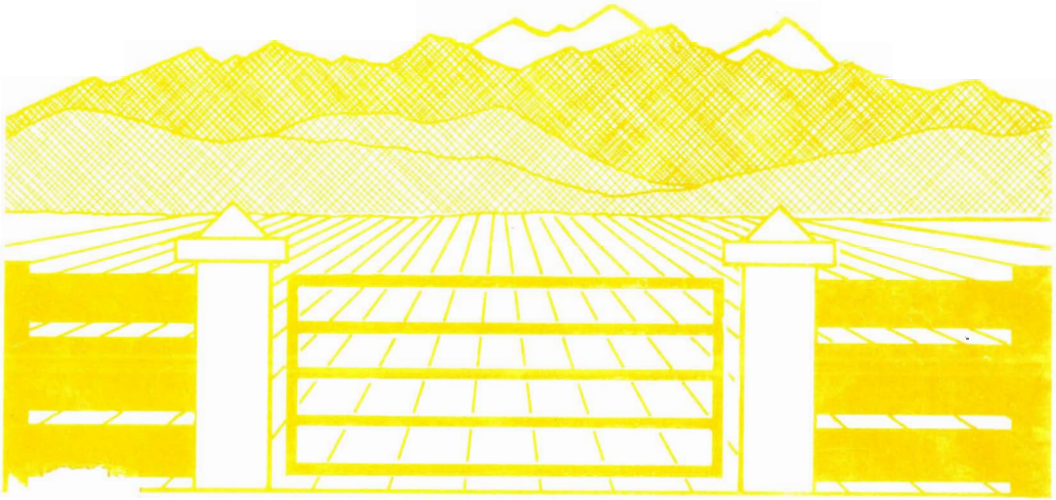
Lincoln College
Farm Management and Rural Valuation Department

1981 Farm Budget Manual



Part 1 Technical (Volume 1)

1981 FARM BUDGET MANUAL

Part 1: TECHNICAL

Volume 1 Sections 1-15

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PREFACE

The 1981 Edition is being published in two volumes as a result of major revision and incorporation of new material, particularly in the fields of Goat, deer and poultry production, soils, forestry and horticulture.

A number of people have made contributions to this Manual, but several deserve special mention-particularly Miss Elizabeth Burtt for her supervisory role, and Miss Nicola Bell, Miss Diana Boyle and Miss Megan Ryde for their conscientious work with the major task of revising and updating the information gathered.

To all other members of the College Staff, commercial firms and organizations who provided information and assistance in the revision of this Manual, I extend my grateful thanks.

R.J. Diprose
Senior Lecturer in Farm Management
Editor
March 1981

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SECTION 1

PHYSIOLOGICAL CHARACTERISTICS OF DOMESTIC ANIMALS

1. PHYSIOLOGICAL CHARACTERISTCS OF DOMESTIC ANIMALS

The following information is given as a handy guide and is not intended to be very specific. More detailed information can be obtained from the appropriate sources: Your veterinarian, the Ministry of Agriculture and Fisheries, or text books.

1.1 NORMAL AND EXPECTED RANGE OF TEMPERATURE, PULSE AND RESPIRATION.

	Rectal Temperature Deg. °C	Pulse (Beats/Min)	Respiration (Breaths/Min)
Sheep	38.9 (37.2 – 40.5)	75 (60 – 120)	12 – 20
Cattle	38.6 (37.8 – 39.3)	70 (40 – 100)	31 (27 – 40)
Pig	39.3 (38.8 – 40.3)	(55 – 86)	(8 – 18)
Horse	37.8 (37.2 – 38.1)	44 (23 – 70)	11.9 (10.6 – 13.6)
Dog	38.9 (36.7 – 40.5)	(100 – 130)*	18 (11 – 38)
Goat	39.3 (37.8 – 40.5)	90 (70 – 135)	19

* Heart rate varies in all these animals according to body weight, but the very great range of size in breeds of dog make this difference more marked. Thus, a Great Dane has a resting pulse of about 80, while toy breeds have a resting rate of about 130.

The temperature will vary considerably for each animal within a certain range. Thus, it is highest in the afternoon and lowest soon after midnight. In cattle under paddock conditions, for instance, this range may cover 2.2°C. The range is not so marked in housed cattle, or where the climate is temperate.

Exercise, feeding and excitement, will raise the temperature. Drinking cold water and bleak conditions will lower the temperature.

An abnormal temperature may be of great importance as indicating the nature of the disease. For example, a cow after calving may go down and become semi-comatose; if the temperature is high, it points to the possibility of septicaemia. If the temperature is low, it points to the possibility of a metabolic disease such as milk fever.

Rectal temperature should always be taken, if, for example, symptoms are being noted in order to telephone a veterinarian for advice. It is often the most important single piece of information. It should be taken in the rectum, with an ordinary human clinical thermometer, a half-minute thermometer being left in a minute and a half, to obtain an accurate reading.

The pulse and respiration should also be taken in conjunction with the temperature, as they often give most valuable evidence. The simplest way to count the pulse is to hold the hand over the heart area (under the elbow) and count the impulses of the heart beat.

The pulse and respiration will vary widely with exercise, excitement, or weather conditions, quite apart from the effect of disease.

1.2 PUBERTY

	Normal Time (Age in months)
Ewe	8 – 12
Cow	12 – 18
Sow	4 – 5
Mare	12 – 24
Bitch	7 – 10
Nanny	8 – 12

Puberty is the age at which animals are capable of breeding for the first time.
The main factor affecting puberty is body weight, which is affected by feeding, liveweight breed, strain and climate.

1.3 LENGTH OF GESTATION PERIOD

		Average Period	Range (Days)
Mare		347	322 - 419
Cow		283	240 - 321
Ewe		150	146 - 161
Sow		115	109 - 143
Goat		156	150 - 163
Bitch		60	55 - 63
Cat		50	48 - 56
Rabbit		28	20 - 35
Turkey sitting	) Hen	24	27 - 28
on the eggs	) Duck	27	24- 30
of the	) Turkey	26	24 - 30
Hen sitting on	) Duck	30	26 - 34
the eggs of the	) Hen	21	19 - 24
Duck		30	28 - 32
Goose		30	27 - 33
Pigeon		18	16 - 20

1.4 BREEDING TABLE

Time of Service		Calving Date		Lambing Date		Farrowing Date	
July	9	April	17	December	5	October	31
July	23	May	1	December	19	November	14
August	6	May	15	January	2	November	28
August	20	May	29	January	16	December	12
September	3	June	12	January	30	December	26
September	17	June	26			January	9
October	1	July	10			January	23
October	15	July	24			February	6
October	29	August	7			February	20
November	12	August	21			March	6
November	26	September	4			March	20
December	10	September	18			April	3
December	24	October	2	May	22	April	17
January	8	October	17	June	6	May	2
January	22	October	31	June	20	May	16
February	5	November	14	July	4	May	30
February	19	November	28	July	18	June	13
March	5	December	12	August	1	June	27
March	19	December	26	August	15	July	11
April	2	January	9	August	29	July	25
April	16	January	23	September	12	August	8
April	30	February	6	September	26	August	22
May	14	February	20	October	10	September	5
May	28	March	6	October	24	September	19
June	11	March	20	November	7	October	3
June	25	April	3	November	21	October	17

Sheep: 5 months (147 days) less 4 days. **Cow:** 9 months (182 days) plus 9 days. Sow 113 days

1.5 AGE OF ANIMALS

1.5.1 Age of Horses

Location of teeth	Ages at eruption of permanent teeth	"Cups" disappear from wearing surfaces of permanent teeth lower jaw
First pair of middle incisors	2½ years	6 years
Second pair of incisors (Located at either side of "nippers")	3½ years	7 years
Third pair of corner incisors	4½ years	8 years

The age of the older horses is more difficult to determine but, in general, the shape of the wearing surface of the teeth gradually changes from oval to triangular, the forward pitch becomes more marked, and the neck of the teeth at the gums becomes narrower. At 10 years, a groove, known as Galvayne's Groove, appears on the Upper Corner Incisor. At 15 years, this groove is halfway down the tooth, and at 20 years it is the full length of the tooth. This depends on the speed of eruption.

1.5.2 Age of Cattle

The age of cattle is usually determined by general appearance. However, the time that the teeth erupt can be used as a guide to age. During the first few weeks of life, four pairs of temporary incisors in the lower jaw usually appear. These are replaced by the same number of permanent ones as follows:-

Teeth	Age of Eruption
First or middle pair of incisors	22 to 30 months
Second pair of incisors	27 to 41 months
Third pair of incisors	33 to 42 months
Fourth pair of incisors	42 months

The state of dentition, taken alone, is not a reliable guide to the age of cattle.

1.5.3 Age of Sheep

The age of sheep can be gauged by the time of the appearance of permanent incisors, there being four pairs, all in the lower jaw. By the use of age marks and eartags their age is clearly shown. Teeth erupt as follows:

Teeth	Age at Eruption	Common term
First or middle pair of incisors	12 to 18 months	2 tooth
Second pair of incisors	21 to 24 months	4 tooth
Third pair of incisors	30 to 36 months	6 tooth
Fourth pair of incisors	42 to 48 months	fullmouth

Type of feed and pasture have a good deal of influence on the age at which teeth of a sheep begin to wear and fall out. The extent of teeth wear depends largely on the age of culling ewes. Normally a ewe is culled at 6-7 years of age.

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1.6 AGE CLASSES OF LIVESTOCK

Livestock	Age	Female	Male	Neuter
Cattle	(a) Young	heifer calf	bull calf	
	(b) half grown	heifer	bull	steer
	(c) adult	cow	bull	steer
Deer				
(i) Fallow	(a)	fawn	fawn	
	(b) & (c)	doe	buck	
(ii) Red	(a)	calf	calf	
	(b) & (c)	hind	stag	
(iii) Wapiti	(a)	calf	calf	
	(b) & (c)	cow	bull	
Ducks	(a)	duckling	duckling	
	(b) & (c)	hen	drake	
Fowls	(a)	chick	chick	
	(b)	pullet		
	(c)	hen	rooster/cock	capon
Goats	(a)	kid	kid	
	(b) & (c)	doe/nanny	buck/billy	
Horses	(a)	foal	foal	
	(b)	filly	colt	gelding
	(c)	mare	stallion	gelding
Pigs	(a)	piglet	piglet	
	(b)	gilt	boar	barrow/hog
	(c)	sow	boar	barrow/hog
Sheep	(a)	lamb	lamb	
	(b)	ewe hogget	ram hogget	wether hogget
	(c)	ewe	ram	wether
Turkeys	(a)	poult	poult	
	(b) & (c)	hen	tom/gobbler	

1.7 Table of Oestrus

	Duration of Oestrum	Return after Parturition	Recurrence if not pregnant
Ewe (Merino)	36-48 hrs	60-150 days if no suckling, otherwise 4-6 months.	17 (12-19) days.
Cow	14 hrs (10-18 hrs)	40-120 days	21 (18-24) days
Mare	4½-9 days	9-14 days	21 (12-25) days
Sow	2-3 days	7 days after weaning	21 (14-26) days
Bitch	4-13 days	5-6 months	5-6 months

1.8 Conversion of stock number to STOCK UNITS (Ewe Equivalents)

SHEEP		s.u.
Breeding ewe (Std 55 kg)		1.0
Breeding ewe (ligh, e.g. Merino)		0.9
Breeding ewe (heavy, e.g. Border Romney)		1.1
Stud ewe		1.1
Ewe hogget, not mated		0.7
Ewe hogget, mated		1.0
Wether hogget		0.7
Wether, 2th and older		0.7
Ram hogget		0.8
Ram, 2th and older		0.8

Stock units are conventionally calculated for winter tally, at 30 June and 1 July each year.

CATTLE		s.u.
Heifer calf, autumn-born		2.0
Rising 1 year heifer		3.5
Rising 2 year heifer, empty		4.5
Rising 2 year heifer, in-calf		6.0
Rising 3 year heifer, in-calf		6.0
Beef breeding cow		6.0
Steer or bull calf, autumn-born		2.0
Rising 1 year steer/bull		4.0
Rising 2 year steer		5.0
Rising 3 year steer, and older		5.5
Rising 2 year bull, and older		5.5
Nurse cow, multiple-suckled	up to	8.0
Dairy cow, light breed (e.g. Jersey)		7.5
Dairy cow, heavy breed (e.g. Friesian)		8.5
Horse		7.0

NOTE: Stock unit conversion ratios to be used by the R.B.F.C. in administering the Livestock Incentive Scheme are slightly different in some cases from the above ratios.

SECTION 2

SHEEP PRODUCTION

2 SHEEP PRODUCTION

2.1 NEW ZEALAND SHEEP STATISTICS

2.1.1 Sheep Numbers by Statistical Areas as at 30 June 1979

Statistical Area	Total Sheep '000	Percent change from last year '000	[1] Breeding Ewes '000	[1] Percent change from last year '000	Hog gets Ewe '000	Hoggets Wether '000	Other sheep '000
Northland	1 872	8.1	1 277	8.3	400	156	39
Central Auckland	861	−3.0	582	−1.5	144	118	17
South Auckland Bay of Plenty	9 099	0.6	6 583	2.7	1 778	540	198
East Coast	2 789	2.6	1 947	2.3	658	121	63
Hawke's Bay	7 504	2.0	5 436	1.1	1 649	264	155
Taranaki	1 528	1.2	1 119	4.8	279	98	32
Wellington	9 891	6.7	6 961	6.6	2 082	630	218
North Island	33 544	3.2	23 905	3.7	6 990	1 927	722
Marlborough	1 492	3.3	1 021	6.2	280	161	30
Nelson/Westland	1 069	3.9	761	7.0	215	72	21
Canterbury	10 822	2.1	8 055	4.9	2 021	536	210
Otago	8 290	2.5	6 096	3.8	1 602	444	148
Southland	8 306	−2.1	6 270	0.6	1 772	117	147
South Island	29 979	1.1	22 203	3.5	5 890	1 330	556
NEW ZEALAND	63 523	2.2	46 108	3.6	12 880	3 257	1 278

1: These breeding ewes, include ewes not put to the ram. Prior to June 1979, ewes not put to ram were included with other sheep.

Source: Department of Statistics.

2.1.2 Ewe Numbers at 30 June and Tailing Percentages for Spring of 1977 and 1978 respectively.

Statistical Area	Ewe Numbers at June 1977 '000	1978 '000	Tailing % 1977	1978
Northland	1,032	1,179	94.2	87.9
Central Auckland	545	591	90.8	86.0
Sth.Auckland/Bay of Plenty	5 932	6 413	91.0	80.2
East Coast	1,819	1,904	80.9	82.6
Hawke's Bay	5,222	5,376	86.7	85.5
Taranaki	1,008	1,068	89.2	81.0
Wellington	6 384	6 528	85.0	86.8
North Island	21 942	23 059	87.5	84.1
Marlborough	938	961	90.9	89.7

Nelson/Westland	651	711	93.8	90.5
Canterbury	7 569	7 678	97.3	92.3
Otago	5 646	5 875	97.3	96.7
Southland	6,034	6,231	106.7	106.2
South Island	20,838	21,456	99.5	97.2
NEW ZEALAND	42,780	44,515	93.3	90.4

(**Source:** "Annual Review of the Sheep and Beef Industry, 1978/79", N.Z. Meat and Wool Boards' Economic Service).

2.2 BUDGETING NOTES

2.2.1 Lambing Percentage

There are several common methods for calculating the lambing percentage figure:

1. $\frac{\text{Number of lambs docked}}{\text{Number of ewes to ram}} \times \frac{100}{1}$
2. $\frac{\text{Number of lambs docked}}{\text{Number of ewes alive at docking}} \times \frac{100}{1}$
3. $\frac{\text{Number of lambs surviving to sale}}{\text{Number of ewes put to the ram}} \times \frac{100}{1}$
4. $\frac{\text{Lambs born}}{\text{Ewes lambing}} + \frac{\text{Lambs born}}{\text{Ewes to Ram.}}$

The 3rd calculation is the only correct one for budgeting and should be used in preference to 1 and 2.

These two methods are often used by farmers but give a false picture of the flock's lambing performances.

2.2.2 Mortality

The average mortality for a ewe flock on low country is 4%–5%. On harder country, this figure is higher. 6%–10% overall is common on South Island high country runs with occasional losses of greater than 15%.

Lamb losses are usually taken as from docking to sale. Average death allowances are 2-3% for stores and 3-4% for export lambs.

2.2.3 Culling

It is usual to cull to some extent in most ewe flocks. The criteria on which the sheep are culled vary a lot with the flock policy and

the type of country. Sheep would be predominantly culled for age and or body condition at 5-7 years of age. Any ewe with bearing trouble, bad udder, poor constitution, barreness and very poor wool performance may be culled at any age. Culling is heavy in ewe lambs and 2 tooth ewes. Usually total numbers of ewe lambs are sufficient to allow fairly heavy culling in selection of ewe lambs to go into winter. Culls from hill farms are readily sold to farmers on lower country, either as ewe lambs or as 2Ts in the autumn.

Most hill country farmers discard ewes when they have lambed 3 or 4 times because of a drecreasing wool production, or when the mouths are worn down. These '4 year olds' and '5 year olds' are sold at local ewe fairs for export lamb production. They are usually mated to a terminal cross bred meat sire (termed 'cast for age' or c.f.a. ewes.)

2.2.4 Rams

It is usual to buy rams as 'one-shear by private treaty and a small number at local ram fairs, which are either stud or flock. The average farmer buys flock rams. Rams last 'on average' 4 breeding seasons and are usually disposed of by killing for farm dogs. One rame per 70 ewes is a common ration but recent research has shown that 1:150 is adequate. This depends on the breed and the type of country.

2.2.5 Home Killing and Dog Tucker

On sheep farms, a suitable allowance is ½ a sheep per household per week. This varies with the number of employees and the time of the year. It is usual to keep some cull lambs for house meat but wether hoggets may be bought. Dogs are usually fed on ram meat or other sheep that are killed for this purpose. It cannot be stressed enough that ALL meat or offal fed to dogs should be either frozen or cooked for the legal minimum periods of time for the control of hydatids and sheep measles. Meat frozen for 10 days at −10°C or boiled for 1 hour is deemed safe for dogs.

For further information, contact the Hydatids Officer at your local Council office.

It should also be emphasized that all meat for home consumption should be prepared in hygienic surroundings. Farm-killed meat must NOT be offered for sale.

2.2.6 Flock Replacements

Method 1:

It is essential in any budgetary estimate to state the class, number and performance of the sheep flock on the property and to tie this up in a stock reconciliation covering a twelve month period. An example is given here of a store sheep unit carrying 2,000 ewes and breeding own replacements. Ewes last 5 seasons and 100 per cent of lambs survive to weaning. Mortality in the ewe flock is 5 per cent and approximately 5 per cent of the 4, 6 and 8 tooth ewes and the 5 years ewes are culled each year. Twenty per cent of the 2 tooth ewes are culled before going into the ewe flock.

The procedure is as follows:

1. Establish the total loss from the ewe flock annually which is 5% deaths and 5% culling or approximately 200.

2. Ewes are kept 5 seasons so divide this total loss by 5 to get the approximate loss in each age group of the flock 200 ÷ 5 = 40. There are more sheep in the younger age groups but stock losses tend to increase with age after the 2T year so equal annual losses have been allowed.

3. In a flock being kept for 5 seasons, more than 1/5th of the sheep are 2T, more than 1/5th are 4T, approximately 1/5th 6T, less than 1/5th are 8T and less again are 5 year olds because of deaths. The flock composition is found by taking 1/5th of the total flock and calling this 6T ewes, e.g. 2 000 x 1/5th = 400 6T ewes.

   The number of sheep in each other age group is then found by adding or subtracting the appropriate number of annual losses per age group.

   e.g. number of 2T ewes = 400 + (2 x 40) = 480 2T

4. Thus, the flock composition is

480	2T ewes
440	4T ewes
400	6T ewes
360	8T ewes
320	5 year ewes
2,000	

5. Cull mixed age ewes for sale. These make up half of the annual loss per age group, e.g. $\frac{40}{2}$

∴ 20 4T ewes
20 6T ewes
20 8T ewes
20 5 year ewes

80 for sale annually

6. Cast for age ewes for sale are 320 less half the annual loss per age group (deaths only, as they are all being culled).

e.g. $320 - \frac{40}{2}$

= 300 less say 20 for dog tucker

= 280 C.F.A. ewes to sell

7. Two tooth ewes required are sufficient for 20% culling.

∴ $480 \times \frac{120}{100} = 576$ of which 96 will be culled.

Ewe lambs to be kept at weaning to ensure this number of 2T ewes allowing 5% death rate in ewe hoggets.

$= 576 \times \frac{100}{95} = 607$, say 610 and cull 99 2T

8. Lamb disposal: 100% survival to sale or flock.

∴ 1 000 wether lambs to sell less 50 killers
1 000 ewe lambs less 610 to flock gives 390 to sell
Less 20 culls for house mutton and dog tucker
= 370 ewe lambs to sell

9. This stock performance will now be formally summarized in a stock reconciliation. (over page).

10. Summary of Sales:

Wether Lambs:	Prime off the mothers	9% = 90	
	Seconds off the mothers	1% = 10	
	Prime off Feed	50% = 500	
	Seconds off Feed	35% = 350	= 950
Ewe Lambs			= 370
2T Ewes			= 99
Mixed Age Ewes (Culls)			= 80
Cast for Age Ewes			= 280

Summary of Sheep Killed:

49 Wether hoggets and 2T wethers for the houses
20 Ewe hoggets (some for the house, rest for the dogs)
20 Old thin ewes for dogs
10 Old rams for dogs

Ewe Hoggets						
2 tooth Ewes	48					
4 tooth Ewes	440					
6 tooth Ewes	400					
8 tooth Ewes	360		360			
5 year Ewes	320		320			
Rams	50	13				
Killers	60		50			
Totals	2740	13	4680	2680	1770	135

2740 + 13 + 4680 = 7433

2680 + 1770 + 135 + 10[illegible] = 7433

Method 2

This simple accurate method can be adapted to fit any situation.

Example 1:

Flock of 1900 ewes.
5% death rate. 5% culling rate.
Ewes bought as 5 yr. c.f.a. and last 2 years.

Problem:

How many 5 yr. ewes to be bought each year?

We know that we have two age groups –
5-year ewes and 6-year ewes.

We know that the number of 6 yr. ewes is the number of 5 yr. ewes less 10% (5% deaths + 5% culls).

We know that the 5 yr. ewes + 6 yr. ewes = 1900.

Therefore mathematically the number of 5 yr. ewes + 90% of the 5 yr. ewes = 1900.

So let the number of 5 yr. ewes required = x.

$\therefore\ x + 0.9x = 1900$
$\therefore\ 1.9x = 1900$
$\therefore\ x = 1000$

$\therefore$ the number of 5-year ewes to be bought is 1000.

The number of 6-year ewes in the flock will be 0.9 x 1000 = 900.

Example 2:

From example 1 assume that instead of ewes lasting 2 years that half will, in fact, produce 3 crops of lambs. Now we have 5 yr., 6 yr., and 7 yr. ewes.

Death rate still 5%.

Culling rate of 5% for rising 6 yr. ewes and 50% for rising 7 yr. ewes.

Let number of 5 yr. ewes required = x
number of 6 yr. ewes = 0.9x
number of 7 yr. ewes will be the number of 6 yr. ewes less 5% deaths, less 50%.

e.g. $\frac{0.95\ (0.9x)}{2}$ $= 0.4275x$

$\therefore\ x + 0.9x + 0.4275\,x = 1900$

$2.3275x = 1900$

$x = 1900/2.3275$

$\therefore\ x = 816$

$\therefore$ Number of 5 yr. ewes required $= 816$

$\therefore$ Number of 6 yr. ewes is $0.9(816) = 735$

$\therefore$ Number of 7 yr. ewes is $\frac{0.95(735)}{2} = 349$

$\underline{1900}$ ewes

Example 3

The method is equally well applied to any mixed age flock.

Take 1000 ewe flock. Buy 2 tooth replacements. Take 4 crops of lambs – 5% death and 5% cull rate. Sell 5 yr. ewes.

Let $1x$ = number of 2 tooths required.

$\therefore\ 0.9x$ = number of 4 tooths

$\therefore\ (0.9)\ (0.9x) = 0.81x$ = number of 6 tooths

$\therefore\ (0.9)\ (0.81x) = \underline{0.729x}$ = number of 4 yr. ewes

$\underline{3.439x} = 1000$

$x = 1000/3.439$

$= 290.7 =$ say 291

$\therefore$ number 2 ths. $= 291$

4 ths. $= 262$

6 ths. $= 235$

4 yr. $= 212$

$\underline{1000}$ ewes

Example 4:

A two-flock system of 2000 Corriedale ewes. Aim is to breed own replacements from part of flock – balance to the fat lamb sire.

We require a 20% culling margin in ewe hoggets, i.e. cull 1 in 5 of the ewe hoggets.

Take 5½ crops of lambs, and build in a 5% death rate + 5% culling rate in age groups.

Then let

$$
\begin{aligned}
1.0x &= \text{number of 2 tooths required.} \\
0.9x &= \text{number of 4 tooths} \\
0.9\,(0.9x) = 0.81x &= \text{number of 6 tooths} \\
0.9\,(0.81x) = 0.729x &= \text{number of 8 tooths} \\
0.9\,(0.729x) = 0.656x &= \text{number of 5 yr. ewes} \\
\frac{0.9\,(0.656x)}{2} = 0.295x &= \text{number of 6 yr. ewes} \\
\hline
4.39x &= 2000 \text{ ewes}
\end{aligned}
$$

$$\therefore\ x = \frac{2000}{4.39} = 456 \quad \text{2 tooth ewes.}$$

Flock Structure:

456	2 tooths
410	4 tooths
369	6 tooths
332	8 tooths
299	5 yr. ewes
134	6 yr. ewes
2000	ewes

Given that we need 456 2 tooths then with a 115% lambing and 4% hogget death rate, what number of ewes do we need to put to the Corriedale ram?

456 2 tooths represent 80% or 0.8 of the ewe hoggets.

∴ Number of ewe hoggets required = 456/0.8 = 570

and to allow for the 4% death rate 570 ewe hoggets represent 0.96 or 96% of the ewe lambs at weaning.

