Herds	48
6a.	Submission Rate for Two Year-Old Friesian Cattle According to Body Weight Before Calving in Four Dairy Herds	50
6b.	Pregnancy Rate for Two Year-Old Friesian Cattle According to Body Weight Before Calving in Four Dairy Herds	50
7a.	Submission Rate For Three Year-Old Friesian Cattle According to Body Weight Before Calving in Four Dairy Herds	52
7b.	Pregnancy Rate For Three Year-Old Friesian Cattle According to Body Weight Before Calving in Four Dairy Herds	52
8a.	Submission Rate for Mature Friesian Cattle According to Body Weight before Calving in Four Dairy Herds	54
8b.	Pregnancy Rate for Mature Friesian Cattle According to Body Weight Before Calving in Four Dairy Herds	54