∴ Ewe lambs at weaning = 570/0.96 = 594

Assuming that ewe lambs represent ½ or 50% of lambs born to Corriedale ram, then total Corriedale lambs required to obtain 594 weaned ewe lambs = 594 x 2 = 1188.

Given a lambing % of 115 then the number of ewes required to produce 1188 lambs = 1188/1.15 = 1033.

In summary then, of the 2000 ewes, 1033 go to the Corriedale ram and 967 go to the fat lamb sire.

Stock Units Opening 1 / 7 / 80	Rate	Class of Stock Breed	Opening Nos. @ 1/7/80	Nat. Incr.	Killed	Deaths and Losses	Sales	Purch-ases	Closing Nos. @ 30/6/81	Class of Stock	Closing s.u.'s 30/6/81
	Ewes										
		Lambs		1150							
		Unmated Hgts	580			14	556		580	Unmated Hgts	406
		Mated Hgts				10	114			Mated Hgts	
		Ewes: 2th	456						456	Ewes: 2th	
		4th	410			23	23		410	4th	
		6th	369			20	21		369	6th	
		4yr	332			19	18		332	4yr	
		5yr	299			16	17		299	5yr	
		6yr	134			15	150		134	6yr	
		Aged				13	121			Aged	
2000	1.0	TOTAL EWES	2000						2000	TOTAL EWES	2000
	Wethers - m.s. and wether										
		Lambs		1150							
		Hgts	50			10	1090		50	Hgts	
		2th	20		28	2			50	2th	
		Aged			19	1			20	Aged	
49	.7	TOTAL WETHERS	70						70	TOTAL WETHERS	49
	Rams										
		Lambs									
		Hgts								Hgts	
		2ths	12		1			12	12	2ths	
		Aged	38		9	2			38	M.Age	
40	.8	TOTAL RAMS	50						50	TOTAL RAMS	40
		TOTAL SHEEP	2700	2300	57	145	2110	12	2700	TOTAL SHEEP	
			(a)	(b)	(c)	(d)	(e)	(f)	(g)		

2495	TOTAL S.U's	÷	100ha	EFFECTIVE AREA =	15	S.U's /ha	S.U's /ha	15	=	166 ha	÷	2495

LAMBING PERFORMANCE (Based on Ewes to Ram)
Tailing = 115 % Survival to Sale = 114 %

RECONCILIATION
(1) Totals a + b + f = 2012
(2) Totals c + d + e + g = 2012

DEATH RATES
Ewes = 5.3 % Hgts = 1.9 % Lambs = 1.0% Rams = 5.3 % Total (1) must = Total (2)

SECTION 3

WOOL PRODUCTION

3. WOOL PRODUCTION

3.1 SHEARING

Adult sheep are usually shorn once per year, dry sheep in September – October, and wet sheep after the dry shearing. Wet ewes may also be shorn pre-lambing (usually August). The practise of shearing 3 times every 2 years (pre-lambing every second year) is also used by some farmers. In the South Island, most sheep are first shorn as hoggets 13 months after birth although a proportion are shorn in January. This practice is more common in the damper districts and particularly in the North Island. Shearing twice a year is common in high producing North Island Romney flocks.

3.2 CRUTCHING

Lambs which are not shorn are crutched in January – February. Ewes are crutched in June – July and may also be lightly crutched or "ring-crutched" before rams go out.

3.3 WOOL PREPARATION

The trend today in shed preparation is towards simplification, particularly with average and low grade wools, where little skirting is being done.

The main types of wool considered for budgeting purposes include fleece, necks, pieces, bellies and locks at main shearing and lambs-wool, crutchings and deadwool at other times.

Where skirting is carried out at mainshearing, the following proportions are likely to occur.

Type	Greasy Weight (kg)	%
Fleece	3.40	75
Necks	0.13	3
Pieces	0.40	9
Bellies	0.30	7
2nd Pc's/Locks	0.27	6
	4.50	100

Ewe crutchings amount to 0.2 to 0.3 kg, making a total clip of 4.75 kg per year, for well fed sheep.

The range in annual clip per sheep as a guide is approx. 3.0 kg to 5.5 kg. Cross-bred hoggets not shorn as lambs average the same as or slightly more than ewes, whereas the slower maturing finer wool breeds average slightly less than ewes.

When shorn as lambs, hoggets would produce 1.0 to 1.5 kg as lambs, and approx. 3.0 kg as hoggets.

Lambs crutch about 0.1kg.

3.4 BUDGETING PROCEDURE

When quoting wool weights, it should be clear that figures refer to numbers actually shorn and that weights include crutchings and do or do not include lambs' wool (if it is district practice to shear lambs).

Obtain shearing tallies by deducting ½ to ⅔ of the annual deaths, depending on the month of shearing. Assess the wool weight per class of sheep and obtain the total wool yield per class of sheep. Add the totals. Then, with the weighted price of the whole of the fleece clip, assess the income from wool. Normally current quotations for the Average Grade of the major class of wool in the clip are a good guide to overall price per kg.

An example:

No. per class as at 1.4.78	Less Deaths	Shearing tally	Greasy Weight per sheep incl. crutchings	Total (kg)
1000 ewes	30	970	4.5kg	4,365
400 hoggets	6	394	3.4kg	1,340
1050 lambs shorn		1 040	1.1kg	1,144
lambs crutched				
100 rams and killers	30	70	4.5kg	315
2550 TOTAL	96	2 484		7 164

Total Clip = 7 164 kilograms

Av. price/kg = 196 cents

∴ Income from wool = $14 041.44

3.5 WOOL CLASSIFICATION

The Bradford count classification system for wool is being replaced in New Zealand by the micrometer measure i.e. the diameter of the wool fibre.

The Wool Board has produced the following table showing the relationship between the micrometer measure (commonly called 'micron') and the Bradford count.

Wool Board Micrometer/Quality Relationships

Micrometers	Quality Number
19	70s
20	64/70s
21	64s
22	60/64s
23	60s (Merino)
24	60s (Quarter-bred)
25	58/60s
26	58s
27	56/58s
28	56s (52/56s lambs)
29	54/56s (50/52s lambs)
30	52/54s (50/48s lambs)
31	52s (46/50s lambs)
32	50/52s
33	50s (44/48s lambs)
34	48/50s
35	46/50s
37	44/48s
40	36/44s

The New Zealand Wool Board is also using a new Type Structure Index for wool. The sequence of this index is as follows:

MICRON/CATEGORY/STYLE/LENGTH

Example: 35F2D

This index means the wool fibres have a diameter of 35 micrometers, they are from main body wool of style B and are from 100 to 150 mm in length.

Type Structure

CATEGORY	Micron Code / Category Code / Style Code / Style		A/BB	BB/B	B	B/C	C	C/D	CARB
			0	1	2	3	4	5	6
				L E N	G T	H	C O D	E S	
WARP	19 20 21 22 23	W	V	V	V				
SPINNERS; PAPER FELTS; CASING PAPER FELTS	19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 31 32 33 34 35 37	A	V V EG DEG CDE	V V EG DEG CDE	V				
MAIN BODY-WOOL	19 20 22 24 26 28 30 32 33 21* 23 25 27 29* 31 31 33 35* 37 40 32 34 38 41	F	GJLOP	W,X W,X,Y,Z A-L O P A-G A-EGJLO	W, X W,X,Y,Z A-L O P, A-G A-EGJLO	W,X W,X,Y,Z A-L.O.P A-G A-EGJLO	W,X W,X,Y,Z A-L O P A-G A-EGJLO	W,X W,X,Y,Z A-L O P A-G A-EGJLO	X* Z* E*L*
PERENDALE	31 33 35	X		FK	FK	FK	FK		
			SUP/GD	GD/AV	AV	AV/INF	INF	DISC	CARBO
			0	1	2	3	4	5	6
SOFT COTTS	22 26 28 31 33 37 40 38	G		X,Y EFK DG	X,Y EFK DG	X,Y EFK DG	X,Y EFK DG		
HARD COTTS	22 26 28 31 33 37 40	H		X,Y FK	X,Y FK	X,Y FK	X,Y FK		
DOWN FLEECE	25 27 28 30	D		X,Y,Z	X,Y,Z	X,Y,Z	X,Y,Z		
FIRST LAMBS	22 26 27* 28 29 30* 31 33 40 38 41	L	T OPS MOPS GJMOPS	T OPS MOPS GJMOPS GJM DEGJLO	T OPS MOPS GJMOPS GJM DEGJLO	T OPS MOPS GJMOPS GJM DEGJLO	T OPS MOPS GJMOPS GJM DEGJLO	T* MP M*P*	T T T T*
SECOND LAMBS	22 26 27* 28 30 40 38	M		T PS LPS LP JP	T PS LPS LP JP	T PS LPS LP JP	T PS LPS LP JP	T* T JP	T T
NECKS	21* 23 25 26 27 28* 30 32 34* 38	N		W,X,Y EGKL DG	W,X,Y EGKL DG	W,X,Y EGKL DG	W,X,Y EGKL DG		T* T*
PIECES	21* 23 25 26 27 28* 30 31 33 35* 40 38	P		W,X,Y EGK DG	W,X,Y EGK DG	W,X,Y EGK DG	W,X,Y EGK DG	T* E*K* T	T* T*
BELLIES	21* 23 25 26 27 28* 30 31 33 35* 40 38	B		W,X,Y EGK DG	W,X,Y EGK DG	W,X,Y EGK DG	W,X,Y EGK DG	T* E*K* T	T* T*
CLOTHING ODDMENTS (Incl. 2nd Crt.)	22* 28* 30 32 35* 40 38	C		R JLOPS JP JLO	R JLOPS JP JLO	R JLOPS , JP JLO	R JLOPS JP JLO	T* L*P* T	T* T*

SECOND PIECES AND LOCKS	22 28 35 39	S			RS PRS OPS LOP	RS PRS OPS LOP	RS PRS OPS LOP		
CRUTCHINGS (Firsts)	22 27 (lbs) 28 30* 33 (lbs) 34 37* 40 38 41	K	JLOPS EGJLOP	RS T OR OR JLOPS EGJLOP	RS T OR OR JLOPS EGJLOP	RS T OR OR JLOPS EGJLOP	RS T OR OR JLOPS EGJLOP		T T* T*
EYE CLIPS	22 26 32 38	E		T		T			T
STAINS	22 28 35 38	Y				LR GLP		LR GLP	
DEAD	22 28 35 38	V		T	T		T		
MUD	28 35	J							LP GP
BLACK	28 35	O			T		T		
BRANDS	28 35	T			T				
DOUBLE FLEECE	22 28 35	R			T		T		
DOWN ODDMENTS	25 27 28	Z				PS		PS	

LENGTH STANDARDS

Code	mm	(barbe*)
A	200 up	
B	150-200	
C	125-175	(120/125*)
D	100-150	(115*)
E	100-125	(110*)
F	100-175 (washing)	
G	75-125	
J	75-100	
K	75-150 (washing)	
L	50-100	
M	75	
O	50-75	
P	50 (25-75)	
R	25-50	
S	Up to 35	
T	Unspecified	

Merino/Halfbred/Down

V	Speciality
W	Full combing
X	Short combing
Y	Carding
Z	Clothing

Merino/Halfbred/Down
Lengths applicable to specific microns

	V	W	X	Y	Z
19	65mm+	50-75	35-60		UP TO
20	70+	50-85	35-75		
21	75+	60-85	35-75	25-50	35
22	75+	60-85	50-75		
23	75+	60-85	50-75	25-60	35
24	80+	60-100	50-85		
25	85+	60-100	50-85	25-75	50
26	90+	75-100	50-85		
27	90+	75-110	50-100	35-75	50
28	95+	75-110	50-100		
29	100+	85-110	60-100	50-85	60
30	105+	85-110	65-100		
31	110+	85-125	75-110	50-85	60
32	110+	100-125	75-110		
33	115+	100-135	85-110		

Style Descriptions

FLEECE AND SECOND SHEAR BODYWOOL

Super A/BB	Good colour, well grown, well skirted, sound, free even.
Gd/Super BB/B	Good colour, well skirted, F.N.F., may be slightly irregular for length and quality. Combing wools must be sound.
Good B	Fair to good colour, skirted, may be felty and contain slight vegetable fault.
Gd/Av B/C	Fair colour, may contain light skirtings, light vegetable fault and odd cott.
Average C	Fair to poor colour, may be unskirted, contain light to medium vegetable fault and be partly cotted.
Inferior C/D	Poor colour, may contain cott and medium to heavy vegetable fault (but not carbonising).

COTTS

Good/Av	Good colour, free, skirted.
Average	Fair to good colour, fairly well skirted, may contain slight vegetable fault.
Av/Inferior	Fair colour, semi-skirted, may contain light vegetable fault.
Inferior	Poor colour, unskirted, may contain vegetable fault.

DOWN FLEECE

Good/Av	Good colour, skirted, may contain slight vegetable fault.
Average	Fair/Good colour, semi-skirted, may contain slight vegetable fault.
Av/Inferior	Fair/poor colour, may be unskirted and contain light vegetable fault.
Inferior	Poor colour, unskirted, may contain vegetable fault.

LAMBS' FIRSTS

Super/Gd	Good colour, well picked, free from vegetable fault and of regular length.
Good/Av	Good colour, fairly well picked, free from vegetable fault maybe slightly irregular in length.
Average	Fair/good colour, semi-picked and may contain slight vegetable fault.
Av/Inferior	Fair to poor colour, may be unpicked and contain light vegetable fault.

Inferior	Poor colour, unpicked, may contain light to medium vegetable fault.
Disc	Heavily discoloured, unpicked, may contain light to medium vegetable fault.

LAMB SECONDS

Gd/Av	Fair/good washing colour, free from vegetable fault.
Average	Fair colour, may contain slight vegetable fault.
Av/Inferior	Fair/poor colour, may contain light vegetable fault.
Inferior	Poor colour, may contain light to medium vegetable fault.
Disc	Heavily discoloured, may contain light to medium vegetable fault.

NECKS

Good/Av	Good colour, may contain little vegetable fault.
Average	Fair/good colour, may contain slight vegetable fault.
Av/Inferior	Fair colour, may contain light vegetable fault.
Inferior	Fair to poor colour, light to medium vegetable fault.

PIECES, BELLIES AND CLOTHING ODDMENTS

Good/Av	Good washing colour, free.
Average	Fair to good colour, may contain slight vegetable fault.
Av/Inferior	Fair to poor, may contain light vegetable fault.
Inferior	Poor colour, may contain light to medium vegetable fault.
Disc	Heavily discoloured, may contain light to medium vegetable fault.

SECOND PIECES & LOCKS

Average	Fair colour, may contain light vegetable fault.
Av/Inferior	Fair to poor colour, may contain light vegetable fault.
Inferior	Poor colour, may contain light to medium vegetable fault.

CRUTCHING FIRSTS (including Lambs' crutchings)

Super/Gd	Good colour, well picked, free from vegetable fault.
Good/Av	Good average washing colour, fairly well picked, free from vegetable fault.
Average	Fair colour, semi-picked, may contain slight vegetable fault.
Av/Inferior	Fair/poor colour, may be unpicked and contain slight vegetable fault.

Inferior	Poor colour, may contain light to medium vegetable fault, unpicked.
EYE CLIPS	
Good/Av	Good colour, may contain light vegetable fault.
Av/Inferior	Any colour, medium vegetable fault.
Carbo	Heavy vegetable fault.
STAINS	
Av/Inferior	Light to medium urine stain, may contain light vegetable fault.
Disc	Heavy urine stain, may contain heavy vegetable fault.
DEAD	
Gd/Average	Fair/good colour, may be slightly irregular in length, free from vegetable fault. No skin.
Average	Fair colour, may be short or mixed in length slight vegetable fault. No skin.
Inferior	Inferior, all lengths.
MUD	
Carbo	Muddy oddments requiring machining.
BLACK	
Average	Must be skirted fleece
Inferior	Pieces and unskirted fleece.
BRANDS	
Average	All in.

DOUBLE FLEECE

Average	Fair to good colour, may contain light vegetable fault.
Inferior	Poor colour, heavy vegetable fault.

DOWN ODDMENTS

Av/Inferior	Fair colour, may contain slight vegetable fault.
Disc	Poor colour, may contain vegetable fault.

3.6 Summary of Wool Characteristics of Breeds

(Source – "Wool and Woolclassing" – Henderson)

Breed	Micron Range	Range of Quality	Average Staple Length (mm)	Crimps per cm.	Nature of Crimp in Staple	Shape of Staple	Lustre	General
Merino	- 23	60s - 90s	100 - 50	3 - 6	Precisely defined and mostly V-shaped.	Rectangular aggregate of small staples. Tip is flat or nearly flat.	Bright	Softness is main and outstanding characteristic. Staples are firm.
Quarterbred (¾ Merino, ¼ Lincoln or English Leicester or Romney)	21 - 26	58s - 64s	115 - 75	2.5 - 3.5	Well defined. Usually rounded.	Tends to be rectangular. Tip is nearly flat and is more open than Merino.	Bright	Soft wool but falls short of Merino in this respect. Of good staple length and staple is firm.
Polwarth	21 - 26	58s - 64s	115 - 80	2.5 - 3.5	Well defined. Usually rounded.	Tends to be rectangular. Tip is nearly flat and is more open than Merino.	Bright	Soft wool but falls short of Merino in this respect. Of good staple length and staple is firm.
Corriedale	26 - 33	50s - 58s	130 - 80	1.5 - 2.5	Well defined. Usually rounded.	Most rectangular. Tip nearly flat in finer wools and slightly pointed in coarser wools.	Bright	Moderately soft. Staple is firm.
Borderdale	30 - 35	48s - 54s	150 - 100	1.2 - 2.4	Round	Oval to Rectangular	2nd demi-lustre or bright	Staple is firm
Halfbred (½ Merino, ½ Lincoln or English Leicester or Romney)	26 - 33	50s - 58s	130 - 80	1.5 - 2.5	Well defined. Usually rounded.	Rectangular and often large. Tip nearly flat in finer wools and slightly pointed in coarser wools.	Bright	Moderately soft. Staple is firm.

Summary of Wool Characteristics of Breed (continued)

Breed	Micron Range	Range of Quality	Average Staple Length (mm)	Crimps per cm.	Nature of Crimp in Staple	Shape of Staple	Lustre	General
Romney	32 - 37	44s - 52s	180 - 115	.75 - 2.5	Round	Usually oval or rounded. Pronounced pointed tip on most coarse wools	1st or 2nd demi-lustre	Staple is usually rather open in the tip and is much less firm than the coarsest Half bred or Corriedale wools which overlap the finer Romney wools in quality.
Border Leicester	35 - 37	45s - 46s	200 - 150	.75 - 1.25	Round. In some wools plane of crimp spirals round staple.	Round or flat. Tip on many fleeces tightly curled in form of corkscrew.	2nd lustre or 1st demi-lustre.	Staple is firm throughout its length. Corkscrew nature of crimp and staple tip. Particularly in round stapled wools, is a marked characteristic.
Coopworth	34 - 37	445 - 505	175 - 125	.8 - 1.5	Round	Round & Flat	1st demi-lustre	Staple is firm throughout lenght. Soft but springly handle.
English Leicester	37 - 40	40s - 44	230 - 150	.6 - 1.0	In individual fibres is round and in staple, the wave appears very deep. carried well to tip of staple.	Very flat with pronounced pointed tip.	1st or 2nd lustre	A heavy handling wool with firm staples.

Summary of Wool Characteristics of Breeds (continued)

Breed	Micron Range	Range of Quality	Average Staple Length (mm)	Crimps per cm.	Nature of Crimp in Staple	Shape of Staple	Lustre	General
Lincoln	40	36s - 40s	250 - 200	.5 - .75	Round	Oval to flat with pointed tip.	1st lustre	Very firm handling staples. Plane of crimp sometimes spirals about the staple but does not curl in tightly at tip as in Border Leicester.
Cheviot	28 - 33	50s - 56s	130 - 75	1.5 - 2.5	Round - not very precisely defined.	Rectangular. Has a slightly pointed tip.	Chalky or 2nd demi-lustre.	A full-handling rather spongy wool.
Perendale	28 - 37	48s - 56s	150 - 100	1.5 - 2.5	Round	Usually oval. Sometimes rectangular.	2nd demi-lustre	Staple is mostly similar to fine Romney. Generally a full handling wool.
Ryeland	28 - 29	54s - 56s	90 - 60	1.5 - 2.5	Round or may be indefinite.	Rectangular or may be definite. Tip flat.	Chalky or 2nd demi-lustre	Usually a very full-handling spongy wool. Some of the 2nd demi-lustre wools have well-defined staple.
Dorset Horn	28 - 33	50s - 56s	115 - 90	1.5 - 2.0	Not well defined.	Rectangular. Staple tip flat or slight pointed	Chalky or 2nd demi-lustre.	Individual fibres well crimped but irregularly. Rather spongy wool.

Summary of Wool Characteristics of Breeds (continued)

Breed	Micron Range	Range of Quality	Average Staple Length (mm)	Crimps per cm.	Nature of Crimp in Staple	Shape of Staple	Lustre	General
Suffolk	28 - 29	54s - 56s	100 - 75	1.5 - 2.0	Not well defined and usually apparent only in wool from young sheep or in shoulder wool.	Rectangular and large. Staple tip flat or slightly pointed.	Chalky	Spongy full-handling wool. Individual fibres well, but irregularly, crimped. Many fleeces do not show any clear staple crimp. Since all of this group have coloured legs and head, edges of fleece may contain coloured fibres. Generally body wool is free of colour. Because of great similarity of wools within this group, individual breed wools cannot be distinguished with any consistent certainty.
Shropshire	27	56s - 58s	90 60	1.5 - 2.0				
Hampshire	29	54s - 56s	100 - 75	1.5 - 2.0				
Dorset Down	26 - 29	54s - 58s	90 - 60	1.5 - 2.0				
South Suffolk	28 - 30	52s - 56s	90 - 60	1.5 - 2.0				
South Dorset Down	28 - 30	56s - 58s	75 - 50	1.5 - 2.0				
Southdown	21 - 26	58s - 64s	60 - 40	Not Apparent	Not apparent	Indefinite	Chalky	Finest and softest of the Down type wools. Very full-handling and spongy. May have coloured fibres on edge of fleece from about legs and head.

3.7 AVERAGE PERCENTAGE CLEAN WOOL YIELDS OF FULL FLEECE WOOL

Source: "Wool Board Statistical summary of Wool sold by Auction."

Breed	Category F/2 Wool (Fleece Wool/B. Grade) microns	Quality	Average Yield %
Lincoln, English	40	36/40s	76
Leicester, Border	37	44s	77
Leicester, Romney,	37	46s	78
Romney Crossbred	34	48s	78
Perendale	33	50s	77
Coopworth	31	52s	76
	30	54s	75
Halfbred, Corriedale	33	50s	71
Borderdale	30	54s	70
	27	56s	69
	26	58s	68
	24	60s	67
Quarterbred	26	58s	69
	24	60s	68
	21	64s	67
Merino	23	60s	66
	21	64s	65
	19	70s	64
	29	54s	69
Southdown, Suffolk	28	56s	66
Ryeland, Dorset Horn	26	58s	63
Dorset Down, Hampshire	24	60s	60
South Suffolk, Shropshire	21	64s	59
South Dorset Down			

3.8 AVERAGE PERCENTAGE CLEAN WOOL YIELD OF ODDMENTS OF GOOD/AVERAGE GRADE

Micron	Quality Number	Necks	Bulky Pcs. & Crutch-ings	Bellies	Locks & Second Pcs.
21	64	63	57	55	
23	60	65	58	56	45
26	58	68	60	58	
28	56	69	60	58	48
31	52	75	65	63	
33	50	75	66	63	
35	48	75	66	63	57
38	44		68	65	

3.9 AVERAGE PERCENTAGE YIELD OF FIRST LAMBS*

Micron	Quality Number	First Lambs
22		61
26		68
28	52/56	77
29	50/52	78
30	50/48	78
31	46/50	79
33	44/48	79

*Note change in micron/quality number relationship.

3.10 STATISTICAL REPORT ON WOOL SELLING SEASON

SEASONAL SUMMARY

DISPOSALS:	JULY TO JUNE (Full Season)		
1. Sales	1975/76	1976/77	1977/78
(a) at Auction:			
Greasy :bales	1,325,563	1,360,104	1,559,189
: kilograms	198,608,840	204,350,314	235,729,511
: average price (c/kg)	190.43	218.85	265.09
(ii) Scoured : bales	34,938	35,543	34,893
: kilograms	4,429,981	4,536,548	4,550,930
: average price (c/kg)	263.24	303.60	353.62
TOTAL BALES SOLD AT AUCTION	1,360,101	1,395,647	1,594,082
(b) Privately:			
(i) Brokers	13,568	18,627	33,564
(ii) Private Buyers & W.M.A.	333,489	406,433	462,638
(iii) Extra Choice	67,337	20,270	19,880
TOTAL SOLD PRIVATELY	414,394	445,330	516,082
2. Growers Shipments (in bales)			
(a) Greasy	9,012	10,255	5,843
(b) Scoured	40,395	43,758	42,950
(c) Slipe	9,313	4,468	1,263
TOTAL GROWERS SHIPMENTS	58,720	58,481	50,056
3. Slipe Disposals (in bales)			
Freezing Companies and Fellmongers	212,664	204,680	216,802
TOTAL DISPOSALS			
(a) In bales	2,046,044	2,104,138	2,377,022
(b) In kilograms (greasy equivalent)	317,013,263	328,635,575	368,124,357
SCOURING: (in tonnes)			
(a) On account Growers	8,577	8,981	9,320
(b) On account Exporters	97,218	108,745	127,376
TOTAL SCOURED	105,795	117,726	136,696

EXPORTS: (in tonnes)			
(a) Greasy	111,324	117,742	127,678
(b) Scoured	106,297	121,395	140,812
(c) Slipe	25,161	19,985	16,753
TOTAL EXPORTS	242,782	259,122	285,243
LOCAL MILL PURCHASES: (in bales)	121,492	156,814	138,626
BOARD MARKET ACTIVITIES (N.Z. & U.K.) : in bales			
(a) Bids (Market Intervention incl. S.P.C.)	401,928	47,852	422,064
(b) Purchases			
(i) Intervention	122,256	5,679	136,345
(ii) Extra Choice	67,337	20,270	19.880
(iii) Other	1,735	28	864
(c) Sales – all	91,430	137,918	115,342
(d) Government Supplementary Minimum Prices Scheme			
(i) Supplement Paid ($)		1,362,443	27,641

Source: Wool News August 1980.

3.11 SAMPLING AND TESTING OF WOOL

3.11.1 Introduction

Sale by sample was introduced in New Zealand in 1970 as a means of holding down the steadily increasing cost of handling wool in brokers' stores. If wool is to remain competitive in a textile world it has to arrive at its destination at a price that is comparable to other fibres.

Since 1970 however sale by sample has not moved forward as fast as hoped by the instigators of the scheme. But with more brokers realizing the advantages of the sale by sample method, more of the New Zealand wool clip will be sold this way in the future.

There are two main aspects of the scheme. Firstly, the wool is grab-sampled by the brokers. This sample is displayed in an open box in the woolstore for the buyers to examine. Core samples are also taken from a number of bales in the lot and these are tested according to International Wool Textile Organization guidelines. The results of these tests are shown on a certificate which accompanies the grab-sample.

Unfortunately in the last few years there have been a lot of problems with the system, mainly as a result of human error. These have been rectified and the sale by sample system is being developed as a useful tool in the expansion of the wool industry's marketing activities.

As with any new scheme, there are the critics, who in this case are asking where are the advantages of the sale by sample in cash or economic terms. Many people are not convinced that crossbred wools require fibre diameter specifications, as at least 50% of the wool is scoured in N.Z., and that pre-sale test certificates are not needed for all wools because buyers are skilled at assessing yield, etc. In-store handling efficiencies is the area where economies are to be made and there will be considerable interest by growers in this region. Competition in the wool brokering industry is regarded as desirable by many people. This leads to a more healthy industry. Tradition is important in the brokering and buying trade but tradition must not stand in the way of progress. However, change must be motivated by a competitive element and not by the directive of academic theories.

3.11.2 Advantages of the Sampling and Testing System

There are several reasons why pre-sale testing is good business for the wool grower:

(i) The test data gives buyers greater confidence in putting full value on high yielding wools, which make up a large proportion of the New Zealand wool clip.

(ii) The payment is on the certified measured clean weight of wool, without the normal allowance for moisture variation in the store. This more than covers the cost of the test.

(iii) The data helps the buyer achieve the correct weight and average fibre diameter for an order. It reduces his risk of claims and gives him a certificate to combine with others or as a check on scouring efficiency. In Australia, where 70% of wool is sold by sample, these advantages are putting 5 to 6 cents per kilograms at least on sale-by-sample wool.

In New Zealand, the Wool Board has had to support prices at auction while buyers became acquainted with the new system. Now sale-by-sample returns are normally on a par with traditional showing and occasionally above.

(iv) The system brings efficiencies in woolstore operation. Traditional display meant as much as 9 separate moves around the store of the woolbales. With pre-sale testing, the wool could be handled within an hour and not touched again until delivery out of the store. There are distinct advantages in saving labour, space and time, as well as increasing lot sizes.

(v) The grower will gain by supporting the system that leads on to greater economies. Samples can be sent far from the bulk of the wool for sale at a point convenient for the buyers – thereby cutting their costs. At a later stage, measurement could remove the necessity of even showing samples. The Wool Research Organization has a system for measuring color of scoured wool and plans to adapt it for greasy wool. Measures of length and strength are also being developed. Data-only sales could be conducted on telephone or TV – with greater savings and efficiency.

The replica of a pre-sale test certificate shown below contains the results of various tests done on a line of crossbred wool grown in Canterbury.

PRESALE TEST CERTIFICATE

To I.W.T.O. – 3 Specifications

Test on: 35 bales of Greasy New Zealand Wool WTS No. 87687 W

Centre	Broker	Sale No.	Lot No.
LINC	CACF	9	T.257

Gross Weight : 6879 kg
Declared Tare : 42 kg
Nett Weight : 6837 kg

Sub-Samples Tested	Vegetable Matter Base *	Hard Head and Twigs	Wool Base **	95% Confidence Limits
5	0.61	0.11	63.83	0.54

The following yields are derived from the above using published data and allowances.

	Clean Wool Content	Scouring Basis 16%	Scouring Basis 17%	IWTO Schlum Dry	IWTO Noble Oil	IWTO Carded Sliver	JCSY	ASTM CWFP
Yield %	76.42	76.48	77.14	74.23	77.80	74.93	75.17	74.22
Clean Weight	5225	5229	5274	5075	5319	5123	5139	5075

FIBRE FINENESS

Readings	Mean	95% Confidence Limits
4	35.5	0.4

* **Vegetable Matter Base:**

The oven-dry weight of ash-free, alcohol extractives-free burrs (including hardheads), twigs, seeds, leaves and grasses present, expressed as a percentage of the weight of the core sample.

Note 1. 'Hard heads' are Noogoora burrs (**Xanthium pungens**), Bathurst burrs (**Xanthium spinosum**) and similar burrs of a bean-like nature covered in readily removable spines. They do not contribute to a loss of wool during processing.

Note 2. 'Twigs' are small pieces of stick, woody leaf stalks and similar woody material. They do not contribute to a loss of wool during processing.

** **Wool Base:**

The oven-dry weight of wool fibre free from all impurities, i.e. ash-free, alcohol extractives-free and free from all vegetable matter and other alkali-insoluble impurities, expressed as a percentage of the weight of the core sample.

3.11.3 Core Sampling

The use of core sampling of wool to determine the various characteristics of the wool has been a big step forward in the wool marketing industry. It assists both buyer and producer. There are two bodies that offer core sampling facilities in this country. They are the New Zealand Wool Testing Authority established by the Wool Testing Authority Act 1964, and Wool Testing Services (N.Z.) Ltd., a commercial organization.

The International Wool Textile Organization (I.W.T.O.) has set out regulations and guidelines for core sampling of wool which must be observed by all testing authorities. Some of the more important are shown below:

(i) Every bale in a lot shall be core sampled at the time of weighing.

This avoids a change in weight of the bale.

(ii) The weight of cores taken shall be sufficient to provide five subsamples, each preferably 200 grams and not less than 150 grams.

(iii) Sampling equipment and the number of cores taken per lot shall be such as to produce a sampling precision of ± 1% IWTO Clean Wool Content at a probability level of 0.95.

(iv) Cores may be taken by:

- Manually operated pressure coring equipment.
- Power driven rotary coring equipment.
- Automated power pressure coring machines.

(v) The tube must be entered in the direction of compression of the bale.

(vi) The point of penetration must be randomly positioned over the surface to be cored but must not be nearer than .5cm from the edge of the bale.

(vii) When manual or power driven coring equipment is used, the following procedure will apply:

- Where one core per bale is taken, the core shall be taken alternately through the cap and base of succeeding bales.
- Where two cores per bale are taken, the core shall be taken through the cap and base of each bale.
- Where 4, 6, 8 or 10 cores are taken, then 2, 3, 4 or 5 shall be taken through cap and base respectively.
- Where three cores per bale are taken, alternate bales shall be cored 2 cap – 1 base and 1 cap – 2 base.
- Where 5, 7, or 9 cores are taken, alternate bales shall be cored according to the same principle, with corresponding increases in numbers.

(viii) When automated coring equipment is used, the core is taken from 95% or more of the length of the bale. The core shall be taken through the base of the bale where contamination with bagging material is more readily avoided.

(ix) Before the coring tube is inserted, sufficient bagging must be removed from the penetration area to avoid contamination of the sample with bagging.

(x) On withdrawal of the tube, the core shall be extruded into a sample container without loss of material and without undue exposure to the atmosphere. The sample container shall be so constructed that the sample stored in it shall not show a material change in its moisture content during storage, before weighing.

Scale of Core Samples per Bale of Wool

1. Greasy Wool and Slipe Wool

5	bales	=	12	core(s)	per	bale
6	"	=	10	"	"	"
7	"	=	9	"	"	"
8	"	=	8	"	"	"
9	"	=	7	"	"	"
10 - 14	"	=	6	"	"	"
15 - 19	"	=	5	"	"	"
20 - 24	"	=	4	"	"	"
25 - 39	"	=	3	"	"	"
40 - 74	"	=	2	"	"	"
75 and over		=	1	"	"	"

2. Scoured Wool

2	bales	=	12	"	"	"
3	"	=	8	"	"	"
4	"	=	6	"	"	"
5	"	=	5	"	"	"
6 - 7	"	=	4	"	"	"
8 - 11	"	=	3	"	"	"
12 - 24	"	=	2	"	"	"
25 and over		=	1	"	"	"

3.12 NEW ZEALAND SELLING SYSTEM

3.12.1 Modes of Sale

There is no controlled marketing of New Zealand wool. Growers sell their individual clips in one or more of the following ways:-

(a) At auction in New Zealand
(b) At auction in the United Kingdom
(c) Privately to a wool merchant or mill
(d) Privately through a co-operative

About 78% of the shorn wool produced is sold on behalf of growers at auction in New Zealand by the auction selling woolbrokers, about 20% is sold privately, and 2% is shipped for sale by auction at Bradford.

The bulk of the slipe wool (i.e. wool removed from the skins of slaughtered sheep) is produced by freezing works from animals purchased from growers at a "schedule price" (which may alter weekly). Freezing Companies in turn sell most of this wool through traders specialising in slipe wool. Small quantities are sold at auction in the United Kingdom and New Zealand. Approximately 15% of slipe wool production remains in grower ownership, mostly in pools (operated by grower co-operative associations). A relatively larger proportion of grower or pool wools are sold at the U.K. (Bradford) auctions.

3.12.2 Auction Sales in New Zealand

(i) General Organisation

Although wool auction sales in New Zealand are legally public auctions, they are attended only by the recognised woolbuyers, i.e. woolbuying firms with representatives resident in New Zealand. Woolbuyers purchase wool at the sales in fulfilment of, or in anticipation of orders from their principals.

The sales are conducted by woolbrokers at eight auction selling centres, four in the North Island (Auckland, Napier, Wanganui and Wellington) and four in the South Island (Christchurch, Timaru, Dunedin and Invercargill).

(ii) Woolbrokers' and Woolbuyers' Association

The brokers have a national association with branches at each of the eight selling centres. Woolbuyers also have an association, and in matters of policy the individual buyers and individual brokers agree to abide by the decisions of their respective associations. Representatives of the two associations meet regularly to discuss common problems, and are represented on various wool industry committees dealing with areas of common interest such as the rostering of the sales, shipping, etc.

(iii) Woolbrokers' and Woolbuyers' Regulations

Woolbrokers and woolbuyers are parties to agreed regulations covering:-

- the procedure for display or showing of wool
- weighing, lotting and cataloguing of the wool
- insurance arrangements
- the facilities for buyers to value and inspect wool

- the sampling of wool by buyers
- the auction sales rules
- the after-sale procedure regarding confirmation of purchases, rebranding of bales for exports
- documentation
- shipping instructions and payment for wool purchases
- press market reports after each sale (with the Wool Board)

(iv) **Roster of Auction Sales**

A roster of auction sales is drawn up by the Wool Auction Sales Committee. The Committee comprises representatives of the woolbuyers, woolbrokers and the Wool Board (representing the growers). The roster sets out dates for the sales and the quantities to be offered at each sale.

Sales at each centre are normally held on one day commencing at 8 a.m. However, when there is too much wool available at a centre to be sold in one day, or too little for a viable sale this general rule is varied by rostering.

(a) Double sales, i.e. two-day sales at the same centre. The two selling days are separated by a non-selling day.

(b) Combined sales, i.e. sales for two centres are held on the same day. Wool is valued at each centre but is all sold at one or the other.

During most of the season sales are held on two days and occasionally three days each week. Usually there is at least one clear day between selling days but in a few cases two sales, one in the North Island and one in the South Island, are rostered on consecutive days. Limits are set on the amount of wool and number of lots which may be offered in one day and the total amounts which may be offered at double and consecutive sales. The purpose of these limits is to ensure that selling days are not unduly long and that too much wool is not offered over a short period which might tend to depress the market.

(v) **Woolbuyers**

Teams of buyers travel from selling centre to selling centre arriving two or three days in advance of the sale to give them time to value the offering. As valuing and selling is going on constantly in both islands, most firms have to employ a separate team of buyers for each island.

At the beginning of each season, the Woolbuyers Association arranges seating for buyers at the sale according to the quantities of wool purchased during the three previous seasons. Those buyers who purchased the most wool are given a choice of the best seats. There are usually about 40 buying firms at a sale.

(vi) **Display and Sale**

Brokers receive the wool into store from growers and weigh it. If the wool is to be skirted, reclassed or "binned", the bales are segregated for this purpose. Binning is a process whereby wool of similar type belonging to various growers is mixed together and offered in large, uniform lots, which makes the composite offering more attractive to buyers. The final sale proceeds are distributed equitably among the growers whose wool went into the binned lines. Larger clips are often reclassed by brokers. Reclassing involves taking the wool as packed in the shearing shed and dividing it more precisely according to quality and style with the aim of getting the best possible price for each lot. Wool not binned or reclassed is offered in growers' lots as received into store. In order to make larger lots, which are more attractive to buyers, growers' lots are sometimes "interlotted" (i.e. similar wool from several different growers is combined in one lot).

The quantity of growers' wool that is binned or reclassed by brokers has declined in recent years.

The Woolbrokers' and Woolbuyers' Regulations provide that wool must be displayed for valuation by the buyers for an agreed number of days before the sale. Various forms of sale by sample are being progressively adopted by the New Zealand trade. Conventionally a proportion of the bales in each lot (about a quarter or a third) are stacked for inspection by the wool buyers.

Buyers inspect the wool on show and assess the quality, length, style and yield, etc. This enables them to arrive at a valuation. They then mark their valuations or "limits" in copies of the catalgues made available to them by brokers and thus are ready at the sale to compete in bidding for the particular lots of wool they wish to purchase. Brokers also make valuations before the sale, and it is their practice to communicate these valuations to growers. Growers may instruct their brokers to place a reserve (i.e. to decide the lowest acceptable price) on their wools.

At the auction sales, lots are "knocked down" (i.e. sold) to the highest bidder. Bids are usually in½ cents per kilogram up to 100 cents, and in cents per kilogram above that level.

(vii) **Market Reports**

After each sale, market reports are issued to the press, showing the trend of prices, and comparisons of prices of types of wool with prices at previous sales. These reports are issued jointly by the New Zealand Woolbuyers' Association, the local Woolbrokers' Association and the New Zealand Wool Board.

(viii) **Payment for Purchases and Shipments**

Buyers pay for their wool purchases on or before "prompt date", which is usually 18 days after the sale. After the sale, the wool, which has been drawn out by the buyers to make the valuation described above, is replaced in the bales and the bales are then sewn up. In the shipment of wool, a procedure known as "dumping" is used. Two bales are pressed together and are bound with wires, thus compressing the bulk of two normal bales into the space occupied by one. On occasions they may then be "unitised" into 12 bale (6 double dump) parcels. An increasing quantity of wool is being packed in containers and it is expected that in the future 75% of New Zealand wool exports will be shipped in this way.

Overseas shipping companies operating in New Zealand have their representatives in attendance at auction sales to facilitate the booking of space in ships and to ensure prompt shipment of the wool after the sale. The buyers arrange with the shipping company for the wool to be shipped, and give them the final destination and any new marks (or "countermarks") with which to label the bales.

3.12.3 Private Buying in New Zealand

In addition to the auction system, growers may dispose of their wool privately to local merchants. The merchants visit the farms, or the grower takes all or part of this clip to the merchant and they settle on a mutually acceptable price – normally based on current auction values. The New Zealand Co-operative Wool Marketing Association is a private buying organisation run on co-operative lines. Members sell their wool to the Association and receive a preliminary advance followed by a

final payment when the wool is sold, and at the end of the season, a share of any overall trading profit achieved by the Association.

Including N.Z.C.W.M.A. private buying accounts for about 20% of sales by growers of total greasy and scoured wool. This proportion can fluctuate quite widely in differing market situations from season to season.

Private buyers dispose of their purchases either within the New Zealand wool trade (i.e. to exporting firms), to local processing mills, at auction or, in a minority of instances, by direct export to overseas consumers.

3.12.4 United Kingdom Auctions

Approximately 2% of New Zealand greasy and scoured wool is consigned to the United Kingdom and sold at the Bradford auctions on account of growers. Sale by sample is extensively used at Bradford sales, and the CIF sample sale allows wool to be sold by this method when the bales themselves are en route from New Zealand by ship. British and Continental mills have easy access to immediately available wool at the Bradford auctions.

SECTION 4

BEEF CATTLE PRODUCTION

4. BEEF CATTLE PRODUCTION

4.1 BEEF CATTLE STATISTICS

4.1.1 Beef Cattle Numbers as at June 1979 ('000)

Statistical Area	Beef Cows	Total Cattle	% of Total Cattle
Northland	206	627	12.24
Central Auckland	59	260	5.07
Sth. Auckland/Bay of Plenty	328	1 094	21.35
East Coast	159	381	7.43
Hawke's Bay	195	611	11.92
Taranaki	44	183	3.57
Wellington	243	792	15.46
NORTH ISLAND	1 234	3 948	77.07
Marlborough	40	102	1.99
Nelson	29	89	1.73
Westland	25	72	1.40
Canterbury	128	364	7.10
Otago	116	307	5.99
Southland	84	240	4.68
SOUTH ISLAND	422	1 174	22.92
NEW ZEALAND	1 656	5 122	100.00

* = Beef cows and heifers, 2 years old and over, bred from this season

Source: 'Annual Review of the Sheep and Beef Industry (1979/80' N.Z. Meat and Wool Boards' Economic Service.

4.2 FACTORS INFLUENCING BEEF CATTLE PERFORMANCE

The major factors influencing beef cattle performances are the physical performance of the cattle and the level of market returns.

4.2.1 Physical Performance

(i) Calving percentage.

The average calving percentage of a hill country breeding herd is 80 – 85%. However, in very rough country or under harsh climatic conditions it may fall as low as 60%. On the other hand, under good conditions and management, calving percentages of 95% are not uncommon.

(ii) **Death rate.**

A figure of 2 – 3% is acceptable for breeding cows, but this can rise considerably in years with hard winters and late springs, which may also increase deaths in calves, from birth to weaning, from 3 – 4% to over 10%. After weaning death rates are low, 2 – 3% and the main cause of loss is bloat.

(iii) **Replacement rate.**

A breeding cow on hill country will be retained for produce on average for 4 - 6 years before being replaced. Under good conditions this could be considerably longer. Consequently about 20% of the herd is replaced annually. This figure is greater if the herd is in an expansion phase.

The majority of heifers are mated to calve for the first time as 3 year olds but an increasing number are being mated 1 year earlier.

Bulls are used for an average of 3 – 4 seasons.

(iv) **Growth rate.**

The growth rate of growing beef cattle is affected by the quality and quantity of feed available and by the breed or cross of the animal. The actual weight gains vary greatly but calves single suckling beef cows gain from 0.5 – 1kg/day. The average figures for weaners would be

Autumn	Winter	Spring	Summer
0.5	0.0 – 0.6	1.0 – 1.2	0.6 – 0.8 (kg/day)

4.2.2 Stock Sale Policy

(i) **Breeding herds.**

The most popular breeding herd policy is to sell all weaner steers and heifers in excess of replacement requirements at 6 – 9 months of age in the Autumn weaner sales.

However, on some properties, all, or a proportion of weaners, are kept over the winter and sold as yearlings. On very hard hill country steers may not be sold until they are 2 - 3 years of age, still in store condition. Where breeding herds are situated on properties with some high quality grazing area the steers may in fact be held right through to 20 months and sold in a finished or prime condition.

Cull cows are normally sold in the autumn.

(ii) **Finishing Cattle.**

Many policies are possible, but the main ones are:

- Purchase of weaners in autumn to sell the following autumn at 18 – 20 months.
- Purchase of yearlings in the spring to sell at 18 – 20 months.
- Purchase of 2 year olds in spring for sale the following summer/autumn.
- Purchase of 2½ year old steers in autumn to sell on the local winter market.

4.3 METHODS OF SELLING CATTLE

There are a number of alternative methods of selling cattle as follows:

4.3.1 By Auction

The majority of **weaners, yearlings** and **older store stock** are sold by public auction in many recognised centre. **Prime stock** for local consumption are also sold this way.

4.3.2 By Private Treaty

A small but increasing number of **store** stock change hands by private treaty. The price is normally agreed on a per head basis but some sales on a per kg liveweight basis are made. Private sales may also be for delivery at some forward date.

A number of prime cattle are sold for both the local and export trade by private sale.

4.3.3 On Schedule

The New Zealand meat export companies issue a price list or schedule indicating the base price, by grade, for cattle sold for export. This price is paid on the hot carcase weight, and grade.

The majority of **steers, heifers, cull cows and bulls** destined for export are sold on this basis.

4.4 DRESSING OUT PERCENTAGES

The most important single factor influencing the value of a store or prime beef animal is its carcass weight. Carcass weight can be estimated from liveweight when dressing out percentage is known.

$$\text{Dressing out \%} = \frac{\text{carcass weight}}{\text{liveweight}} \times \frac{100}{1}$$

For example:

	Dressing out %
Store cattle	45 – 48
Grass finished	50 – 53
Crop finished	52 – 55
Grain finished	54 – 58

4.5 BEEF STOCK RECONCILIATION

An example of a beef cattle stock reconcilliation is given here for a breeding cow policy, using a balance date of 30th June. It is important to note that the balance date chosen affects the classes of stock chosen, i.e. whether heifers are referred to as 20 month heifers or rising 2 year olds.

The example assumes

Angus cows mated to Angus bulls, with all surplus calves sold as weaners and reared replacements, herd.

4.5.1 Production Parameters –

To reconcile beef cattle numbers the following production parameters must be from:-

(i) Calving percentage or natural increase.
(ii) Deaths and losses.
(iii) Culling percentage of each class of stock.
(iv) Replacement numbers required, being determined by the combined deaths and culling rates.
(v) Age at which heifers first go to the bull, i.e. at 14 months of age or 26 months of age.
(vi) Time of calving: spring or autumn.
(vii) Number of bulls per 100 cows.
(viii) Bull replacement rate

For this example, these decisions are:-

(i) Calving percentage 75%.

(ii) Deaths and losses – Calves 6%
– Yearlings 4%
– Heifers 4%
– Cows 5%
– Bulls 2%

(iii) Culling programme. Calves are culled as weaners and only replacements are kept. Major culling then is on age, constitution and whether or not the cow is in calf. Figure used 18 – 20%.

(iv) Replacement numbers required 25 heifers per 100 cows.

(v) Heifers go to the bull at 26 months of age.

(vi) Spring calving

(vii) Number of bulls, 3%

(viii) Each bull used for 3 seasons, therefore replacement rate is 30%.

The above data is then included in the annual reconciliation over page:-

Stock Units Opening 1/7/80	Rate	Class of Stock / Breed	Opening Nos. @ 1/7/80	Natural Increase	Killed	Deaths and Losses	Sales	Purchases	Closing Nos. @ 30/6/81	Class of Stock	Closing s.u.'s 30/6/81
	Heifers										
		Calves		37						Calves	
94.5	3.5	R1yr	27			2	8		27	R1yr	94.5
117.0	4.5	Dry R2yr	26			1			26	Dry R2yr	117.0
		I.C. R2yr				1				I.C. R2yr	
		I.C. R3yr	25						25	I.C. R3yr	
		M.A. Cows	75			1 4	4 16		75	M.A. Cows	
600	6.0	TOTAL BR. COWS	100						100	TOTAL BR. COWS	600
	Steers										
		Calves		38						Calves	
		R1yr				2	36			R1yr	
		R2yr								R2yr	
		R3yr								R3yr	
		R3yr +								R3yr +	
		TOTAL STEERS								TOTAL STEERS	
	Bulls										
		Calves								Calves	
		R1yr								R1yr	
		R2yr								R2yr	
		M.A.	3				1	1	3	M.A.	
16.5	5.5	TOTAL BULLS	3						3	M.A.	16.5
		TOTAL CATTLE	156	75	-	11	65	1	156	TOTAL CATTLE	
			a	b	c	d	e	f	g		

828	TOTAL SU's ÷	55.2	EFFECTIVE AREA =	15	SUs/ha	SUs/ha	15	=	55.2	:	828

CALVING PERFORMANCE (Based on Cows Mated)
Cows = 75 %: Heifers = - %:

DEATH RATES
Cows = .5 %: R1yr Hfs = .37 %: R2yr Hfs = .38 %
Bulls = - %: R1yr Sts = - %: Steers = - %

RECONCILIATION
(1) Totals a + b + f = 232
(2) Totals c + d + e + g = 232
Total (1) must = Total (2)

SECTION 5

DAIRY CATTLE PRODUCTION

5 DAIRY CATTLE PRODUCTION

5.1 DAIRY STATISTICS

5.1.1 Description of Dairy Herds 1978/1979

TOTAL HERDS includes Factory Supply and Town Supply herds at 31 January 1979 – N.Z. Dairy Board estimate.

All other figures relate to Factory supply herds with 10 or more cows in milk at 31 January 1979.

District	Total Herds 10 dairy cows in milk	Av. number cows in milk Dec 78/Jan 79	Distribution according to herd size % of herds of: .....number of cows 10-39	40-59	60-79	80-99	100-149	150-199	200-249	250-299	300 plus
Northland	1 984	114.3	3.7	5.8	12.0	20.7	39.5	11.4	4.7	1.3	0.8
C. Auckland	1 396	111.6	3.0	7.6	14.9	19.9	37.6	11.0	4.2	1.0	1.0
S. Auckland	5 526	134.6	1.0	2.2	7.1	15.6	42.3	20.2	8.0	2.2	1.5
Bay of Plenty	1 281	131.3	3.1	3.4	7.8	15.4	40.5	18.0	7.9	2.3	1.6
Cent. Plateau	453	129.3	1.3	1.0	3.6	14.0	60.2	12.7	3.6	1.8	2.0
West Upland	68	132.0	2.4	4.8	7.1	7.1	40.5	33.3	4.8	0.0	6.0
East Coast	45	103.8	13.3	6.7	33.3	13.3	13.3	6.7	6.7	0.0	6.7
Hawkes Bay	294	105.9	4.3	6.9	11.3	23.8	37.2	14.7	0.9	0.9	0.0
Taranaki	2 818	121.6	1.4	4.6	10.7	18.0	42.4	16.3	4.7	1.4	0.4
Wellington	967	116.2	4.5	8.8	12.6	15.5	36.8	12.9	5.5	1.5	1.8
Wairarapa	465	124.2	3.3	5.3	8.9	17.1	38.9	18.7	5.1	1.3	1.3
Nelson/M'borough	409	197.8	5.3	12.3	19.3	19.8	31.6	9.2	2.0	0.3	0.3
West Coast	293	117.5	1.8	4.4	7.0	18.1	53.5	9.6	3.7	1.5	0.4
N. Canterbury	345	74.7	24.5	17.6	21.4	11.9	17.0	4.4	2.5	0.0	0.6
S. Canterbury	95	73.9	13.7	23.5	21.6	21.6	15.7	3.9	0.0	0.0	0.0
Otago	233	77.2	19.8	17.4	18.6	16.3	20.9	5.8	1.2	0.0	0.0
Southland	235	69.0	19.7	30.6	18.5	13.3	13.9	3.5	0.6	0.0	0.0
North Island	15 297	125.6	2.1	4.1	9.4	17.1	41.5	16.8	6.2	1.8	1.2
South Island	1 610	92.0	11.0	14.9	16.5	17.0	30.5	7.2	2.1	0.5	0.3
New Zealand	16 907	123.2	2.7	4.9	9.9	17.1	40.7	16.1	5.9	7.1	1.1

Source: New Zealand Dairy Board 55th Farm Production Report - 1978/79 season.

5.1.4 Milkfat Processed in Dairy Factories 1978-1979 Season (000 tonnes)

District	1978 June	July	August	Sept.	Oct.	Nov.	Dec.	1979 Jan.	Feb.	March	April	May	TOTAL
North Auckland	0.043	0.489	2.771	4.227	5.247	5.132	4.596	3.691	2.521	2.707	2.158	0.890	34.478
South Auckland	0.210	1.263	8.238	14.672	18.700	17.767	16.613	14.121	9.671	10.598	9.422	4.367	125.642
Bay of Plenty	0.018	0.132	1.353	2.731	3.559	3.402	3.133	2.654	1.996	2.196	1.637	0.565	23.376
Taranaki	0.018	0.100	1.999	5.181	7.429	7.344	6.825	6.099	4.443	4.433	3.867	1.778	49.516
Wellington/Hawke's Bay	0.078	0.081	1.001	2.593	3.757	3.744	3.368	2.939	2.057	2.067	1.926	1.042	24.653
North Island	0.367	2.065	15.362	29.404	38.692	37.389	34.535	29.504	20.001	22.001	19.010	8.642	257.659
South Island	0.088	0.060	0.148	1.065	2.207	2.567	2.440	2.223	1.728	1.728	1.462	0.757	16.515
NEW ZEALAND	0.455	2.125	15.510	30.469	40.899	39.956	36.975	71.727	23.729	23.729	20.472	9.399	274.174

Source: New Zealand Dairy Board 55th Farm Production Report, 1978-79 Season.

Note: Because of rounding, some totals do not add to the figures shown.

5.1.5 Percentage of Suppliers to Dairy Factories Supplying Wholemilk (by district)

District	1977 - 1978 %	1978 - 1979 %
Northland	95	96
South Auckland	99	99
Bay of Plenty	98	99
Taranaki	99	99
Wellington-Hawke's Bay-East Coast	96	97
Nelson-Marlborough-West Coast	97	98
Canterbury	67	73
Otago	68	70
Southland	100	88
North Island	98	99
South Island	87	88
NEW ZEALAND	97	98

Source: New Zealand Dairy Board, 54th Farm Production Report, 1977-78 Season.

5.1.6 Dairy Cattle at 30th June 1977

(NEW ZEALAND DEPARTMENT OF STATISTICS)

District	Dairy Cows/Heifers 2 years old and older		Dairy Heifers 1 and under 2 years old		Dairy heifer calves	Bobby calves	Breeding bulls of all ages	TOTAL DAIRY CATTLE
	In calf or in milk	Not in calf	In calf	Not in calf				
Northland	227 509	4 033	29 394	13 030	41 577	1 055	6 453	323 051
Central Auckland	155 781	3 187	19 217	13 053	27 050	372	3 636	222 296
South Auckland - Bay of Plenty	932 992	10 907	131 757	54 998	170 703	1 095	27 056	1 329 508
East Coast	4 055	225	495	430	677	57	148	6 087
Hawkes Bay	36 131	938	4 641	3 292	6 864	114	1 043	53 023
Taranaki	324 110	5 492	56 290	16 819	69 473	346	9 306	481 836
Wellington	108 911	3 337	25 495	12 750	34 162	307	5 243	262 205
NORTH ISLAND	1 861 489	28 119	267 289	114 372	350 506	3 346	52 885	2 678 006
Marlborough	13 823	313	2 199	552	2 992	58	401	20 347
Nelson	35 773	1 213	5 998	2 070	8 078	217	875	54 224
Westland	18 745	624	3 490	832	4 297	42	573	28 603
Canterbury	38 951	1 801	5 138	4 294	7 742	636	1 220	59 782
Otago	19 555	845	2 147	1 953	3 622	342	565	29 029
Southland	18 475	744	3 025	1 352	4 129	516	617	28 858
SOUTH ISLAND	145 331	5 540	21 997	11 053	30 860	1 811	4 251	220 843
NEW ZEALAND	2 006 820	33 659	289 286	125 425	381 366	5 157	57 136	2 898 849

Source: Agriculture Statistics 1976-77

5.2 MEASUREMENT OF MILK AND CREAM:

Dairy companies measure milk by the litre (volume) and farm separated cream by the kilogram (weight). Payment for milk and cream is on the basis of kilograms of milkfat. Milkfat is shown on advice notes as kilograms per litre (kg/litre) for milk and kilograms per kilogram (kg/kg) for cream. One litre of milk weighs 1.032 kilograms.

5.3 COMPOSITION OF MILK AND PRODUCT YIELDS:

Milk is composed of the following fractions:

Milk fat	4.68%
Protein	3.73%
Casein	2.86%
Solids-not-fat	8.97%

The quantities of various products obtained from 500 000 litres of milk have been calculated as follows:

Assume (i) that the whole amount is used for the manufacture of (a) butter, (b) buttermilk powder, and (c) skim milk powder or casein,

(ii) that the whole amount is used to make cheese.

When the milk is separated, 5 740 kg of cream (40% fat) and 44 250 kg of skim milk are obtained.

(i)	(a)	Butter yield at 1.216 kg per kg milk fat	= 2 845kg
	(b)	Buttermilk – 60% of cream less 16% retained in butter and wash water = 2 898kg Buttermilk powder at 9% yield of buttermilk	= 261kg
	(c)	Skim milk powder at 98% recovery and 3.5% moisture	= 4 264kg
		Casein in skim milk at 3.003% = 1 329kg Casein in yield at 98% recovery and 11% moisture	= 1 445kg
(ii)		Cheese yield at 2.496 kg per kg fat	= 5 841kg
		Whey fat recovery at 6.2% of the milk fat entering the cheese-making process	= 145kg

Note: The yields of butter, buttermilk powder, skim milk powder and casein are based on milk composition with allowance for losses and over-run, i.e. moisture content etc. in commercial products. The cheese yield is calculated from factory data.

5.4 COW PRODUCTION:

5.4.1 Milkfat Production

When considering the milkfat production on a farm for budgeting purposes, work from milkfat figures supplied to the factory **not** from herd test figures. Obtain from the farmer figures for as many years factory production as possible, the number of cows and heifers to be milked during the season in question and estimate the number of effective milkers. Assess factory fat per cow and compare the total production with previous production, taking due regard of the season and the past present efficiency of the management on the farm.

5.4.2 Town Milk Production

The above remarks also apply to town milk-producing properties, but with these farms the concept changes from milkfat production to total litres of milk sold. The main difficulty in assessing the litres produced per cow, is to obtain the effective number of milking cows during the year. A useful method is to obtain the number of cows milked per month for the whole year. A town supply dairy cow usually milks for 9½ months, so this total is then divided by 9.5.

5.4.3 Effective Milking Cows

Average milkfat per cow was formerly calculated by dividing the amount of milkfat supplied to the dairy factory by the effective number of cows, i.e. the number of cows in milk on 15th January increased by 5% to give effective average production.

In recent years, it became apparent that the 5% correction was too high, and it was decided to stop using a conversion factor and the term "effective number of milkers" from the 1968-1969 season onwards. Instead, the number of cows in milk in December in the North Island and January in the South Island has been used.

5.5 THE TOWN MILK SUPPLY QUOTA SYSTEM:

5.5.1 Quota Milk

The New Zealand Milk Board is guaranteed a daily quota supply by the local association, who in turn organize the obtaining of this quantity by allocating a daily quota for the whole of the year to the farmer suppliers. The farmer must take out shares in the association to become a supplier and his milking shed and stock must comply with certain standards as set down by the Ministry of Agriculture and Fisheries.

The basis of allocation of quotas varies from one district to another. In Canterbury, the Canterbury Dairy Farmers Limited relates the increases in quota for 1979 to the amount of surplus milk supplied in the months of February, June, July, and the supplier's other lowest month of the year. The milk year operates from September 1st to August 31st.

5.5.2 Surplus Milk (milk produced in excess of the quota amount)

All milk produced on a town supply farm is taken by the local association, and the milk in excess of requirements is usually sent in from the receiving depot to a local dairy factory, where a lower price is obtained. In the spring months nearly all producers send in milk above their quota, but in other months of the year a proportion of the producers are unable to meet their full quota. Other farmers have an excess supply at this time and it is in these months that some excess milk is accepted at full quota prices.

5.5.3 The Quota Price

The price paid to town supply farmers in any one year is related by a special formula to the price for milkfat supplied to butter and cheese factories. It is computed by the New Zealand Milk Board who purchase the milk, on a guaranteed quota basis, from local producers associations. However, the price is finally fixed by the Government because of the consumer subsidy on town milk. Milk produced in excess of quota requirements receives a lower price, and there are penalties imposed on farmers that do not produce their quota amounts.

5.5.4 The Payment Scheme

As mentioned, the acceptance of surplus milk varies with the season, and throughout the country.

For example, the Canterbury Dairy Farmers Limited pay out on the following basis:

September	– full price paid for quota + 10%
October to January	– full price paid for quota + 5% All excess at surplus milk prices.
February to May	– Full price paid for quota + 20%. All excess at surplus milk prices.
June and July	– Full price paid for quota + 25%. All excess at surplus milk prices.
August	– Full price paid for quota + 20%. All excess at surplus milk prices.

It must be noted that the percentage figures shown above may change during the season.

The actual prices paid to the supplier by the local dairy company may also change during the season. The New Zealand Dairy Board may make interim increases in the price paid, which is then supplemented by the usual end-of season- bonus payment.

For every rise of 1 cent per kilogram of butter fat it receives on the international market (this means a rise above the expected price of butter for example, on which payments for milk during the season are based), it pays out 0.06 cents per litre supplied. The bonus for surplus milk supplied during the season is slightly lower.

The local dairy company also may declare a bonus payment at the end of the season. The Canterbury Dairy Farmers Ltd., for example, processes all surplus milk and trades as follows:

The milk is separated and the cream is sold as town cream. The butterfat is sold to the Tai Tapu Central Co-op Dairy Company Ltd. which makes it into butter. The C.D.F. Ltd. converts the remainder of the milk into skim milk powder, which has proved a successful venture in recent years.

5.6 CALVING PATTERNS AND ANALYSIS OF TOWN SUPPLY MILK PRODUCTION:

Because the seasonal production of milk is so important on a town supply farm, it is necessary to estimate the likely pattern of production (quota and non-quota milk) on a monthly basis so that likely deficiencies can be remedied and income can be more accurately estimated. To do this, a table showing cows calving, and the numbers in each month of their lactation, is drawn up. In such a table, cows calving means the number which actually calve down and enter the herd rather than total cows carried, i.e. they are the effective milkers. Another point to note is that if 10 cows are calving in August, then because some calve late in the month there will only be an effective 5 for the whole month.

As well as a knowledge of numbers of cows in milk each month and the month of lactation they are in, it is necessary to know the average production per cow per day in each month of lactation, in order to assess overall monthly production. The average Canterbury town supply herd produces and sells about 3 410 litres of milk per effective cow. A good herd of Friesians, well managed and fed, should produce about 4 090 litres per effective cow while one or two herds are producing about 5 450 litres per cow.

Lactation patterns of production in litres per day per cow for each month of lactation are given below for each of the 3 above-mentioned levels of production.

Period	3 410 litres/cow	4 091 litres/cow	5 455 litres/cow
Month 1	16 litres/day	18 litres/day	25 litres/day
Month 2	18 " "	20 " "	27 " "
Month 3	16 " "	18 " "	25 " "
Month 4	14 " "	18 " "	23 " "
Month 5	14 " "	16 " "	20 " "
Month 6	11 " "	14 " "	18 " "
Month 7	9 " "	11 " "	16 " "
Month 8	7 " "	9 " "	11 " "
Month 9	4.5 " "	7 " "	9 " "
Month 10	4.5 " "	4.5 " "	7 " "

CALVING SCHEDULE

MONTH 1979-80	Cow Calving	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
								1979												1980					
July	8	6	6	6	6	6	6	6	6	6	5	1	-	8	8	8	8	8	8	8	8	8	7	3	1
August	11		9	9	9	9	9	9	9	9	9	7	1	-	11	11	11	11	11	11	11	11	11	9	3
September	6			10	10	10	10	10	10	10	10	10	4	-	-	6	6	6	6	6	6	6	6	6	5
October	5				2	2	2	2	2	2	2	2	1	-	-	-	5	5	5	5	5	5	5	5	5
November	3					1	1	1	1	1	1	1	1	-	-	-	-	3	3	3	3	3	3	3	3
December	7						1	1	1	1	1	1	1	1	-	-	-	-	7	7	7	7	7	7	7
January	20							15	15	15	15	15	15	14	12	11	11	7	1	20	20	20	20	20	20
February	13								25	25	25	25	25	25	25	25	25	20	14	2	13	13	13	13	13
March	9									13	13	13	13	13	13	13	13	13	11	7	2	9	9	9	9
April	10										7	7	7	7	7	7	7	7	7	6	5	3	10	10	10
May	8											11	11	11	11	11	11	11	11	11	11	10	3	8	8
June	9												11	11	11	11	11	11	11	11	11	10	5	-	9
		82	97	98	103	99	81	85	89	92	88	87	90	90	98	103	108	102	95	97	102	105	99	93	93

PRODUCTION

	J	J	A	S	O	N	D	J	F	M	A	M	J
Per Cow	13.18	16.15	14.47	15.21	17.62	17.17	14.94	15.03	15.37	14.25	14.95	14.64	15.13
Total Milk	37290	45065	43975	47000	59000	52550	43995	45190	45470	46380	44410	42205	42205
Quota Milk	36787	36487	36487	32274	31834	30807	31834	31834	34034	36382	35208	36382	35208
Surplus Milk	503	8578	7488	14726	27166	21743	12161	13356	11436	9998	9202	5998	6997

MILK RETURNS

Quota Milk	36787	36487	36487	32274	31834	30807	31834	31834	34034	36382	35208	36382	35208
Quota Price	17.16	19.15	19.15	13.49	10.95	10.95	10.95	11.37	11.37	14.97	14.97	18.72	19.15
Quota Income	6312.64	6987.26	6987.26	4353.76	3485.82	3373.37	3485.82	3619.53	3869.67	5446.39	5270.64	6810.71	6742.33
Surplus Milk	503	8578	7488	14726	27166	21743	12161	13356	11436	9998	9202	5998	6997
Surplus Price	6.37	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66
Surplus Income	32.04	571.29	498.70	980.75	1809.26	1448.08	809.92	889.51	761.64	665.87	612.85	399.47	466.00
Chilling Margin (.152¢ per 1)	56.68	68.50	66.84	71.44	89.68	79.87	66.87	68.69	69.11	70.50	67.50	64.15	64.15
Total Income	6401	7627	7553	5406	5385	4901	4363	4578	4700	6183	5951	7274	7272

5.7 HERD REPLACEMENTS

5.7.1 Herd Wastage

There are several causes of wastage in tested dairy herds. The New Zealand Dairy Board (Farm Production Division) has analysed wastage and culling figures of dairy farms for the 1976-1977 season as follows:

Cause of Wastage	%
Sold for dairying	1.61
Accident or injury	0.29
Low production	5.05
Old Age	0.60
Unsuitable temperament	0.55
Unsuitable dairy type	0.19
Sold – reason not given	2.87
Disease	
Bloat	0.64
Calving troubles	0.12
Catarrh	0.04
Facial eczema	0.22
Johne's Disease	0.01
Lameness (incl. arthritis)	0.06
Leptospirosis	0.01
Mastitis	0.95
Metabolic –	
Grass staggers	0.10
Milk fever	0.13
Other	0.05
Reproductive –	
Abortion and brucellosis	0.33
Low fertility	3.19
Salmonellosis	0.02
Tuberculosis	0.03
Deaths – cause unknown	0.30
WASTAGE, ALL DISEASES	6.18
TOTAL WASTAGE	17.35

For budgeting purposes, 18 – 23% could be taken, the figures assessed after obtaining all the pertinent information about the farm, the management and the district. Cull cows are usually sold as boners. For the appropriate prices, refer to the latest beef schedule available.

5.7.2 Calving Statistics

The table below, based on information from the New Zealand Dairy Board (Farm Production Division), shows the various factors that affect the overall calving percentage.

Percentage of yearlings not in calf at the end of the mating season	7.4%
Percentage of milking cows not in calf at the end of the mating season	6.9%
Percentage of cows in calf to first service:	
(i) Natural service – 49 day period conception rate	68-70%
(ii) Artificial breeding – 49 day period conception rate	67.0%
Percentage of 2 year olds in calf which abort	3.6%
Percentage of older cows in calf which abort	2.6%
Percentage of cows calving within 6 weeks of district median calving date	85.0%
Percentage of all calves born that are female	48.0%
Percentage of heifer calves dying before one week or age	5.7%
Percentage of heifer calves dying between one week and one year of age	6.4%
Percentage of yearling heifers dying before two years of age	3.0%

The effective calving percentage, being calves alive after one week of age to cows mated, is approximately 86%.

5.7.3 Number of Heifers available as replacements.

In effect, the number of heifer calves available for rearing is 43 out of every 100 calves that are born. This includes late calves and free-martins which are not suitable for dairy stock, and these are disposed of as bobby calves. They amount to about 20%. Thus you have 32 heifer calves left that are suitable for rearing.

Losses from one month to 2 years are about 10% and of those that survive to the 2 year old stage, 5% do not get in calf. Thus we have approximately 27 heifers that will calve into the herd. As about 20% are required to maintain the numbers in a herd, there are 7 heifers that can be sold for dairying or need not have been reared. It is usual for a farmer to ensure he has sufficient replacements by having the number of yearling heifers equivalent to 25% of the number of cows in the milking herd.

5.7.4 Bulls

The average herd life of bulls is 4 years. This means that having been used in the herd for the first time at 15 months of age, the average bull would be 6 years old when culled.

The main causes of loss or disposal are prevention of inbreeding, poor results from the bull's progeny, sterility, accidents and difficulty in handling a bad-tempered beast. The increasing use of A.B., plus the high remuneration received for bull beef in recent years, has tended to reduce the active life of a bull in the herd.

5.8 STOCK RECONCILIATIONS

This section gives examples of dairy stock reconciliations on seasonal and town supply farms.

5.8.1 Seasonal Supply Herd

The balance date usually used on this type of dairy farm is 30th June, which coincides with the herd's dry period.

Class of Stock	On hand 1/7/78	Purchases	Natural Increase	Sales	Deaths/ Missing	On Hand 30/6/79
Cows to calve	173	4	–	44	2	131
Heifers to calve	57	–	–	6	2	49
Yearling heifers	69	–	–	19	–	50
Heifer calves	–	–	112	63	2	47
Bull calves	–	–	112	110	2	–
Bulls	–	3	–	3	–	–
TOTALS	299	7	224	245	8	277

Reconciling the numbers is the major part of the exercise:

On hand 1/7/78	299	On hand 30/6/79	277
plus purchases	7	plus sales	245
plus natural increaseq	224	plus deaths	8
	530		530

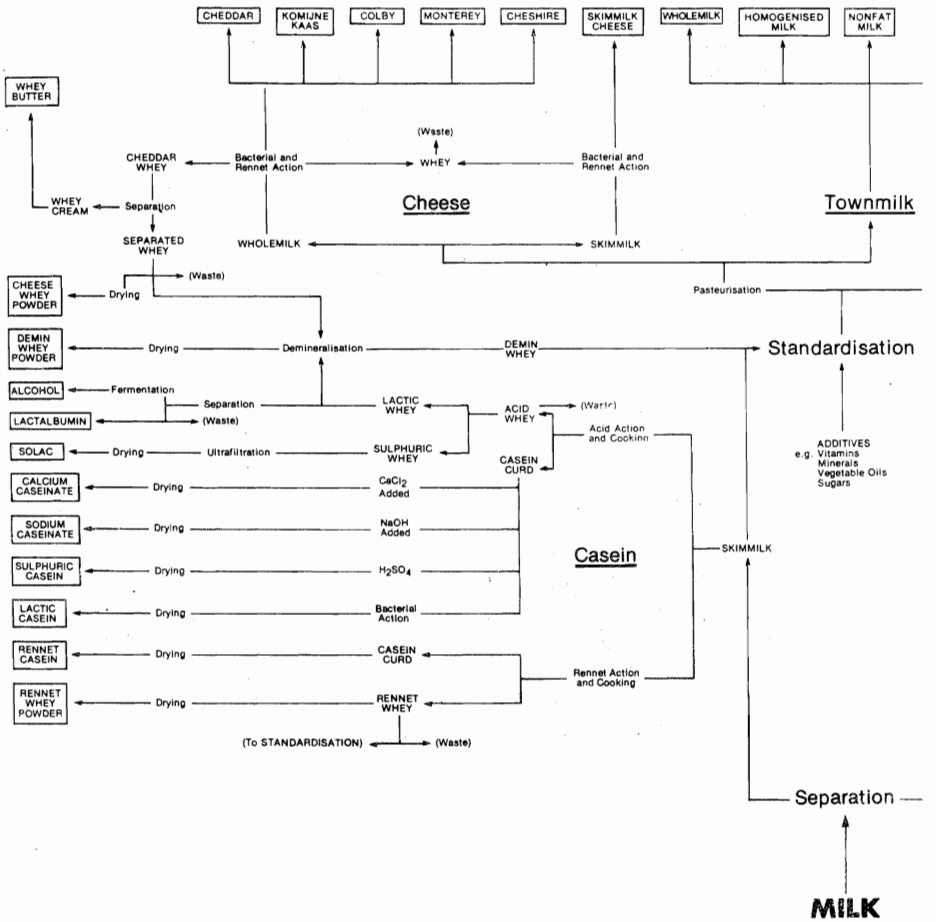
5.8.2 Town Supply Herd

The balance date used in the following example is March 31st.

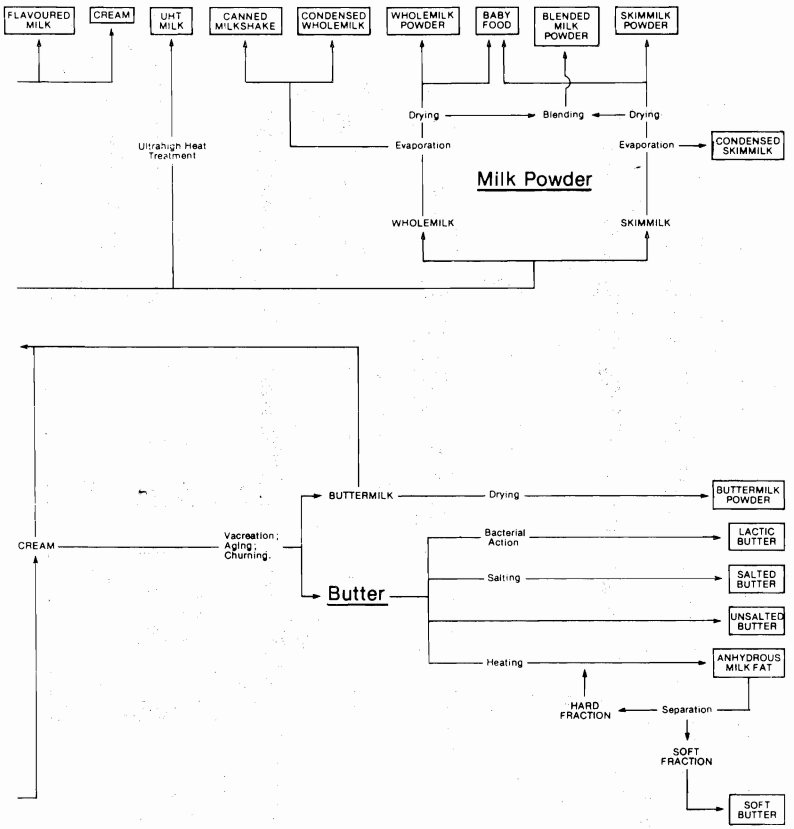
On hand 1/4/78			**On hand 31/3/79**		
Mature cows	94		Mature cows	100	
In-calf heifers	24		In-calf heifers	28	
Yearling heifers	30		Yearling heifers	42	
Heifer calves	12		Heifer calves	10	
Bulls	2		Bulls	3	
		162			183
Purchases:			**Sales:**		
Heifer calves	6		Cull cows	16	
Bull calf	1		Bobby calves	46	
		7			62
Natural Increase:	100		**Losses:**		
			Cows	2	
			Heifers	2	
			Calves	20	
		100			24
TOTALS:		269			269

As is obvious, the two preceding stock reconciliations are of two different styles. It should be remembered that there are several types of stock reconciliation, but one of the most important features is the ease with which one can work out what is happening to the herd during any year. The other important thing is that they should always balance, i.e. both sides of the table should be the same.

MILK FLOW


CHEDDAR
KOMIJNE KAAS
COLBY
MONTEREY
CHESHIRE
SKIMMILK CHEESE
WHOLEMILK
HOMOGENISED MILK
NONFAT MILK
WHEY BUTTER
(Waste)
CHEDDAR WHEY
Bacterial and Rennet Action
WHEY
Bacterial and Rennet Action
WHEY CREAM
Separation
Cheese
Townmilk
SEPARATED WHEY
WHOLEMILK
SKIMMILK
(Waste)
CHEESE WHEY POWDER
Drying
Pasteurisation
DEMIN WHEY POWDER
Drying
Demineralisation
DEMIN WHEY
Standardisation
ALCOHOL
Fermentation
Separation
LACTIC WHEY
ACID WHEY
(Waste)
LACTALBUMIN
(Waste)
Acid Action and Cooking
SOLAC
Drying
Ultrafiltration
SULPHURIC WHEY
CASEIN CURD
ADDITIVES
e.g. Vitamins
Minerals
Vegetable Oils
Sugars
CALCIUM CASEINATE
Drying
$CaCl_2$ Added
SODIUM CASEINATE
Drying
NaOH Added
Casein
SKIMMILK
SULPHURIC CASEIN
Drying
H_2SO_4
LACTIC CASEIN
Drying
Bacterial Action
RENNET CASEIN
Drying
CASEIN CURD
Rennet Action and Cooking
RENNET WHEY POWDER
Drying
RENNET WHEY
(To STANDARDISATION)
(Waste)
Separation
MILK

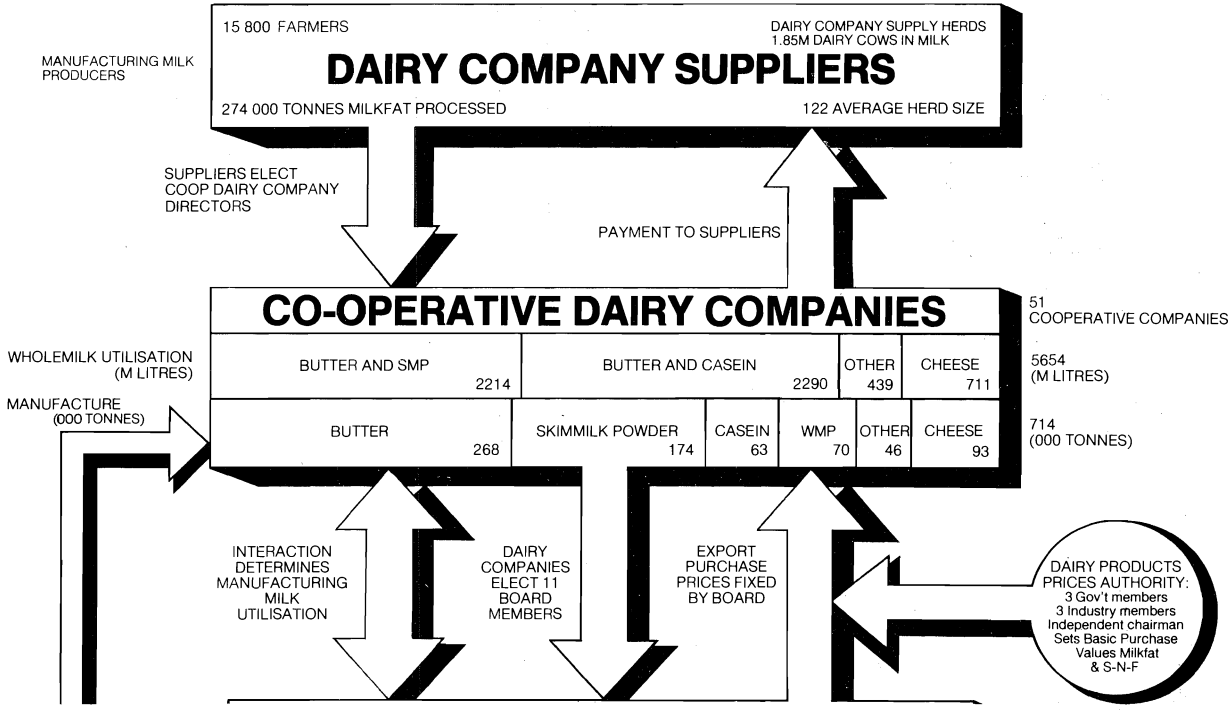
PROCESS CHART

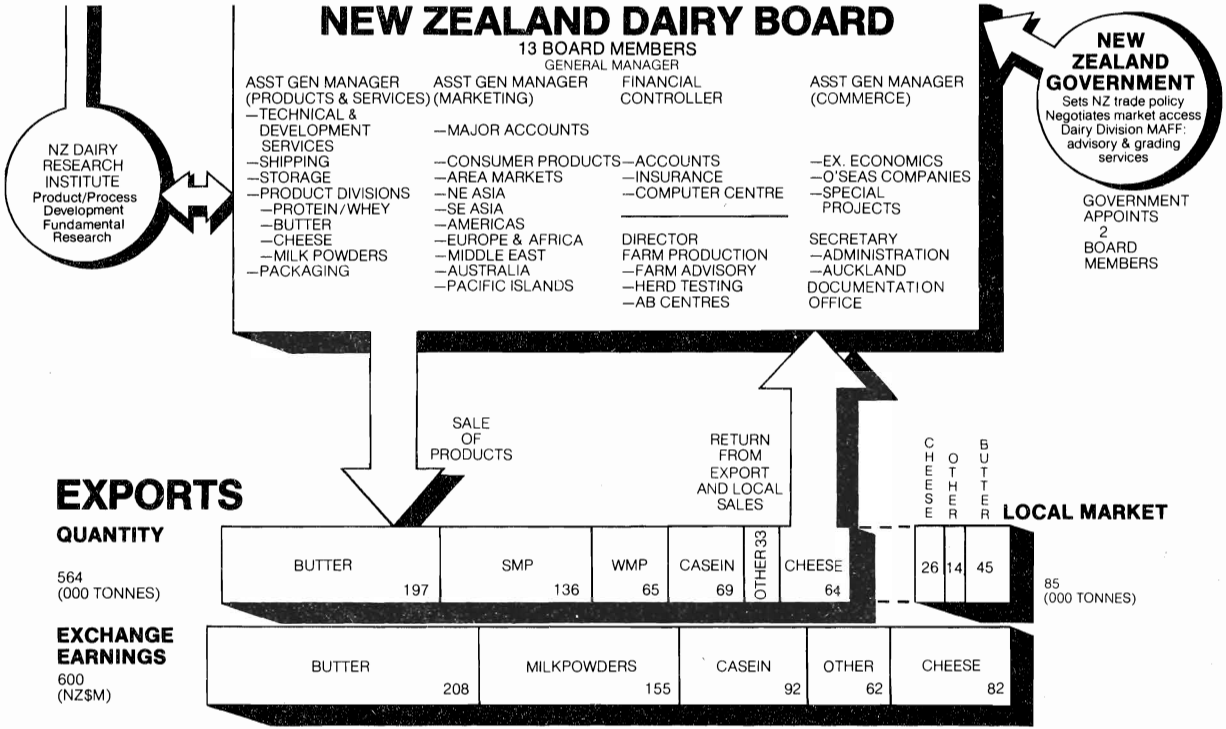


THE NEW ZEALAND MANUFACTURING DAIRY INDUSTRY

A wholly Co-operative industry

(1978-79 SEASON)





NOTES

1. Liquid milk sector is excluded and represents 512 M litres
2. Butter includes AMF in butter equivalent
3. Statistics Productions, Manufacture, Local Market — Year ended 31 May 1979
   Exports, Exchange Earnings — Year ended 30 June 1979
4. Dairy Products Prices Authority operates as part of industry price smoothing mechanism

SECTION 6

PIG PRODUCTION

6. PIG PRODUCTION

6.1 PIG PRODUCTION STATISTICS

6.1.1 Pig Population in New Zealand (30th June 1978)

Region	No. of holdings	Breeding sows 1 yr & over	Mated gilts	Boars	Other Pigs of all ages	Total	Total Pigs Jan. 1979
Northland	464	2443	206	313	13351	16313	15384
Central Auckland	336	5890	701	480	49039	56110	52094
South Auckland/Bay of Plenty	1306	15209	1525	1201	111513	129448	137700
East Coast	209	472	67	64	2667	3270	4578
Hawke's Bay	424	1678	192	168	10175	12213	13276
Taranaki	362	4281	386	383	37699	42749	45132
Wellington	785	7861	704	689	50048	59302	61129
North Island	3886	37834	3781	3298	274492	319405	329293
Marlborough	143	2555	149	207	18131	21042	22435
Nelson	211	2142	83	170	14720	17116	17208
Westland	27	104	9	13	924	1050	1098
Canterbury	1046	9234	2799	967	66343	79343	94157
Otago	427	2088	261	212	16887	19448	22823
Southland	374	1729	284	199	13533	15745	15795
South Island	2228	17852	3585	1768	130539	153744	173516
NEW ZEALAND	6114	55686	7366	5066	405031	473149	502809

Source: Pork Industry Council 27th Annual Report. Year ended Sept. 30th 1979.

6.1.2 Number of Breeding Sows in relation to Pigs Slaughtered.

Year	Breeding Sows at 31 Jan.	Total Pigs Slaughtered year ending 30 Sept.	Pigs Mktd. per sow	Slaughtered Animals Under 41kg Porkers	Over 41 kg Baconers	90+kg Choppers	Est. Total Wt. of pigmeat in carcass form (tonne)
1975	54835	720100	12.8	262000	439900	18200	34200
1976	55920	721400	12.9	230600	475600	15100	32800
1977	60809	825700	13.2	285500	519500	20700	39800
1978	55686	801700	12.8	286300	492400	23100	38300
1979	NA	727293	12.7	254130	453760	19620	36710

Source: Pork Industry Council Annual Report, 1979

6.2 NUTRITION

With the large reductions in the supply of skim-milk and whey as pig feeds, barley, and to a lesser extent maize, are being used as substitutes. Cereal grains are a concentrated source of digestible energy (DE) but are inadequate in terms of protein quantity and quality for both the young growing pig and the adult sow in the reproduction cycle. Many of the essential vitamins and minerals are also in short supply, but these are usually adequately supplied by the inclusion of a mineral/vitamin proprietary mixture. Three exceptions are:

(i) Calcium and Phosphorus – usually added in various combinations of ground limestone, steamed bone flour, dicalcium phosphate and rock phosphate.

(ii) Sodium and Chlorine – added in the form of common salt (0.25% of air dry diet).

(iii) There is field evidence that sows may benefit in certain situations from additional supplies of the vitamins A, D and E during gestation.

The modern pig farmer using an all-meal diet, and who has control over the composition of the rations he uses, is principally concerned with the protein portion of feed requirements for both nutritional and economic reasons. Therefore some guidelines in ration formulation with particular emphasis on protein are included here. Calculations of protein requirement on a crude protein basis are now not considered sufficiently reliable for accurate ration formulation. In choosing the types and the levels of protein supplements, emphasis is placed upon the supply of lysine, tryptophan and methionine plus cystine since these are most likely to be the limiting amino acids in cereal based diets.

REQUIREMENTS OF PIGS ACCORDING TO LIVEWEIGHT FOR APPARENT DIGESTIBLE ENERGY (ADE) AND LYSINE, TRYPTOPHAN, METHIONINE PLUS CYSTINE CALCIUM AND PHOSPHORUS (% AIR DRY WEIGHT).

	Starter 4-9kg	Creep 9-17kg	Weaner/ Grower 17-44kg	Porker 44-70kg	Baconer 70-90kg	Breeder
ADE (MS/kg)	14	13.8	12.5	12.5	12.5	12.5
Lysine (%)	1.2	1.0	0.85	0.8	0.7	0.5
Tryptophan (%)	0.18	0.17	0.17	0.15	0.15	0.10
Methionine plus cystine(%)	0.65	0.60	0.55	0.50	0.50	0.35
Calcium	1.1	1.1	1.1	1.1	1.1	1.1
Phosphorus	0.8	0.8	0.8	0.8	0.8	1.0

(**Source:** ARC [1967] and N.R.C. [1968].)

ESTIMATED AVERAGE LEVELS OF CERTAIN NUTRIENTS IN SELECTED N.Z. FEEDSTUFFS (AIR DRY BASIS)

	ADE (MJ/kg)	Lysine (%)	Trypt. (%)	Meth & Cys. (%)	Ca. (%)	P. (%)	Upper Inclusion limit (%)
Barley	12.8	0.3	0.17	0.35	0.03	0.35	–
Maize	14.2	0.2	0.08	0.30	0.02	0.30	–
Wheat	14.1	0.3	0.12	0.28	0.05	0.40	–
Meat and bone meal	12.0	2.4	0.19	1.20	10.50	5.20	20
Dried Blood meal	11.3	7.5	1.10	2.20	0.28	0.22	5
Dried liver meal	16.3	4.8	0.60	2.20	0.50	1.25	5
Skim-milk powder	14.6	2.8	0.50	1.30	1.25	1.00	–
Buttermilk powder	14.6	2.8	0.50	1.20	1.30	0.90	–
Fish meal (whole)	13.4	6.0	0.90	2.50	4.50	2.00	–
Uniwhite lupin meal	12.8	1.6	0.25	0.64	0.07	0.48	–
Pea meal	14.6	1.6	0.22	0.45	0.17	0.42	–
Dehydrated lucerne	8.2	0.9	0.50	0.45	1.43	0.25	5
Ground limestone					34.00	0.02	
Steamed bone flour					24.00	12.00	
Dicalcium phosphate					26.00	18.00	
Rock phosphate					34.00	14.00	

A more complete list of feedstuffs can be found in the Pork Council Advisory Service Manual.

(**Source:** N.Z. Poultry Research Centre, Massey Pig Research Centre, Lincoln College, Wheat Research Institute, N.R.C. [1968]).

EXAMPLE FORMULATION FOR PORKER PIGS (%), WITH CALCULATED LEVEL OF LYSINE (AIR DRY BASIS)*

	DIET			
	A	B	C	D
Barley	78	55	85	–
Maize	–	–	–	83
Maize and Bone Meal	12	–	10	11
Dried Blood Meal	–	–	4	5
Skim Milk Powder	10	–	–	–
Uniwhite Lupin Meal	–	40	–	–
Steamed Bone Flour	–	5	1	1
Lysine (%)	0.80	0.81	0.80	0.81

* Further additions to these diets would be a suitable vitamin/mineral supplement and finely ground salt (0.25%).

Since cereals and protein concentrates fluctuate in price on a seasonal and annual basis, it is recommended that the cost of energy and the critical amino acids be calculated for all the possible alternatives. After selecting the economically desirable sources, then formulations can be made to satisfy requirements on an approximate least cost basis.

6.3 FEEDING SCALE:

On all meal feeding, it is generally recommended that growing pigs be allowed to consume meal *ad libitum* up until approximately 30kg, from which time they are fed restricted amounts. The following feeding scale is designed to allow an acceptable growth rate and feed conversion efficiency, but producing a carcase of reasonable quality where the diet is nutritionally adequate.

Average Pen Weight (kg)	Daily Intake (kg meal/pig)*
17.5 – 20.0	1.00
20.0 – 22.5	1.09
22.5 – 25.0	1.27
25.0 – 27.5	1.36
27.5 – 30.0	1.45
30.0 – 32.5	1.54
32.5 – 35.0	1.63
35.0 – 37.5	1.68
37.5 – 40.0	1.72
40.0 – 42.5	1.80
42.5 – 45.0	1.86
45.0 – 47.5	1.90

47.5 – 50.0	2.00
50.0 – 52.5	2.04
52.5 – 55.0	2.09
55.0 – 57.5	2.13
57.5 – 60.0	2.18
60.0 – 62.5	2.18
62.5 – 65.0	2.22
65.0 – 67.5	2.25
67.5 – 70.0	2.25
70.0 – 72.5	2.35
72.5 – 75.0	2.40
75.0 – 77.5	2.45
77.5 – 80.0	2.49
80.0 – 82.5	2.54

* This scale is assuming 3 000 kcal. (12.5MJ) digestible energy/kg. Where the energy density is higher (for example: due to the use of wheat or maize as a significant fraction of the diet), daily intake will need to be adjusted accordingly.

SUGGESTED LEVELS FOR BREEDING STOCK

Gestating Sows	2 – 2.5 kg/day
Lactating Sows	1.5 kg/day for sow plus 0.5 kg/piglet
Mating Sows	3 – 3.5 kg/day
Boars	2.5 kg/day

6.4 PIGLET SURVIVAL

Piglet mortality is still averaging between 15 and 20%.
The major causes are:
Disease - mainly bacterial infections in the gut.
Poor environment, leading to disease and loss of vigour among newborn piglets.
Mechanical accidents e.g. overlaying.
Starvation, associated with low birthweights and low viability.

The risk of disease will be lower if farrowing quarters are kept clean and dry. Most important in the prevention is the absorption of adequate amounts of antibody in the sows colostrum by the newborn piglet. Killed E. Coli organisms given orally to piglets may give protection against E. Coli scours. Injecting the sow before farrowing with an E.Coli vaccine causes passive immunity for the piglet via colostrum.

Physical environment is important. The piglets body temperature must be maintained. However a piglet is poor at controlling heat loss, as hair and fat under the skin does not give good insulation at this stage. Cold piglets, huddle up to the sow, increasing the chance of being overlain. The overall temperature should not be less than 25°C in the farrowing house, until the piglets are 3-4 days old, then reduced to 18-20°C.

Starvation, single highest cause of loss. Other causes of starvation are:
Litter size larger than no. of teats.
Teats drying off during suckling.
Growing piglets - less room at udder.
Mastitis and Agalactia in the sow.

In batch farrowing, a cross fostering policy (evening up the litters, both piglet size and piglets per sow), should be practised. Smaller piglets will find it easier to obtain milk, if grouped with piglets of their own size.

There may be times when there are more piglets than sows, due to death or prolonged Agalactia. Hold a sow back at weaning and foster surplus piglets. A sow reaches peak milk production 3 weeks after farrowing. If rearing piglets artificially - from birth to 3 kg, liquid sow milk substitute, 3-6kg milk based solid creep. Cow's colostrum if available, is good. The liquid diet should be fed 4-6 times daily, 80-12ml per piglet.
(Reference Pork Industry Gazette June 1980)

SECTION 7

GOAT PRODUCTION

7 GOAT PRODUCTION

7.1 GENERAL

Goats are used in New Zealand for meat, fibre and milk production. The most predominant breed is the feral, used for weed control and periodically slaughtered for meat (chevon). Annually 100,000 goats are slaughtered through meat works and game packing houses. The majority are obtained from 'Annual roundups' in the North Island hill country. In both North Auckland and Golden Bay there are small numbers of milking goats producing milk for powder and or cheese production. There are about 1,000 purebred female Angora goats in New Zealand in 1980 of which some 250 are located on a Lands and Survey farm near Kerikeri. These goats provide mohair, the goat derived apparel fibre.

7.1.1. Requirements

Little is yet known about relative stocking rates of goats, or stocking rates of goats versus other species. As yet no data has been published on the grazing behaviour of goats at pasture and on the necessity of providing browse or roughage, although preliminary data from Ruakura and Lincoln would suggest roughage is not required for high levels of production.

7.1.2. Fencing

Goats have a tendency to go under or through fences rather than over then. Electric fences are usually very effective in controlling goats, as is close mesh sheep netting of 8-10 wire high tensile fencing which is well battened. An electric wire offset from the fence 10-15cm above ground level are also effective. Normal sheep yards are adequate for all stock handling.

7.1.3. Environment

Goats prefer dry environments, with adequate shelter as they are very susceptible to climatic stress, more so than sheep or cattle. In wet environments they suffer badly from foot scald or rot. Goats in wetter environments may also be more susceptible to pneumonia and worms.

7.1.4. Water.

In New Zealand unless pasture is in high DM goats will obtain sufficient water with their diet, the exception being the lactating goat. Goats housed indoors appear to require 600-700g of water per day (20-30kg liveweight).

7.1.5. Breeding.

Apart from the ferals a limited genetic base exists in all other goat breeds within New Zealand. In the case of the angora this is being rectified with imporations from Australia, more specifically Tasmania. For chevon production ferals can be crossed with the larger mature milking breeds e.g. Saanen and Toggenberg. This will result in an increase in both pre-and post-weaning growth rates.

7.1.6. Reproduction

Does (female) first mated at 30-40kg Liveweight (75% at mature size) (12-18 months old).
Early mating will reduce mature size. Incidence of oestrus restricted to declining day length (usually).
Oestrous period 18-24 days and may be synchronized with teaser bucks.
Symptons of oestrus (heat) similar to cattle. Restless, frequent urination and bleating, tail fanning, swollen vulva, clear mucous secretion from vulva.
Ovulation at the end of oestrus.

Ratio bucks to does	3:100 extensive conditions 1:100 possible 1:25 young bucks
Gestation period	150 days
Kidding percentage	150 to 180 'normal'
Birth weight of kids	2.5 to 3 kg

Although two kiddings per year are theoretically feasible, more commonly three kiddings in two years are obtained. Meat breeds have a shorter kidding interval than milk breeds.

7.1.7. Management Routine

Figures 1 and 2 (over page) illustrate operation calendars for the sping and autumn kidding systems; timing of musters, and the allocation of stock classes within the 2 blocks. There are three main musters a year including a slaughter stock muster.

Due to the low meat returns, a full-scale drenching programme is not economical but one or two drenchings of young animals in early autumn should improve growth rates. Lice control is essential.

(Each ring represents one block)

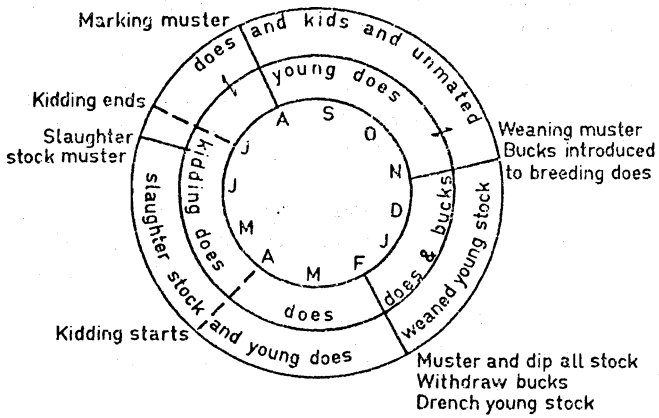


Fig 1: Two-block system – autumn kidding.

(Each ring represents one block)

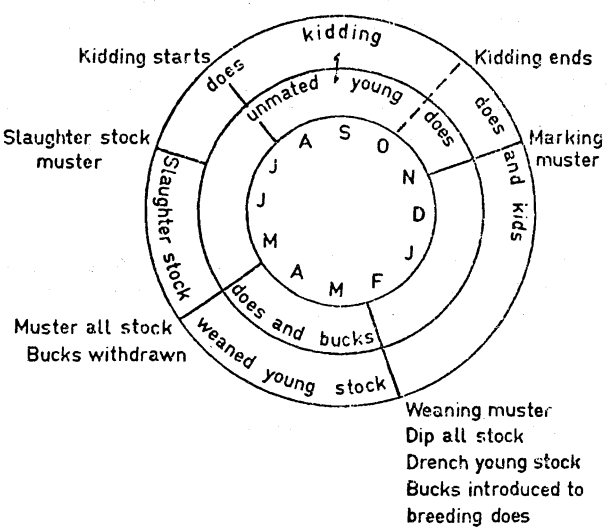


Fig 2: Two-block system – spring kidding.

7.1.8. Grazing

In order to maintain pasture in good order, both sheep and cattle should be grazed on goat blocks, as goats tend to eat bushes in favour of pasture grasses.

Goats will generally prefer food which they have eaten in early life. i.e. if used to gorse, goats will graze it. If not, it may take up to 3 months before they will eat it readily.

7.1.9. Mustering and Handling Feral Goats.

In dealing with goats it is advisable to have some knowledge of their movement patterns and habits.

(i) Familiarity with camping places and good natural shelter enables the farmer to locate mobs easily. Mustering points can be created by providing artificial shelter.

(ii) Goats' feeding patterns are fairly regular, usually from about an hour after sunrise to 11 am and from 1.30 pm until sunset.

(iii) Goats are easier to muster when mixed with sheep although a few difficult animals will not respond to dogs.

(iv) It is important to note that in a mob there will be a dominant male and more importantly a dominant female. Recognizing these will assist stock handling.

(v) Kids and dams will constantly be found close togther, especially in the first 2 weeks after which the kids start to wander. The dams are very sensitive to unusual events at this stage.

7.1.10. Identification.

Branding is essential for farm goats to differentiate domestic animals from wild, noxious goats. Either earmarks or hornmarks are used.

7.2 GOATS FOR MILK PRODUCTION

7.2.1. Introduction

Profitable dairy goat farming will depend on:

(i) Good stock quality

(ii) A balanced diet of grass, pasture weeds and browse.

(iii) Adequate shelter.

(iv) Established and reliable markets.

It is similar to dairy cow farming although goats tend to respond to individual attention, needing more time and labour.

7.2.2. Requirements

Goats are thought to require high fibre in their diet, provided by woody plants or hay. Their diet consists of approximately 50% grass, 40% browse and 10% other pasture weeds.

Ideal farm cover would be about 60% pasture and 40% woody plants e.g. willow, blackberry, manuka, heath and gorse.

One hectare will provide enough new scrub growth to feed approximately five to seven dairy goats. However goats are being milked successfully at Ruakura on grass with no browse at all. With 40% browse, two and a half milking does can be run per hectare. With less browse more goats can be run but with hay provided. All pasture needs one bale to 10-12 does per day.

No. of Milking Does	30	40	60	80	100
Other Stock (g.e.)	5	8	10	16	20
Total stock (g.e.)	35	50	70	95	120
Browse required (ha)	5	7	10	14	17
Pasture (ha)	7	11	15	21	26
Total area (ha)	12	18	25	35	43

Clean Water is a requirement for both dairy and stock.

Shelter is essential and if natural shelter is not available movable shelters should be provided. Suggested trees for shelter belts are willow and wattle as these are edible and can be pruned for goat roughage.

Subdivision

Two main blocks are the main requirements. This allows spelling of the browse.

Another two separate paddocks are necessary for holding kids prior to weaning, and one for holding bucks. If there is only one buck in the mob, a chain is sufficient.

After weaning all female and wether goats can be run together. Goats do better when free to roam and select their own food.

Winter feed is accumulated from the shrub plants that grow in October-March.

7.2.3. Stock

Dairy breeds available in New Zealand.

(i) Saanen

(ii) Toggenberg

(iii) British Alpine

(iv) Anglo-Nubian.

Choice of stock should be based on those with the greater milking ability rather than breeding performance as this will result in greater net income. Cross breeding may give hybrid vigour.

Ways of developing a milk herd.

(i) Purchase purebred does for rearing.

(ii) Obtain the best quality buck of the preferred breed. Research his milking background. Artificial insemination is an alternative to this.

(iii) Providing they are very well fed from mating and through the following lactation, goats can breed at one year of age.

(iv) Another way to develop a milk herd is to up grade feral stock The quality can be variable and the process in grading up from feral stock can be slow.

When selecting does it is important to consider feet, mouth, body constitution, udder characteristics, and teat placement.

The likely quality of stock from a feral muster and price relativity

% of Muster	Quality	Value of grades, with average price $25.
10	Good	$50
40	Fair	$30
50	Poor	$15

Reference: MAF Ag Link FPP282, FPP141.

SECTION 8
DEER PRODUCTION

8. DEER PRODUCTION

8.1 FERAL - DISTRIBUTION

There are eight species of Feral deer in New Zealand. Red deer (Cervus elaphus) is by far the most numerous and widespread species; others include Fallow, Sika, Whitetail (or Virginia), Sambar, Rusa, Moose and Wapiti. Red is the most important and popular species for deer farming.

There are still limits in deer farming. Farming of deer is prohibited in certain areas. Summarised they are:-

Red, Wapiti and Fallow - farmed anywhere in New Zealand except in the four 'deer free' areas, which are Northland, Coromandel, Taranaki and South Auckland. Rusa and Sambar - anywhere in the North Island except the four zones. Whitetail or Virginia - anywhere in the South Island and Stewart Island. Sika or Japanese - limited to Rotorua district and Counties of Taupo and Hawkes Bay.

8.2 CAPTURING WILD DEER

Animals are shot with a tranquilizer dart. The neck or rump is aimed for. Fentaz takes effect in 10-15 minutes, although it may take longer if a deer is excited, or has run some distance. A deer hit by a dart runs to a standstill but rarely falls to the ground.

8.2.1 Effects of Capture

Bloat is an occasional side effect. Erratic breathing is more prevalent in animals which were excited at the administration of the dose. Animals showing signs of poor respiration should be handled carefully. At high altitudes deer may suffer temperature shock. Capture during pregnancy may be unsuccessful and harmful to the foetus. Abortion is almost certain in late stages of pregnancy. Hinds should not be captured after the third month of pregnancy (usually July).

8.2.2 Drugs

The use of drugs for deer capture, and for the velveting operation should be under supervision of a veterinarian.

8.3 DEER FARMING

8.3.1 Legislation

Deer farming was legalised under the Deer Farming Regulations 1969, which set standards for venison export and sought to ensure

that reinfestation of forest and farmlands did not occur. Permits are issued only after strict requirements have been met, covering the suitability of the land, stock numbers and fencing. Today some 250 farms of reasonable size are located throughout New Zealand.

8.3.2 Farm Location

(i) Proximity to house: It is desirable that the manager lives on the property - this deters poachers and stock become familiar with people and vehicles.

(ii) Access: Vehicle access needs to be considered particularly on hilly country.

(iii) Topography and Land Quality: Deer adapt readily to a wide variety, but respond well to improved nutrition. It is advisable to run deer on better class land to obtain maximum returns. However some feed restrictions may have to be exercised with adult hinds to avoid calving difficulties. Fencing costs are lower on easier country and farm planning more straight forward.

(iv) Shelter: Cover should be provided in at least some paddocks. Wild captured deer should be put into darkened pens for 1-3 days, and then let out into paddocks. If suitable pens are not available, the paddock should have adequate cover in which wild-capture deer can hide until settled. Calves (or fawns) automatically seek cover in the first few weeks. Deer will also seek shade on warm days.

(v) Water: Deer must have a good supply of water. Exact requirements are not known. Red deer like to wallow and drinking water troughs may need to be protected.

8.4 GRAZING MANAGEMENT

Yearling Red stags can be semi set-stocked from August to February at 30 per hectare on first class flat land. Animal growth rate on such a system where pasture was kept at 2-5 cm in length was 220 gm per day, over the 6 months of spring and summer.

Electrified wires, used as front and back barriers, for strip grazing management, have proved satisfactory.

8.5 PHYSIOLOGY

Details of farmed Red deer are summarised below.

Puberty - Hinds, 16 months (weight dependant)
Stags, 14 months (motile sperm first detected)

Onset of breeding season - About 6 weeks (2-3 oestrous cycles)

Onset of breeding season - Hinds, Mid April (earlier in N.I.)
Stags, March

Duration of breeding season - about 6 weeks (2-3 oestrous cycles)
Length of oestrous cycle - 8.2 days
Gestation length - 223 days
Onset of calving - late Nov.
Duration of calving - 23 days (range 18-21 days)

8.6 MATING MANAGEMENT AND BEHAVIOUR

8.6.1 Hinds

In some localities, feral hinds may not calve until three years old. A considerable number in a herd may not calve each year. Yearling hinds at 65 kg liveweight and over can achieve 90% calving.

8.6.2 Stags

Management is a crucial factor during mating. Stags display competitive behaviour. Herding and mating of hinds occurs both day and night. Roaring begins about a month before hinds are mated, and can take place without mating, and vice-versa. Antlers should be removed at this time for safety. Two points should be considered in mating management:-

(i) Stags can mate 50-100 hinds in the main period of mating (Mid-April to Early May).

(ii) In small paddocks dominant stags can hold more hinds in a harem, than they can mate.

8.6.3 Calving

Excessive stress and human interference may have disastrous affects on calving e.g. multiple suckling, mis-mothering and rogue behaviour by hinds attacking and killing their young.

Use low stocking rates, provide shelter where possible and reduce handling of calves to a minimum.

Calves are usually weaned at three months.

8.7 DISEASES

8.7.1 Common diseases in farmed Red deer

Deer in the first 12-15 months are more susceptible to disease. In the settling down period deer are at a greater risk due to stress caused by capture, transport, or being introduced to established farm herds. Any animal that appears to be diseased should be separated from the herd and given veterinary attention. As with all farmed species the health of deer can be greatly affected by management, particularly stocking rate and nutrition.

8.7.2 Yards

There should not be any rough boards which can cause abscesses if splinters enter the cheeks or infect the dart wounds.

8.7.3 Paddocks

Recently captured or bought-in animals should be isolated in separate paddocks for about a week to settle.

8.7.4 Pasture

Farmers should aim to maintain a palatable leafy sward without rank growth. This can be controlled by sheep or cattle, but the risk of transferring infections such as malignant catarrhal fever virus (sheep) is high. Never the less, the disease risks must be weighed against the advantage of using sheep and cattle. Deer should be separated into age and sex groups.

8.7.5 Winter feed and Shelter

Deer have a lower feed intake over winter, but should not be starved, and should have some form of shelter.

Disease	Symptoms	Control/Treatment	Remarks
Malignant Catarrhal Fever (M.C.F.)	Become depressed. May lag to rear of herd, scour and refuse to eat. Death usually occurs within 24 hours of development of recognisable signs, and may happen without any clinical signs. 2 forms: intestinal head and eye.	Control: Antibiotics are ineffective against viruses, death is almost inevitable therefore animals suspected of having condition, separated immediately. Reduce contact.	Probably the most serious disease affecting farmed red deer. Occurs throughout the year, but most deaths occur in the winter. Thought to be caused by bovine malignant catarrh (BMC) virus, which may be carried by sheep.
Yersiniosis	Affected animals are depressed and lag behind. Scouring occurs however, often the condition is acute and deer are found dead.	Treatment: Any associated stress identified and corrected antibiotics given by injection, orally in nuts or drinking water. An affected herd should be spread out.	Has become a major disease in recent years. In some species causes abcesses which resemble tuberculosis. It can be isolated from faeces of clinically normal deer and animals.
Turberculosis	Generally chronic (long-lasting) no specific clinical signs are seen. In a few cases abscesses have appeared over rib cage.	Control: Tuberculin test is a reliable test. Deer coming to or on a property should be tested. Animals found with the disease should be destroyed, not treated.	Unfortunately some tuberculous Feral deer have been captured and have infected other deer. The bacteria can be inhaled or ingested with grass or water, or when one animal licks the coat of another.
Starvation/exposure syndrome (winter death)	Generally an affected animal is found dead. The disease is more common during the winter, especially July and August and there is no prior warning. Respiratory distress does not appear to be as severe as for cattle.	Treatment and prevention: If sick deer are found, place them in a sheltered area, give glucose and nuts. Should remain sheltered after recovery to avoid relapse.	Causes - uncertain. Deer have a high metabolic rate, little body fat and a low maintenance diet during winter, coupled with stress and loss a body heat on a cold night may exhaust an animal.
Clostridial Infections	Generally young animals are infected. They become depressed, may stagger, may have severe, often bloody diarrhoea. Death follows rapidly.	Prevention: Vaccination is best method. Sheep vaccines not yet registered for deer. Seek veterinary advice when vaccinating. The following times are a general guide: calves - weaning	Clostridial bacteria cause the familiar conditions of puply kidney, malignant oedema and tetanus in farmed animals.

Disease	Symptoms	Control/treatment	Remarks
		hinds - 6 weeks before calving, stimulating immunity in colostrum.	
Enzootic Ataxia	Affected animals appear bright but when made to run sway in hind quarters, and appear weak in the hind legs. If disease progresses, fore legs also weaken, and animal lies down.	Treatment: Copper injections, best method. Copperised licks can be provided but some animals liking them may suffer copper poisoning.	Caused by copper deficiency. Largely confined to young adults.
Lungworm	Coughing, ill-thrift, parasitic pneumonia, and in severe cases death. These symptoms are not exclusive to lungworm infestation. First stage lungworm larvae in faeces.	Control: Once endemic on a property, it is extremely difficult to eradicate. Control is based on the worms life cycle. Recommendations: 1) Assume that a lungworm problem will recur unless appropriate control measures are instituted. 2) Keep stocking rates low, lowering the rate can decrease the larvae density on pasture. 3) Drench calves in early March or at weaning and put on to clean pasture. Use an anthelmintic. The most heavily contaminated pasture is where hinds have calved and calves raised. 4) If clean pasture is not available calves should be treated with an effective anthelmentic every 21 days from early March until winter. Appropriate anthelmentics are: Diethylcarbamazine or one of the broad-spectrum ones. 5) If deer are set-stocked, treat susceptible stock every 21 days during their first season to kill	It is not known if deer develop immunity as cattle do. The prescence of lungworm in lungs (found in post mortem) or in faeces does not necessarily indicate a pathogenic burden of lungworm. Although deer may carry an infestation at any time during the year, lungworm appears most important during autumn and early winter.

Disease	Symptons	Control/treatment	Remarks
		the acquired lungworm before they commence laying eggs. The lack of effectiveness of anthelmintics against sever lungworm infestations emphasises the importance of control measures to prevent the development in a severe out-break, all stock should be protected. The foregoing recommendations are based on very little information on lungworm. Vaccination of deer calves for control cannot be recommended.	
Tissue Worm	3 types of reaction to infestation: 1)Acute - characterised most commonly by paralysis of the hind limbs. 2) Chronic - ill thrift 3) Type of pneumonia induced by migration of larvae through lungs. An infestation is diagnosed by finding of characteristic Elaphostrongylus larvae in the faeces or wastings from the lungs.	At present there is no first hand experience or effective anthelmintic treatment in New Zealand.	In New Zealand only lightly infested deer have been encountered 1) and 2) have not been seen, far. Problems of identification, control of intermediate hosts and arthelmintic control are being investigated.

References: MAFAglinks

FPP 247	FPP 417
238	418
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SECTION 9

POULTRY

9. POULTRY

9.1 POULTRY STATISTICS

Commercial Poultry (30 June 1977)
(Excluding flocks under 25 birds.)

Statistical Area	Number of holdings	Hens over 5 months.	Pullets under 5 months	Total Hens and Pullets	Cockerals for breeding	Chickens for meat	Ducks	Turkeys	Other Poultry	Total Poultry	Eggs (doz)	Birds slaughtered for sale.
Northland	33	51,162	16,073	67,235	-	3 776	220	808	360	72 399	1 087 684	28 516
Central Auckland	148	728 395	281 341	1 009 736	6 561	708 454	263	4 457	6 030	1 735 501	11 504 665	2 074 940
South Auckland-Bay of Plenty	189	645 750	196 147	841 897	1 801	251 311	863	991	201	1 097 064	12 953 314	1 093 669
East Coast	25	80 773	33 014	113 787	58	20	40	80	-	113 985	1 430 550	46 362
Hawkes Bay	54	215 475	94 860	310 355	106	1 500	117	299	33	312 390	3 964 309	183 967
Taranaki	39	164 467	73 863	238 330	10 457	767 696	112	20	12	1 016 627	2 779 051	2 725 389
Wellington	136	489 656	178 688	688 344	13 974	686 891	696	401	338	1 370 644	8 518 110	2 461 515
Total North Island	624	2 375 678	873 986	3 249 664	32 957	2 419 648	2 311	7 056	6 974	5 718 610	42 237 683	8 614 358
Marlborough	11	6 541	2 700	9 241	-	-	30	3	155	9 429	119 720	4 393
Nelson]	32	75 741	22 472	98 213	440	14 877	-	-	50	113 580	1 366 516	153 961
Westland]		8 270	2 707	10 977	-	-	-	-	-	10 977	142 820	7 400
Canterbury	164	569 828	207 845	777 673	8 688	518 718	30 124	106 680	469	1 442 352	9 226 869	2 997 069
Otago	110	216 564	57 437	274 001	222	100	243	381	90	275 037	4 735 613	166 685
Southland	37	83 024	37 144	120 168	-	55 250	95	-	30	175 543	1 048 482	211 822
Total South Island	354	959 968	330 305	1 290 273	9 350	588 945	30 492	107 064	794	2 026 918	16 640 020	3 541 330
Total New Zealand	978	3 335 646	1 204 291	4 539 937	42 307	3 008 593	32 803	114 120	7 768	7 745 528	58 877 703	12 155 688

(Source: Agricultural Statistics 1976-77 – Department of Statistics.)

9.2 COMMERCIAL POULTRY

9.2.1 Population and Distribution

Most flocks now have at least 8000 birds and some more than 20 000. More than 64% of the poultry flocks and 71% of the total poultry, population is in the North Island. In June 1978 there were 437 flocks in New Zealand, with over 1000 birds. The small 'family unit' of 1000 - 5000 birds is disappearing. The average commercial egg-production farm now has 8000 - 12 000 birds.

9.2.2 Egg Production

(i) Housing

Almost all are housed in cages. Most of them are in semi-enclosed poultry houses naturally ventilated through ridge ventilators and have wire netting or slatted side-walls. The trend in new housing is towards' controlled environment' and 'high rise' houses.

(ii) Feed

Maize, barley, wheat, wheat meals and meat and bone meals are the major ingredients. Barley is used extensively as it is cheaper than wheat. Maize is the predominant grain food in the North Island.

(iii) Chickens

Few producers today hatch their own chickens. Breeding and incubation are now left to specialist companies.

(iv) Mechanisation

Automatic waterers, feeders, egg collectors and manure removal equipment, together with the use of laying cages, make it possible for more birds per labour unit than in the past.

(v) Breeds

The smaller hybrid type of egg-layer has become popular. Strains have been derived from crossing the White Leghorn with Austrolorp or Rhode Island Red or by upgrading these crosses to produce a white leghorn type. These are sold under trade names - 'Hy-line', 'Shaver', 'Rochedale', 'APB', 'Ross sykes tinted', 'Steggles', and 'S.P.B.'

(vi) Marketing

Handled by the New Zealand Egg Marketing Authority, comprising representatives from the Government and private enterprise. This Authority supervises the handling, grading and distribution of eggs.

9.2.3 Meat Production

(i) Housing

The birds are reared from one day old until seven to nine weeks in controlled environment sheds, each with a capacity of 20 000 birds. Older units have infra-red bar units, but the newer units have oil-fired, hot-air plants which ventilate as well as heat.

(ii) Feed and Management

Most growers have contracts with large companies for which they rear chickens at contract prices. The growers usually supply only the capital and the labour. The company supplies everything else - chickens, feed, management programmes and field services.

(iii) Chickens

Farmers practise an 'all-in-all-out' policy. All the birds leave the farm at the same time which ensures that chicken-borne diseases are kept under control. After each batch of chickens has gone their houses are cleaned and fumigated before the next batch arrives. Four or five batches pass through the house in one year.

(iv) Protection

Broiler chickens (specially bred table poultry) are rapidly increasing in numbers. About 19m were produced in 1977/78. Chicken Meat is steadily increasing, helped by a number of chicken take-away shops throughout the country. Because large-scale production results in substantial economics, the chicken-meat industry has become dominated by a few large, intergrated organisations with modern, automated processing plants each handling up to 4500 birds per hour.

9.3 OTHER POULTRY

9.3.1 Turkeys

Small numbers were once reared on poultry and general farms, but turkey farming has emerged as a distinct unit - large farms near Christchurch and grain-growing areas of the south.

Most farms breed, hatch and rear their own stock. Some specialise in selling them young, others grown them to a marketable weight and sell on a contract basis to poultry processors.

Large farms may range rear turkeys up to 20 - 24 weeks, but the trend is towards housing them intensively, so they reach market weight at an early age.

9.3.2 Ducks

Increasing numbers are being bred. Popular breeds are - Pekin, Aylesbury and their crosses. The Muscovy has also increased in popularity.

9.3.3 Geese

Not generally farmed commercially, are mainly a sideline enterprise. Most common breeds of geese are satisfactory for meat. Most farm flocks are crosses of the two most popular - Emden and Toulouse.

Eggs increase in size as the bird ages, while fertility decreases.

9.3.4 Pheasants and Guinea Fowls

A specialised pheasant production was initially developed to supply birds for release by Acclimatisation societies. Any excess birds were processed and exported. Changes in the relevant legislation now permit the sale of pheasants on the local market, but Pheasant Farms must be licensed by M.A.F.

Breeding and rearing farms are located around Christchurch and Hamilton.

9.4 HOUSEHOLD FLOCKS

9.4.1 Husbandry and Management

(i) Housing

Laying birds in cages and on deep litter need a high standard of hygiene. Poultry houses must be comfortable, have adequate ventilation and light and be free from droughts and dampness.

(ii) Outside Runs

Hens will be healthier if kept inside (few parasites). However, if hens are to be kept outside in a run, it must be kept free from rotting food and accumulated manure. After midday they can be released as most of the eggs will have been laid.

(iii) Feeding

Old accumulated food may be harmful to birds, clean out troughs or area.

9.4.2 Broodiness

Broody Hens look for a warm comfortable place to sit on eggs. First signs are: long periods of nesting, ruffled feathers, marked reluctance to leave box, and characteristic clucking noises.

To break mild broodiness confine the hen to a coop for three to four days. Keep her in sight of the other birds as she will grow restless and show signs of wanting to join them.

9.4.3 Chick Rearing

(i) Natural

Select a broody hen. A good one should rear 12 to 18 chicks, depending on the weather. The hen should be treated with an

insecticide to stop body lice. Then house the hen in a coop. When chicks hatch confine them to a small area. Do not remove a hen from the nesting box until about 24 hours after hatching is completed.

If the chicks are not the hens' own, put a few dummy eggs under her for one to two days, before she is given the day-old chicks. Contrasting coloured chicks will be bullied by the hen. Feed and water must be in reach of the hen and chicks at all times. After 3 - 4 weeks allow the hen and chicks to go into the open but return them at night.

(ii) Artificial

Day old chicks should be brooded in an environment that fosters normal growth and good health. Improvised warming devices usually end in failure.

To achieve a smooth change over between laying flocks, chicks should be obtained 5-5½ months before the new laying pullets are needed.

The brooder house should be: well lit, ventilated without draughts, vermin proof. Also have a dry floor. Do not allow the sun to shine directly on to them. It must provide a temperature of approximately 34°C in winter and 32°C for the rest of the year. The chicks must have adequate space, accessible water and a clean pen with at least 80mm of dry litter. Continue to provide heat until well-feathered, about 3 to 4 weeks. Chicks need to be checked about every half hour during the day.

9.4.4 Pullets

Never place young birds with old birds as this results in disease risk and bullying. Examine new pullets carefully. They can be very nervous of noise. When buying birds, (point-of-lay) don't accept any light or unthrifty birds. Extra care should be given to these new birds, especially for deep litter systems, as most would have been reared in wire cages.

9.4.5 Culling

Simple form i.e. removing sick or dying birds. To help prevent the spread of disease, dead birds should be buried or burnt. Cull the entire flock at 18-20 months or when it has ceased to pay for its feed. Don't keep any beyond a second laying season. The appearance of a birds' comb and wattles and the condition of the pelvic bones, abdomen and vent are good indicators of a birds' laying condition.

9.4.6 Eggs

Dirty ones should be 'dry cleaned', if ineffective a damp cloth should be used.

(i) Blood spots

There is no cure for them. If the hen laying these eggs can be traced, cull it. There is a tendancy for it to be inherited. They are not connected in any way to disease and are not harmful to humans.

(ii) Soft and Shell-less

Failure of calcium salt secretion or eggs passing too quickly. The trouble could be the diet. Birds require sufficient calcium and vitamin D3. the calcium content can be increased by adding small quantities of limestone or crushed shell grit (oyster or pipi).

9.4.7 Home Dressing of Poultry

Can be done with little or no equipment.

Primary concern - Hygiene. Use clean equipement and prevent contamination of the carcass with the contents of the crop and intestine.

Hang the bird by it's feet, sever jugular vein, allow complete bleeding. Immerse bird completely 60-90 seconds in hot water (52-60°C). Test by pulling tail and wing feathers.

Remove feathers immediately after scalding, rapidly but without tearing skin. Remove feet at hock joint. Remove oil gland on the tail : start 25 mm forward of the gland, cut to the end of the tail. Cut the head off, split the neck skin starting from the shoulders. Pull skin away fro the neck. Remove crop, trachea and oesophagus and cut off neck.

With bird on it's back, cut around vent and gently pull outwards, until a few cms of intestine is showing. Make a horizontal cut about 75 mm long, 40-50 mm below the point of the breast. Remove intestines, heart etc. Clean body cavity.

Chill for 2-3 hours, pack in plastic bag. It can be stored in a refrigerator for several days, frozen, if to be stored for more than seven days.

Source M.A.F. Aglinks NZA4

FPP 310/5
FPP 312/7
FPP 309/4

N.C. CATCHMENT BOARD LIBRARY

9.5 DISEASES

Disease	Affected Age Group	Symptoms	Affect on Bird	Control	Remarks
Avian Leucosis Complex					
(a) Marek's disease (fowl paralysis)	3-9 months	Vary depending on nerves affected. e.g. lame legs, wing droops, head twisted. Retarded growth, pale comb, wasting, diarrohea, loss of appetite.	Can cause tumors to develop. Affects ovaries, lungs, and liver. Attacks nervous system.	Day old chickens vaccinated at hatchery at small cost.	
(b) Leucosis (big liver disease)	4 months and older.	Similar to Marek's disease although paralysis does not occur.	Usually affects liver.	Hygiene techniques, preventing introduction of disease. Otherwise no worthwhile treatment of disease.	Chickens pick up disease in first few weeks of life.
Coccidiosis (a) Caecal Coccidiosis	10 days to 6 weeks old.	Chicks are dejected, weak legs, pale heads, ruffled feathers, blood often present in droppings.		Avoid circumstances which will encourage the disease. i.e. overcrowding, damp litter, chilling and poor feeding. Early treatment with zoalene, sulpharquinoxaline, amprolium.	Caused by microscopic parasites that invade the intestines. Excreted in hen droppings and picked up by healthy birds.
(b) Intestinal Coccidiosis	Older birds	Pale, shrunken combs and wattles look unthrifty.	May cause a few deaths. Wasting, and illness, which reduces egg production.	Same as for Caecal. Coccidiosis but may be harder to control.	Lack of vitamin A and heavy roundworm infestation are coupled with the disease.

Disease	Affected Age Group	Symptoms	Affect on Bird	Control	Remarks
Avian Tuberculosis	Second or third season birds.	Paleness of combs and wattles.	Birds become very thin and usually show signs of diarrhoea, lamness and general weakness, although birds continue to eat well other organs and intestines may be affected.	Kill diseased birds. Transfer clear birds to clean ground. In the case of many numbers being affected, it may be necessary to kill whole flock. Seek expert advice.	After an outbreak of tuberculosis it is advisable to dig over the ground, lime it heavily and leave, for at least one year.
Respiratory Diseases	No specific age group.	Thick discharge from eyelids and nostrils, swollen face, gulping and sniffing.	Prevents bird from eating, drowsiness.	Isolate affected bird to a warm comfortable place, well ventilated but free from draughts. Feed on wet mash and plenty of greens. Drugs should only be used on veterinary advice.	Diseases of this nature occur in cold, damp weather, avoid damp conditions, overcrowding, bad ventilation.
Vitamin A Deficiency	All	Similar to those of coryza.	Poor egg production, increased susceptibility to disease.	Feed bird on good laying mash, grain, and green. If synthetic vitamin A and D is not present in poultry feed, add vitamins to the mash.	Exposure to sunlight for a few hours a day enables the bird to acquire sufficient Vitamin D. Intensively kept birds need Vitamins A and D added to mash.
Water bag or Penjuin Disease.		Bird holds itself upright and waddles around like a Penguin of Duck.	Abdomen is enlarged and filled with "dropsical" fluid.	No successful treatment.	Caused by tuberculosis, tumors in abdomen, ovarian cysts, egg peritonitis or liver disease.
Fowl Pox		Thick cheesy deposits in mouth, and nodules are present on combs and wattles.		In high risk areas vaccination will be necessary. Where breathing is restricted, deposits may be removed and site swabbed with iodine.	

Disease	Affected Age Group	Symptoms	Affect on Bird	Control	Remarks
Bumble Foot		Lamness and obvious swollen foot.	Starts with cut or bruise, gets infected and an absess develops. Pain causes bird to stop laying.	Remove puss by squeezing with the aid of hot water or a poultice. When lancing the cut, make incision fairly deep and remove yellow dead core. Wash foot in warm antiseptic, bandage it and secure bandage with stockholm tar or shellic varnish.	Occurs often amoung household flocks, less often in commercial farms.
External Parasites					
(i) Body Lice	All		Reduced egg production, unthriftiness, loss of weight.	Spray all birds with malathion. Clean and disinfect poultry unit to get rid of lice eggs.	Found on parts of bird which are not densely feathered e.g. below me vent.
(ii) Red Mite		To recognize mites in the fowl-house, look for pearly-white eggs, usually found at end of perches. Mites, as they develop cast their skins, which are similar to cigarette ash, a silvery, white powder, which drops under the perches.	Unthriftiness results.	Avoid: dark poultry houses as this encourages red mite infestation, perches with overlapping ends, as they provide an ideal habitat for mites.	Mites feed on bird dur ing the night. Hides in the day in wall cracks, nests, perches, and floor.

Disease	Affected Age Group	Symptoms	Affect on Bird	Control	Remarks
(iii) Northern Poultry Mite		Lives on bird, feathers look smutty around vent and even black. Vent area will often be scalley and red. Initially only a few birds will show symptoms. Mites evident on eggs before birds.		For mild infestations treat perch ends and cracks with creosote or waste feul oil. Feul oil and Kerosene can be used as a spray. Another effective measure is a 5% solution of coal-tar disinfectant. Maldison (2% solution) can be used as an emulsion to paint roosts and perches. Clean house out before treating, as dust and dirt provide shelter for mites. Spraying treatment should be carried out from undeath perches. Individual dusting may prove simpler for household poultry. Some products available for controlling external parasites are various organo-phosphorous compounds, nicotine sulphate, and rotenone. Rotenone only effective against lice.	For control of external parasites, the poultry house, when empty between flocks, should be thourougly cleaned and sprayed with approved insecticide.

Disease	Affected Age Group	Symptoms	Affect on Bird	Control	Remarks
Scaley Leg	Will spread througout entire flock.	Thickening of the leg and ulceration of the scales.	Birds may become lame in both legs, and eventually the joints will be badly affected.	(i) Soften scales with a soft soap solution and apply a 15% sulphur ointment, rub well under scales. (ii) Dip affected foot and shank into a bucket of feul oil or a mixture of one part kerosine to two parts of linseed oil. Rub mixture in well, avoiding the skin above the shank. Isolate affected birds several treatments, i.e. weekly may be necessary.	Condition is caused by mites which invade the skin under leg scales.

Disease	Affected Age Group	Symptoms	Affect on Bird	Control	Remarks
Internal Parasites. Large roundworm, caecal worm, and the capillaria worm.	Generally under 1 year old, as the older birds are more resistant than the younger ones.	Wasting, loss of condition and reduced egg production.	Most birds have a few large round worms and suffer little effect, but when large numbers of worms are present the bird suffers.	Rear chicks on ground which has not been used by older birds for at least 6 months. Eggs are destroyed by sunlight so keep grass short over summer and it will be safe for younger birds. Drugs to be used to control roundworm.	Large roundworm causes main problems in household flocks. Infection spreads by worm eggs laid in the intestine and excreted in droppings.

Drug	*Effective against*	*Dosing method*
Carbon tetrachloride	Large bowel worm, hair worm	Individual bird-capsule, drenching gun.
Piperazine	Large bowel worm, hair worm	Drinking water or mash
Phenothiazine	Caecal worm	Drinking water or mash
Hygromycin B ('Hygromix')	Caecal worm, large bowel worm, hair worm	Feed (continuous programme from 12 weeks onward)
Methyridine ('Mintic' and 'Promintic')	Hair worm	Drinking water or by injection
Tetramisole ('Aviverm')	All species	Drinking water

Disease	Affected Age Group	Symptoms	Affect on Bird	Control	
Egg Tract Disorders (i) Prolapse of Oviduct.		Red mass at the vent (prolapse)	Small or large part of the oviduct protrudes through the vent, caused by a particularly large or broken egg in the oviduct.	In most cases destroy the bird. Recovery is rare and the bird can be severly pecked and can result in cannibalism.	
(ii) Egg Binding	Young pullet.	Restlessness, shows desire to lay by frequent visits to the next box.	Caused by large egg in oviduct.	Apply the end of a feather, soaked in parafin or olive oil, to the inside of vent and hold bird over container of boiling water. If an egg can be seen remove it. Wash passage with saline solution.	
(iii) Egg Peritonitis	Layers in heavy production.	Dullness, darkened comb and panting may be seen before death.	An egg yolk has either failed to enter the oviduct or been pushed out of it by a reverse movement of its walls. Can also be caused by rupture of oviduct, peritonitis from a secondary bacterial infection.	No treatment for contition. To help prevent it - non fattening diet and exercise.	Often causes bird to die suddenly.

SECTION 10

LIVESTOCK PRODUCTION FROM PASTURE AND FODDER CROPS

10.0 LIVESTOCK PRODUCTION FROM PASTURE AND FODDER CROPS

10.1 INTRODUCTION

The main theme of animal evolution has been dictated by the dietary environment, so that animal and plant development have more or less remained in phase with each other. Plants contain celluloses, polymers of glucose which make up that fraction of plant dry matter called "fibre". It is therefore anomalous that during evolution animals failed to develop cellulase enzyme to break down cellulose that could be secreted in the digestive juices. This anomaly is particularly apparent because cellulose is one of the most abundant naturally occuring organic compounds found on land.

Herbivores have overcome this deficiency by developing capacious diverticulae in their digestive tracts in order to harbour symbiotic microorganisms, which have, in fact, become the animal's cellulase producing tissue. These microorganisms digest by fermentation the fibrous and soluble constituents of plants. Unfermented fibre is excreted in the faeces, but the small amount of soluble constituents which passes on down the digestive tract together with other food material, including microorganisms, becomes subject to normal enzymic digestion. The single nutrients produced by microbial fermentation, mainly acetic, propionic, and butyric acids, are absorbed by the organ acting as the fermentation vat. These acids can contribute 60–80% of the animal's energy requirements.

Ruminants utilise pasture by presenting the good for fermentation in the rumen prior to the gastric and intestinal digestion in the post-rumen gut. Livestock production from pasture primarily concerns wool, meat and milk from ruminant animals such as sheep, beef cattle and dairy cows. In order to measure livestock production the nutritive value of pasture has to be assessed, the food requirements of ruminants for particular performance (e.g. rate of liveweight gain, milk production) within a physiological state (maintenance, growth and fattening, lactation) have to be listed, and the annual demand for food by farm animals has to be profiled. If this procedure is followed livestock production from pasture can be calculated.

10.2 NUTRITIVE VALUE OF PASTURE

The nutritive value of pasture is closely related to the composition of the dry matter, particularly the content of fibre and protein. High quality pastures have low amounts of fibre and high quantities of protein. Legumes at the same stage of growth as grasses are better in this respect too.

Average values for the chemical analysis of grass clover and lucerne pastures, together with the hay made from these swards, are given in Table 7.1. The values for protein and fibre show that pasture is most nutritious when young and grazed *in situ*, and that lucerne hay is of higher quality than grass-clover hay (meadow hay). It can also be seen that pasture contains low quantities of fat (ether extract) but more than adequate amounts of gross minerals (ash). The nitrogenfree extract contains soluble sugars and other compounds which are generally, but not invariably, less resistant to microbial fermentation in the rumen than fibre. This latter value, calculated by difference from 100%, unfortunately gives little indication of the nutritive value of pasture because it is so variable.

TABLE 10.1

Chemical composition of pasture fodder

	Dry matter percentage	Protein (Nx6.25)	Ether extract	Ash	Crude fibre	Nitrogen-free extract
		(as percent of dry matter)				
Young pasture	20	28	5	123	15	40
Mature pasture	25	14	4	8	28	46
Young lucerne	18	26	8	10	18	38
Mature lucerne	25	18	4	10	28	40
Pasture hay	85	13	2	8	30	47
Lucerne Hay	90	17	2	9	26	46

The season of the year and the stage of growth within a season affect the protein and fibre contents of pasture. Examples of this for ryegrass white clover pasture are given in Table 7.2 and 7.3 respectively. The dry matter content of pasture is as low as 15% in spring and as high as 30% in summer. Short leafy pasture is typical of good sheep feed in spring, long leafy pasture is indicative of rotationally grazed dairy pasture, and the preflowering and flowering stages correspond to material for silage and hay respectively. Obviously, grazing management will affect the nutritive value of pasture through control of the stage of growth.

TABLE 10.2

Means values for the protein and fibre content of grass/clover pasture according to season of the year

Season	Height (cm)	Protein (Nx6.25)	Crude fibre
		(per cent of dry matter)	
Spring	10-20	26	14
Summer	10-20	10	30
Autumn	10-20	28	14
Winter	10-20	20	19

TABLE 10.3

Mean values for the protein and fibre content of grass/clover pasture according to stage of growth in spring

Stage of growth	Height (cm)	Protein (Nx6.25)	Crude fibre
		(per cent of dry matter)	
Short leafy	5-10	27	17
Long leafy	15-20	21	20
Preflowering	25-35	16	26
Flowering	40-50	11	30

10.3 EVALUATION OF PASTURE

Under most feeding conditions grazing ruminants consume a surfeit of protein and minerals in their requirements. Amino-acid deficiencies are unknown in pasture-fed ruminants and, where certain areas show a soil deficiency in a specific mineral (e.g. selenium in Canterbury, cobalt on the pumice lands of the North Island, iodine in Southland), preventative measures are taken to supplement the animals. This can be done by administering the mineral to the animals directly by drench, by injection or by a mineral lick, or indirectly by incorporating the mineral into fertilisers. Therefore pasture needs to be evaluated solely in terms of the amount of energy in the good that is available to the animal after digestion and metabolism. This available energy is called metabolisable energy (ME). It is equal to the gross energy of a food as it is eaten, less the energy lost in the faeces, urine and as gases from the digestive tract.

Table 7.17 gives the metabolisable energy values of common pasture fodders. The values are expressed in terms of the megajoules (MJ)* of metabolisable energy in a kilogram (kg) of dry matter (D.M.).

When 1 kg of dry matter from pasture is burnt to its ultimate oxidation products, about 18.4 MJ of gross energy are evolved. Thus

* 1 Megajoule (MJ) = .239 Megacalories = 239,000 calories.
1 calorie = heat required to raise the temperature of 1g water by 1°C (15-16°C).

a value of 7.5 MJ ME/kg DM means that in every 1kg of dry matter eaten 10.9 (i.e. 18.4 – 7.5) MJ of energy are unavailable to the animal. This quantity of energy is lost by the animal through excretion in the faeces, urine, and as gas from the digestive tract. Low metabolisable energy values are typical of ruminants given poor quality meadow hay or silage. On the other hand a high value of 12.5 MJ ME/kg DM means that only 5.9 (18.4 – 12.5) MJ of energy were excreted after digestion and metabolism. This is indicative of new grass and lush pasture.

It can be seen from Table 7.17 that the available energy can vary from as low as 7.3 MJ ME/kg DM for poor quality pasture hay to as high as 11.7 MJ ME/kg DM for short leafy pasture. Under restricted grazing conditions the concentration of metabolisable energy in the dry matter within the broad range of values given here controls voluntary intake of pasture. When feeding *ad libitum* voluntary intake is greatest for pastures low in fibre and high in protein. Such pastures have a high concentration of metabolisable energy in the dry matter. As the quality of pasture decreases the bulk of the fodder limits voluntary intake because of the increasing fibre content of the plant.

Pasture quality is in a dynamic state all the time, because of such factors as the age of the pasture, effects of climate or irrigation, grazing management, fertiliser practice, botanical composition of the pasture, which all affect the relative stage of growth or the rate at which pasture plants mature, so that even within any one classification a narrow range of values has to be given. However, for most practical situations pasture fodder can be classified as poor, fair, good, or excellent and simply given values of 7.5, 9.2, 10.7 and 12.5 MJ ME/kg DM respectively. This allows for ease of use of the ME values under normal feeding conditions. Only in scientific experiments where stringent accuracy is needed would a specific value be required. Under these circumstances the pasture in question would be screened in a metabolism trial with sheep fed at the maintenance level of nutrition.

10.4 REQUIREMENTS OF RUMINANTS FOR PASTURE

Authoritative feeding standards are published periodically by the Great Britain Agricultural Research Council (A.R.C.) and the National Research Council (N.R.C.) in the United States. Like in all average figures, a great deal of commonsense is needed when applying tabled feeding standard values to an individual enterprise. No-one should misunderstand and assume that average values are highly precise under all feeding conditions. At best they are guides to feeding practice, and this applies to all feeding tables in spite of certain claims to the contrary.

The food requirements of sheep, beef cattle and dairy cows are given in the following tables in this section. They are based on the A.R.C. feeding standards but have been increased by 30 per cent to allow for the extra energy cost of grazing under New Zealand farming conditions. A recent symposium on the food requirements of grazing ruminants was held by the New Zealand Society of Animal Production at their annual conference in 1971. On reviewing the situation all contributors found that the energy requirements of grazing ruminants were from 10– 50 per cent higher than classical feeding standards would indicate.

10.4.1 Adult Sheep.

Adult sheep spend virtually their entire life at maintenance which in respect to the grazing animal cannot explicitly mean zero energy retention. It is well known that within any system of flock management, fluctuations in liveweight of the ewes are generated, when feed supply is adjusted to the animal's requirement in a particular period fluctuations in liveweight of the ewes are generated, when feed supply is adjusted to the animal's practical requirement in a particular period during the year. The maintenance requirements of sheep, fed on pasture containing different concentrations of ME, are shown in Table 7.4. The maintenance requirement increases with the liveweight of the ewe but decreases as the quality of pasture improves. The food requirement of adult ewes just prior to tupping and during the last four weeks of pregnancy is 1.5 times maintenance; whilst during early lactation the ewe requires to be fed at 3.0 times maintenance decreasing to 2.0 times maintenance by the 3rd month of lactation.

TABLE 10.4

Metabolisable energy requirement (MJ/day) for Maintenance of Adult Sheep

Liveweight	ME concentration (MJ/kg DM) of pasture			
(kg)	7.5	9.2	10.9	12.5
40	8.8	8.4	7.9	7.5
55	10.0	9.6	9.2	8.8
70	10.9	10.4	10.0	9.6

10.4.2 Weaned Lambs.

The metabolisable energy requirement of lambs from the time of weaning to the hogget stage are given in Table 7.5. It can be seen from these values that, for a particular rate of liveweight

gain, lambs require a greater metabolisable energy intake with low quality pasture fodder compared with that of high quality. Rapid rates of gain cannot be achieved with low quality pasture because, in general, the bulk of food in the rumen limits intake before sufficient ME has been ingested to achieve high weight gains. Furthermore, the margin between low and high quality pasture, in terms of requirement for good performance, becomes more marked as daily liveweight gain increases, because of differences in the efficiency of utilisation of metabolisable energy. The metabolisable energy of low quality pasture is used less efficiently than that of high quality pasture.

TABLE 10.5

The metabolisable energy requirement (MJ/day) of weaned lambs and weight gain according to liveweight

Liveweight (kg)	ME concentration (MJ/kg DM)	Daily liveweight gain of lamb (g/day)				
		0	50	100	200	300
20	7.5	5.4	8.8	–	–	–
	9.2	5.4	7.5	10.0	–	–
	10.9	5.0	7.1	9.2	14.6	–
	12.5	4.6	6.7	8.4	12.5	18.4
30	7.5	7.1	10.5	–	–	–
	9.2	7.1	9.6	12.5	–	–
	10.9	6.7	8.8	11.3	17.1	–
	12.5	6.3	8.4	10.5	15.0	20.9
40	7.5	8.8	12.5	–	–	–
	9.2	8.4	11.7	14.6	–	–
	10.9	7.9	10.5	13.0	19.2	–
	12.5	7.5	9.6	12.1	16.7	23.0

10.4.3 Beef Cattle.

The metabolisable energy requirements of growing and fattening cattle are given in Table 7.6. In practical terms they represent the requirements of a beef beast weaned at 150 kg which gains increments of 50 kg to a finished weight of 450 kg. The comments made for weaned lambs also apply here.

TABLE 10.6

The metabolisable energy requirement (MJ/day) of Growing and Fattening Cattle

Liveweight (kg)	ME concentration (MJ/kg D.M.) of pasture	Daily liveweight gain (kg/day)						
		0	0.25	0.50	0.75	1.00	1.25	1.50
200	7.5	46.8	57.3	70.2	85.7	–	–	–
	9.2	45.1	53.1	62.7	74.0	88.6	–	–
	10.9	43.5	50.2	57.7	66.7	77.7	90.7	–
	12.5	41.8	47.2	53.9	61.4	70.6	81.1	94.0
300	7.5	57.3	69.4	83.2	102.0	–	–	–
	9.2	55.6	64.8	75.6	88.6	106.2	–	–
	10.9	53.1	61.0	69.4	79.8	93.6	110.3	–
	12.5	51.0	57.7	65.6	74.0	84.8	97.8	114.1
400	7.5	67.3	81.9	97.8	119.9	–	–	–
	9.2	65.2	76.5	89.0	104.9	124.5	–	–
	10.9	62.7	71.9	81.5	94.5	109.9	30.0	–
	12.5	60.2	68.5	76.5	86.9	99.5	115.8	135.8

Unlike the adult ewe, beef cattle for meat production are required to grow. The faster they grow the more efficient, energetically speaking, is beef production because the daily effect of the maintenance requirement on total production is reduced. Thus feeding cattle to appetite results in a considerable saving of pasture if rapid growth is maintained.

10.4.4 Lactating dairy cows.

The metabolisable energy requirements of lactating dairy cows are given in Table 7.7. The values show that animals yielding heavily require high quality rations to achieve the necessary intake of metabolisable energy to maintain such production.

The metabolisable energy requirements of pregnant, non-lactating Friesian and Jersey cows are given in Tables 7.8 and 7.9 respectively.

TABLE 10.7

The Metabolisable Energy Requirement (MJ/day) of Lactating Dairy Cows

Liveweight (kg)	ME concentration (MJ ME/kg D.M.) of pasture	Milk Yield (kg/day) 0	5	10	15	20	25	30	35
363	7.5	52.7	99.9	–	–	–	–	–	–
(4.9% fat	9.2	50.6	91.1	138.7	–	–	–	–	–
in milk)	10.9	48.9	85.3	126.2	171.3	224.0	–	–	–
	12.5	46.8	83.2	121.2	161.7	204.8	251.2	–	–
500	7.5	66.9	105.3	153.8	–	–	–	–	–
(3.8% fat	9.2	64.8	97.8	135.4	177.6	–	–	–	–
in milk)	10.9	61.9	92.8	125.4	160.9	198.9	210.2	–	–
	12.5	59.8	90.7	121.6	155.0	188.9	224.0	261.2	
590	7.5	76.1	112.4	156.3	–	–	–	–	–
(3.6% fat	9.2	73.6	105.3	140.8	179.3	224.0	–	–	–
in milk)	10.9	70.2	99.9	131.6	164.7	199.8	237.4	281.3	–
	12.5	68.1	97.4	128.3	159.2	191.8	225.7	259.5	296.3

TABLE 10.8

The Metabolisable Energy Requirement (MJ/day) of a Pregnant, Non-Lactating Friesian Cow

ME concentration of pastures (MJ/kg DM)	Weeks from term 8–4	4–2	2–0
7.5	66.0	84.4	93.6
9.2	61.0	76.9	84.0
10.9	56.4	71.0	77.3
12.5	52.2	66.5	72.3

TABLE 10.9

The Metabolisable Energy Requirement (MJ/day) of a Pregnant, Non-Lactating Jersey Cow

ME Concentration (MJ/kg DM)	Weeks from term 8–4	4–2	2–0
7.5	44.7	56.8	62.3
9.2	42.2	53.5	58.5
10.9	39.7	50.2	54.7
12.5	36.8	46.8	51.0

10.5 PROFILE OF ANNUAL DEMAND FOR PASTURE BY RUMINANTS

Pasture can grow all the year and rates of growth are faster in spring and autumn, although the extent of spring flush growth can be increased by irrigation. Under pastoral conditions it is practical to conserve pasture as hay or silage during the periods of abundant supply (usually late spring and early summer) and feed this fodder to the animals when grass growth is slow. This means that ruminants will not only eat pasture *in situ* varying in quality, but also conserved feed that will generally be of lower quality than the pasture being grazed. It is important to profile the annual demand for food by domestic animals according to the physiological state of the animal and the required performance in that state (e.g. rate of liveweight gain in growing beef steers), because pasture quality varies throughout the year.

10.5.1 Sheep

The profile of feed demand for a ewe rearing at least one lamb to prime weight at 12 weeks of age is given in Table 7.10. With the exception of the lactation period, the ewe is fed at and about maintenance nutrition. However, it is important to have the ewe gaining some weight during flushing, tupping, and in late pregnancy when the foetus is growing rapidly. It is also good practice to have the ewe gain the weight lost at lambing during lactation so she enters the summer maintenance feeding period in good condition.

TABLE 10.10

Profile of annual feed demand for a ewe

Month of the year	Liveweight (kg)	Physiological state	Minimum quality of feed required (MJ ME/kg DM)
January	55	Maintenance	7.5
February	55	Maintenance	7.5
March	58	Supermaintenance	10.9
April	61	Supermaintenance	10.9
May	56	Submaintenance	6.7
June	53	Submaintenance	6.7
July	55	Supermaintenance	10.9
August	60	Supermaintenance	10.9
September	52	Lactation	10.9-12.5
October	53	Lactation	10.9
November	60	Lactation	9.2
December	55	Maintenance	7.5

(See also tables 7.5 and 7.13)

It must be emphasised that the last column in Table 7.10 gives the minimum quality of feed tolerated by the ewe according to her physiological state. Pasture fodders of the order of quality below that given in Table 7.10 are liable to result in a reduced harvest of lamb in spring because the bulk limitation to appetite results in the ewe not achieving sufficient intake to maintain fitness for production. On the other hand in seasons of pasture abundance or in situations where farms are understocked, it does not matter if the quality of the pasture is higher than it need be. Under such conditions the positive changes in liveweight will be magnified.

10.5.2 Beef Cattle

The profile of feed demand for a beef animal grown for meat production differs from the ewe in that cattle remain in the physiological state of growth and fattening from birth to weaning. It can be seen from the example given in Table 7.11, that performance according to the type of pasture available during different periods of the year, is the important issue.

TABLE 10.11

Profile of annual feed demand for a growing beef animal

Month of the year	Liveweight (kg)	Growth performance (kg/day)	Quality of feed required (MJ ME/kg DM)
March	150	1.0	10.9
April	181	1.0	10.9
May	211	0.5	50% hay at 7.5
June	226	0.5	50% pasture at 10.9
July	241	0.5	Ave. May-August
August	256	0.5	= 9.2
September	271	1.5	12.5
October	316	1.5	12.5
November	361	1.0	10.9
December	391	0.5	9.2
January	406	0.5	9.2
February	421	1.0	10.9
March	449	–	–

The profile represents the feed demand of a beef animal born in September-October at about 30kg liveweight and weaned in March, 5-6 months later at 150 kg liveweight, onto good quality autumn pasture. Such pasture available at this time would result from adequate summer rainfall, irrigation or hay

aftermath. Liveweight gains are good during this period because of cooler autumn conditions. Cold weather in the May-August period leads to slower liveweight gains because pasture growth is reduced and it is necessary to supplement 50% of the animal requirement with medium quality hay. In spring, lush pasture promotes rapid liveweight gains that tail off in summer because of the temperature conditions and the drying out of pasture. It is assumed that the farmer was able to supply good quality pasture in February so that a finished 18 month old beast is turned to market in March at about 450 kg.

Of course, the profile of feed demand for beef will vary with the geographic location of the property and from season to season. However, the data given so far in this chapter will enable the agriculturalist to profile feed demand according to circumstance.

10.5.3 Dairy Cows.

The profile of feed demand for a lactating dairy cow is similar to that of a beef animal, in that performance, namely yield of milk, is important. Only in the dry period does the physiological state of the animal change and then super maintenance feeding is required because of approaching parturition.

An example of a feed profile for an above average milking cow, weighing 450 kg, that calved on 1st August and was mated again on 15th October, is given in Table 7.12. It was assumed that the farmer has good quality autumn saved pasture that he could break-feed in August, and also that during this period meadow hay furnished only one quarter of the cow's food requirement. Peak milk yield coincides with flush spring growth, and the animal was able to keep on producing well going into late lactation, because of good grass growth in autumn. During the dry period hay made a large contribution to the animal's food requirement.

TABLE 10.12

Profile of Annual feed Demand for a 450kg Dairy Cow

Month of the year	Physiological state	Milk yield performance (kg/day)	Quality of feed required (MJ ME/kg DM)
August	Early lactation	20	10.9
September	Peak lactation	25	12.5
October	Peak lactation	25	12.5
November	Peak lactation	20	10.9
December	Mid lactation	15	9.2
January	Mid lactation	15	9.2
February	Mid lactation	15	10.9
March	Late lactation	15	10.9
April	Late lactation	10	10.9
May	Late lactation	10	9.2
June	Dry period	–	9.2
July	Dry period	–	9.2

10.6 LIVESTOCK PRODUCTION FROM PASTURE

It will be appreciated from the preceding tables in this chapter, that the food requirements of ruminants for a given performance within a physiological state is fairly constant with pasture of known quality. Therefore, the main determinant of total livestock production is the amount of pasture that can be produced, and which can be harvested by the animal or conserved as hay or silage. The number of stock carried depends on the yield of DM per hectare.

Calculations of the annual feed demand of a ewe rearing a single lamb, a growing beef steer, and a lactating dairy cow, based on the above feed profiles given, are shown in Table 7.13–7.15 respectively. The ME requirements (MJ/day) were given in Tables 7.4, 7.6 and 7.7 respectively.

Knowing then the quality of the pasture and the type of production required, the dry matter requirements, expressed on a daily, monthly and annual basis, are easily calculated.

The metabolisable energy requirement of the beef steer (Table 7.14) is based on those periods of the year when the animal weighed, on average, about 200, 300 and 400kg respectively. Since the steer is growing all the time, its daily consumption of dry matter on March 1st (150kg liveweight) would be about 6 kg DM/day building up to an intake of about 11kg DM/day on February 28th (449kg liveweight).

TABLE 10.13

Calculation of the annual feed demand of a 55kg ewe

Month of the year		Physiological state	Food quality (Mcal) (MJ ME/kg DM)	ME requirement (MJ/day)	Pasture D.M. requirement (kg/day)	(kg/month)
January		Maintenance	7.5	10.0	1.33	41.2
February		Maintenance	7.5	10.0	1.33	37.2
March	1.5	Maintenance	10.9	13.8	1.27	39.4
April		Maintenance	10.9	13.8	1.27	38.1
May	0.8	Maintenance	6.7	8.4	1.25	38.8
June		Maintenance	6.7	8.4	1.25	37.5
July	1.5	Maintenance	10.9	13.8	1.27	39.4
August		Maintenance	10.9	13.8	1.27	39.4
September	3.0	Maintenance	12.5	26.3	2.10	63.0
October	2.5	Maintenance	12.5	22.2	1.77	54.9
November	2.0	Maintenance	10.9	18.4	1.69	50.7
December		Maintenance	7.5	10.0	1.33	41.2
					Annual requirement	520.8kg

TABLE 10.14

Calculation of the annual feed demand of a growing beef steer

Month of the year	Liveweight (kg)	Growth performance (kg/day)	Food quality (MJ ME/ kg DM)	ME requirement (MJ/day)	Pasture DM requirement (kg/day)	(kg/mth)
March	150	1.0	10.9	77.7	7.15	221.7
April	181	1.0	10.9	77.7	7.15	214.5
May	211	0.5	9.2	62.7	6.82	211.4
June	226	0.5	9.2	62.7	6.82	204.6
July	241	0.5	9.2	62.7	6.82	211.4
August	256	0.5	9.2	75.6	8.23	255.1
September	271	1.5	12.5	114.1	9.10	273.0
October	316	1.5	12.5	114.1	9.10	282.1
November	361	1.0	10.9	110.0	10.12	303.6
December	391	0.5	9.2	89.0	9.68	300.1
January	406	0.5	9.2	89.0	9.68	300.1
February	421	1.0	10.2	110.0	10.12	283.4
	449 (Slaughterweight)			Annual requirement		3061.0kg

The dry matter requirements of a lactating dairy cow (Table 7.15) are based on its metabolisable energy requirement. It is important to note that the pattern of dry matter intake by a dairy cow over the season differs to that given in Table 7.15. Cows tend to mobilize their body reserves in early lactation (i.e. milk off their back) to furnish their ME requirement when the demand is high. Hence the cow in the present example would probably be eating about 12–13 kg

D.M./day in early lactation, building up to 19 kg D.M./day by January -February. These reserves are replaced in mid and late lactation by eating food surplus to her requirement thus balancing total annual intake. If such surpluses are not available during this period then the cow will compensate by reducing her requirement through decreased milk production.

TABLE 10.15

Calculation of the annual feed demand of a 450kg dairy cow

Month of the year	Milk yield performance (kg/day)	Food quality (MJ ME/kg DM)	ME requirement (MJ/day)	Pasture D.M. requirement (kg/day)	(kg/month)
August	20	10.9	198.9	18.3	567.3
September	25	12.5	224.0	17.9	537.0
October	25	12.5	224.0	17.9	554.9
November	20	10.9	198.9	18.3	549.0
December	15	9.2	177.6	19.3	598.3
January	15	9.2	177.6	19.3	598.3
February	15	10.9	160.9	14.8	414.4
March	15	10.9	160.9	14.8	458.8
April	10	10.9	125.4	11.5	345.0
May	10	9.2	135.4	14.7	455.7
June	Dry period	9.2	61.0	6.6	198.0
July	Dry period	9.2	79.4	8.6	266.6
				Annual requirement	5543.3kg

The data from these examples were used to calculate the hypothetical number of stock units that could be run for a range of pasture yields. The results are presented in Table 7.16. Obviously this type of calculation is restrictive, because allowances have not been made for the pasture required by replacement stock, in the case of the sheep and dairy enterprises, or for the requirements of the breeding beef herd (cf. requirements for dairy cows). Furthermore, financial comparisons of this type are probably more meaningful in the long run. However, the methods of expressing livestock production from pasture are many and varied (e.g. weight ratios, energy ratios, stocking rates, gross margins, etc.), but the first step is to calculate such production.

TABLE 10.16

Carrying capacity in relation to type of enterprise and yields of pasture (Stock no./ha.)

Type of Enterprise	Yield of harvestable dry matter (kg/ha)		
	10 000	12 000	15 000
Sheep (521 kg D.M./annum)	19.2	23.0	28.8
Beef (3061 kg D.M./annum)	3.3	3.9	5.9
Dairy (5543 kg D.M./annum)	1.8	2.2	2.7

10.7 DISCUSSION

In this chapter an attempt has been made to quantify livestock production from pasture. In order to make these calculations the student of agriculture and the agriculturalist must learn to grade pasture according to its quality estimate the dry matter content, and determine the yield per unit area. Once the performance wanted of the animal is known, within the managerial scheme of the farming enterprise, the question then becomes a mathematical problem for which data have been provided in this chapter and elsewhere.

In some farming systems, particularly those in the South Island, and also town milk farms where winter milking is carried out, pasture is the important but not the sole food source. Thus it may be necessary, when calculating livestock production from pasture, to fit foodstuffs, such as grains, succulents, straws and concentrates, into the programme when the profile of feed demand is being determined. The metabolisable energy values for various supplementary foodstuffs, given in Table 7.17, will facilitate this.

TABLE 10.17

Metabolisable energy values of common feeds.

	% DM	*Relative ME value on DM basis	ME Concentration (MJME/kg DM)	% Crude Protein DM basis
Pasture				
Short leafy	15	1.10	11.7	27
Mixed-length leafy	18	1.00	10.8	21
Dry stalky	28	0.76	8.1	10
Lucerne				
Green vegetative	15-25	0.87	8.5-11.0	30
Bud formation		0.85	8.5- 9.5	25
10-20% flowering		0.81	8.0- 9.5	22
Silages				
Grass	15-20	0.86	8.4- 9.5	12-20
Wilted grass	30			
Lucerne	19	0.78	7.1- 8.5	21

Formic acid lucerne	19	0.84	8.0- 9.5	21
Wilted lucerne	30			
Maize	33	0.98	10.2-10.8	8
Hays				
Pasture Good quality	85	0.78	8.4	12
Poor quality	85	0.68	7.3	12
Lucerne	85	0.84	8.0- 9.5	17
Straws				
Oats	86	0.65	7.0	4
Wheat	86	0.54	5.7	3
Barley	86	0.67	7.1	5
Ryegrass	86	0.73	7.1- 8.0	6
Pea	86	0.68	7.2	9
Corn stover	84	0.77	6.9- 9.4	5
Crops				
Swede tops	15	1.26	13.5	15
bulb	10	1.26	13.5	11
Turnip tops	13	1.33	14.1	20
bulb	9	1.21	12.9	12
Choumoellier	15	1.09	11.7	14
Rape	20	1.16	12.4	16
Kale	16	1.10	11.9	15
Mangels	13	1.12	11.9	10
Fodder beet	20	1.13	12.1	9
Japanese millet	17	0.93	10.0	12
Carrots	13	1.22	13.0	9
Potatoes	24	1.19	12.6	8
Green Maize	24	0.91	8.8-11.3	10
Lupins (sweet)	18	0.97	10.3	17
Fodder radish	11	1.00		10
Green Feeds				
Oats	17	1.22	13.0	15
Barley	17	1.18	12.5	15
Ryecorn	17	1.14	12.2	15
Wheat	17	0.89	9.5	15
Concentrates				
Wheat	86	1.26	13.5	14
Barley	86	1.23	13.1	12
Oats	86	1.13	12.0	13
Linseed cake	86	1.13	12.0	26
Peas	86	1.23	13.1	26
Pollard	86	1.14	12.2	18
Bran	86	0.90	9.6	17
Brewer's grains	30-40	0.93	10.0	25
Molasses	75	1.10	11.8	4
Lucerne meal	86	0.93	9.5-10.3	22
Grass meal	86	0.95	9.5-11.1	19

**Relative ME values are relative to leafy pasture with a ME concentration of 10.8 MJME/kg DM.*

These figures are for maintenance feeding. Some variation between the relative values of feeds may occur depending on the productive purpose of the feed.

Refer to the section on animal nutrition in the *M.A.F. Technical Handbook for Advisers* for more information on feed values.

A number of people, including many farmers, have the experience and practical skill to look at an area of pasture, and evaluate it in terms of the number of stock-days that it will carry. Whilst one has to admire such a subjective assessment, the student of agriculture does not have this ability through lack of experience. Therefore, the time is ripe to think of the nutritional value of pasture in terms of the physiological state and performance required of an animal in relation to the profile of annual feed demand. It may well be that errors in application may swamp the advantages of using specific values for particular performances. Even so, the Tables given in this chapter give a precise scheme for the calculation, planning and costing of livestock production from pasture.

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(This section was prepared by Dr. K.T. Jagusch, M.A.F.

NOTE: A useful booklet for use in conjunction with this chapter is the Ministry of Agriculture, Advisory Services Divisions' publication:

'Feed Budgeting' Compiled by Milligan K.E. and McConnell G.R. (1976)

10.8 MONTHLY FEED SUPPLY AND DEMAND TABLES

(prepared by G.A.G. Frengley, 1969)

The following tables show the requirements of a 55 kilogram breeding ewe lambing in mid-August and rearing a lamb for 12 weeks. The figures may be converted to the feed requirements of other livestock by reference to the tables comparing the feed requirements of other classes of stock.

A number of common feeds have been selected and by using the tables, the feed requirements of a flock or herd can be budgeted with reasonable accuracy for any period of the year.

10.8.1 Hay Feeding

Month	Good Lucerne Hay		Very Good Meadow Hay		Low Quality Hay **
	kg/ewe/day	bales/100/ day (29kg bales)	kg/ewe/day	bales/100/ day (27kg bales)	kg/ewe/day
January	1.00	3.4	0.91	3.4	1.22
February	1.10	3.8	1.02	3.7	1.36
March	1.04	3.6	0.96	3.5	1.27
April	1.08	3.7	1.01	3.7	1.31
May	1.08	3.7	1.01	3.7	0.31
June	1.16	4.0	1.07	4.0	1.40
July	1.36	4.7	1.26	4.7	1.76
August	*2.10	7.2	1.95	7.2	*2.31 (+0.22)

Note: * Intake limit is reached.
** An assumption is made that although the feed value of this hay is low it is quite palatable.

10.8.2 Pasture

Leafy pasture (19% D.M.)

Month	kg/ewe/day (fresh weight)
January	3.75
February	4.20
March	3.50
April	4.15
May	4.16
June	4.43
July	5.20
August	8.14
September	10.26
October	10.71
November	11.07
December	5.97

10.8.3 Grain Feeding

Month	Barley kg/ewe/day	Oats kg/ewe/day	Peas kg/ewe/day
January	0.62	1.09	0.62
February	0.68	1.20	0.68
March	0.63	1.12	0.63
April	0.66	1.18	0.67
May	0.66	1.18	0.67
June	0.71	1.27	0.72
July	0.83	1.48	0.84
August	1.29	2.29	1.31

10.8.4 Brassicas and Root Crops

	TURNIPS					SWEDES				
Month	kg/day/ewe	Ewes/ha/week		Ha/1000/mth		kg/day/ewe	Ewes/ha/week		Ha/1000/mth	
		50 t/ha	75 t/ha	50 t/ha	75 t/ha		100 t/ha	150 t/ha	100 t/ha	150 t/ha
January	6.98	1018	1529	4.3	2.8	5.51	2581	3872	1.7	1.1
February	7.75	917	1377	4.7	3.1	6.12	2323	3484	1.5	1.0
March	7.16	988	1482	4.4	2.9	5.67	2503	3754	1.6	1.1
April	7.57	935	1401	4.6	3.1	5.98	2365	3548	1.5	1.0
May	7.57	935	1401	4.6	3.1	5.98	2365	3548	1.5	1.0
June	8.16	871	1305	5.0	3.3	6.44	2206	3307	1.4	0.9
July	9.48	748	1121	5.8	3.9	7.48	1896	2844	1.2	0.8
August	14.74	480	721	9.0	6.0	11.61	1222	1833	0.8	0.5

Month	FODDER BEET (per 50 tonne of crop) kg/day/ewe	Ewes/ha/week	ha/1000/mth	KALE (marrow-stem) (per 50 tonne of crop) kg/day/ewe	Ewes/ha/week	ha/1000/mth
January	4.53	3295	1.00	5.09	1400	3.00
February	5.03	3530	1.12	5.70	1250	3.36
March	4.67	3800	1.04	5.40	1320	3.18
April	4.94	3595	1.10	5.65	1260	3.32
May	4.94	3595	1.10	5.65	1260	3.32
June	5.30	3345	1.18	6.00	1185	4.43
July	6.17	2880	1.38	7.06	1010	4.16
August	9.57	1850	2.14	11.05	645	6.50

Month	RAPE (per 50 tonne of crop) kg/day/ewe	Ewes/ha/week	Ha/1000/mth
January	5.78	1235	3.4
February	6.46	1100	3.8
March	6.12	1165	3.6
April	6.40	1110	3.8
May	6.40	1110	3.8
June	5.24	1045	4.0
July	8.01	890	4.8
August	12.54	570	7.4

Note: For carrots, multiply the kale figures for daily and monthly feed requirements by 1.174. Multiply ewes per hectare per week by a factor of 0.85. If cutting, grams per square metre x 10 = kg wet matter per hectare. For kale, 30cm in height = 25 t/ha.

10.8.5 Silage

Month	Very Good Silage		Average Quality Silage	
	kg/day/ewe	t/100 ewes	kg/day/ewe	t/100 ewes
January	3.10	3.1	3.44	3.4
February	3.44	3.4	3.82	3.8
March	3.19	3.2	3.54	3.5
April	3.38	3.3	3.75	3.7
May	3.38	3.3	3.75	3.7
June	3.63	3.6	4.03	4.0
July	4.22	4.2	4.70	4.6
August	6.53	6.5	7.27	7.2

Note: The above figures are based on the assumption that very good silage has a feed value of 11.3 kJ M.E./kg D.M. and average silage has 8.7 kJ M.E. kg D.M. The percentage D.M. in each case is 20% for very good silage, and 25% for average silage.

10.8.6 Winter Greenfeeds

	A.S.P. (15 cm high, dense, 30% D.M.)			Oats 20% D.M.	Italian Ryegrass 30% D.M.
	kg/ewe/ day	ewes/ha/ week	ha/100 mth	kg/day/ ewe	kg/day/ ewe
May	2.47	574	7.6	3.9	3.6
June	2.65	534	7.8	4.1	3.9
July	3.08	458	9.6	4.8	4.6
August	4.76	294	14.9	7.5	7.1

10.8.7 Maintenance Feed Requirement Relationship Between Livestock Classes (Breeding Ewe constant)

Month	Breeding Ewe	Dry Stock					Steer			Breeding Cow
		20kg	30kg	40kg	55kg	70kg	200kg	300kg	400kg	500kg
January	1.0	0.51	0.66	0.83	1.0	1.09	4.6	5.7	6.7	13.2
February	1.0	0.46	0.59	0.75	0.90	0.98	4.1	5.1	6.0	13.3
March	1.0	0.49	0.64	0.72	0.97	1.06	4.4	5.5	6.5	7.1
April	1.0	0.47	0.60	0.76	0.92	1.00	4.2	5.2	6.1	6.9
May	1.0	0.47	0.60	0.76	0.92	1.00	4.2	5.2	6.1	6.9
June	1.0	0.44	0.56	0.71	0.85	0.93	3.9	4.8	5.7	6.7
July	1.0	0.37	0.48	0.61	0.74	0.80	3.4	4.2	4.9	6.6
August	1.0	0.24	0.31	0.39	0.47	0.52	2.2	2.7	3.2	4.7
September	1.0	0.19	0.24	0.31	0.37	0.41	1.7	2.1	2.5	4.2
October	1.0	0.18	0.23	0.29	0.36	0.39	1.6	2.0	2.4	4.4
November	1.0	0.17	0.23	0.29	0.34	0.37	1.6	2.0	2.3	4.6
December	1.0	0.33	0.42	0.53	0.64	0.70	2.9	3.6	4.3	8.3

Note: * Based on an assumed feed quality of 10.42 kJ M.E./kg D.M.
No allowance for liveweight gain of dry stock or steers has been made.

10.8.8 Reciprocal Maintenance Feed Requirement Relationship Between Livestock Classes (Dry Stock constant)

Month	Breeding Ewe	Dry Stock					Steer		
		20kg	30kg	40kg	55kg	70kg	200kg	300kg	400kg
January	1.0	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
February	1.11	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
March	1.03	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
April	1.09	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
May	1.09	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
June	1.17	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
July	1.36	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
August	2.11	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
September	2.68	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
October	2.80	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
November	2.89	.51	.66	.83	1.0	1.09	4.6	5.7	6.7
December	1.56	.51	.66	.83	1.0	1.09	4.6	5.7	6.7

10.8.9 Pasture

Density**	kg DM/cm	Ewes per month (per cm)* April	May	June	July	August	September
Very Dense	90.7	3.9	3.9	3.7	3.1	2.0	1.6
Dense	63.5	2.7	2.7	2.5	2.2	1.4	1.1
Loose	41.7	1.8	1.8	1.7	1.4	0.9	0.7
Open	27.2	1.2	1.2	1.1	0.9	0.6	0.5
kg D.M. required for 1 month by 1 ewe =		23.0	23.0	24.7	28.6	44.5	56.5

Note: * This figure shows the number of ewes which could be fed for 1 month per centimetre of pasture of given density.

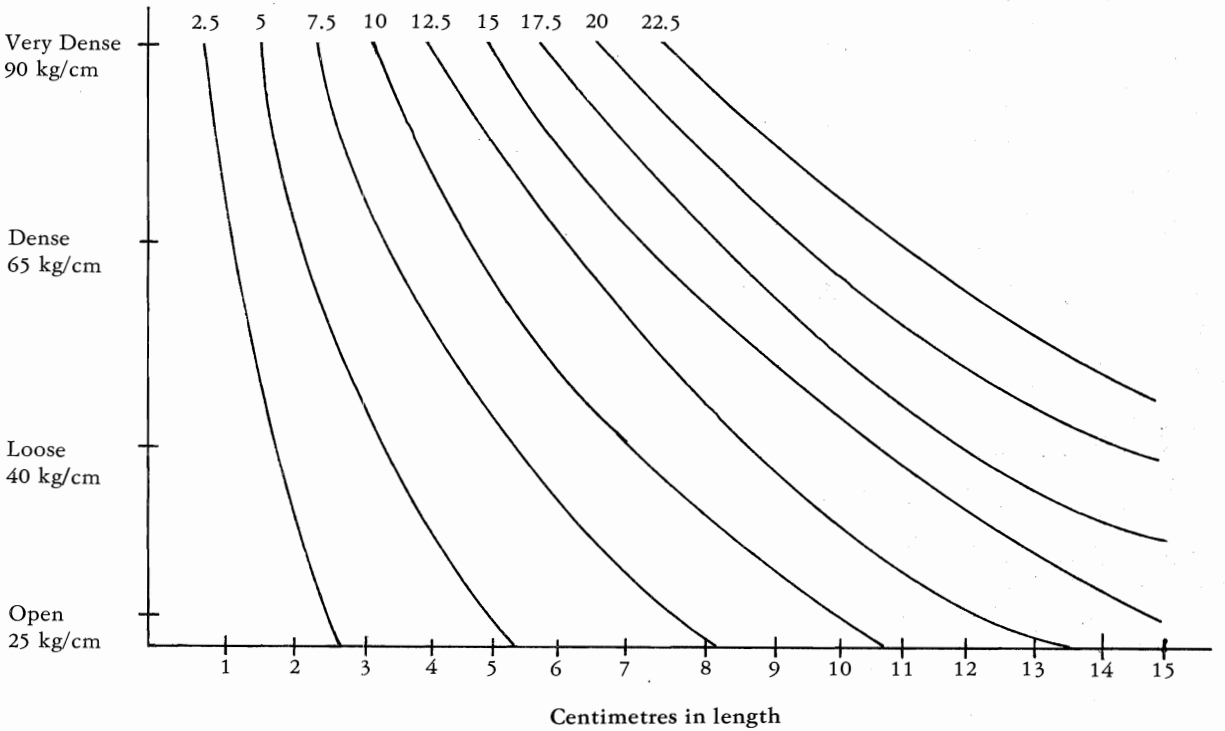
** The pasture density terms are subjective. Very dense pastures rarely exceed 10cm in length and are comparable to a very thick vigorous lawn. Open pastures have reasonably even plant spacing but bare earth can be seen throughout the pasture.

(ii) Relationships between Density, Length and Yield of Winter or Autumn-saved Pastures

Month	Intake (kg)	% of Average Winter Monthly Intake	% of Average Winter 3-Monthly Intake
May	23.0	91	30
June	23.8	91	32
July	28.6	114	38

Average = 25.1kg
Total = 75.4kg

Carrying Capacity of Pasture (S.U./ha) During May, June & July.



The graph shows the maximum number of ewes which can be carried per hectare for the whole period of May, June and July on pasture of the length and density shown. If utilization is poor, losses of up to 50% may occur.

To determine the carrying capacity of an area of pasture if used in one month only, divide by the factor shown in the right-hand column of the previous table. e.g. June – the factor is 0.32.

Example: Assume an area is to be used for one week in July. If the stocking rate is to be 10 S.U./ha over the 3-month period, divide by the factor for the month of July, i.e. 0.38 and multiply the result by 4.4, as there are 4.4 weeks in July.

10.0/0.38 = 26.31

26.31 x 4.4 = 115.76

Thus, the area in question will support about 115 S.U. for that week.

SECTION 11

PASTURE PRODUCTION

11 PASTURE PRODUCTION

11.1 IDENTIFICATION OF GRASSES AND CLOVERS

11.1.1 Identification of Grasses

* Reference: Lambrechtson N.A. 'What Grass is That?'

CU = Creeping underground stems *CA = Creeping above ground*

Name of Grass	Habit	Ligule	Auricle	Hairs	Basal Sheath	Leaves In Bud	Special Botanical Features	Look for these Points
Perennial ryegrass	Tufted	Short blunt	Present	Absent	Red	Folded	Leaves dull above, glossy below.	Red basal sheath, folded leaves in bud.
Italian ryegrass	Tufted	Medium	Present	Absent	Red	Rolled	Edge of leaves rough.	Red basal sheath, rolled leaves in bud.
Tall fescue	As for Italian ryegrass, but coarser throughout.							
Crested dogstail	Tufted	Short blunt	Absent	Absent	Yellow	Folded	Leaves dull above, glossy below.	Yellow basal sheath
Meadow foxtail	CU	Short	Absent	Absent	Chocolate	Rolled	Dark Green – early spring grower.	Chocolate basal sheath.
Yorkshire fog	Tufted or CA	Ragged	Absent	Present	White sheath red veins	Rolled	Pale Green thin soft hairy leaves.	Red veins on white basal sheath.
Timothy	Tufted	Long	Absent	Absent	White	Rolled	Swollen base to stem, blue-green leaves.	Swollen base to stem.
Cocksfoot	Tufted	Variable	Absent	Absent	White	Rolded	Very flat shoot.	Very flat shoot, hairless.
Poa trivialis	CA	Long pointed	Absent	Absent	White	Folded	Two white lines down centre of leaf, leaf shiny below.	Creeping above ground, two white lines on leaf.
Poa pratensis	CU	Small or absent	Absent	Absent	White	Folded	Two white lines down centre of leaf, leaf dull below.	Creeps below ground, lines on leaf.

Identification of Grasses continued

CU = Creeping Underground stems CA = Creeping above ground

Name of Grass	Habit	Ligule	Auricle	Hairs	Basal Sheath	Leaves in bud	Special Botanical Features	Look for these Points
Poa annua	CA or tufted	Large	Absent	Absent	White	Folded	Two white lines down centre of leaf, leaf dull below.	Creeps above ground, lines on leaf.
Danthonia pilosa	CU (slight)	Small	Absent	Present	White	Folded	Long narrow leaf. Tufts of long hairs at the collar.	Narrow long leaf, hairs at collar.
Sweet Vernal	CU or tufted	Large	Absent	Present	White	Rolled	Sweet smell, tufts of long hairs at the collar.	Sweet smell, hairs at collar.
Doab or Bermuda grass	CA	Hairy	Absent	Present	White	Folded	Grows on light dry soils. Tufts or long hairs at the collar.	Creeps above ground, hairs at collar.
Paspalum	CU	Long	Absent	Present	White	Rolled	Broad reddish leaves, long hairs at the collar. Stem swollen at base.	Red leaves, swollen stem, hairs at collar.
Brown Top	CA/CU	Short	Absent	Absent	White	Rolled	Leaf rough from tip to base.	Small ligule, rough leaf.
Red Top	CA/CU	Long or medium	Absent	Absent	White	Rolled	Leaf rough from tip to base; a twitch.	A twitch. Larger ligule rough leaf.
Creeping bent	CA	Long pointed	Absent	Absent	White	Rolled	Leaf rough from tip to base long pointed ligule.	Pointed ligule, rough leaf. Creeps above ground.
Oldman twitch	CU	Short	Present	Present	White	Rolled	Leaves coarse, sheath hairy a bad twitch.	Twitch with hairy sheath.
Prairie Grass	Tufted	Large	Absent	Present	White	Rolled	Broad light green leaves, very hairy sheath.	Very hairy sheath, light-green broad leaves.

Identification of Grasses continued

CU = Creeping underground stems CA = Creeping above ground

Name of Grass	Habit	Ligule	Auricle	Hairs	Basal Sheath	Leaves in Bud	Special Botanical Features	Look for these Points
Floating sweet grass	CA	Long and white	Absent	Absent	White	Folded	Leaf broad, soft and dull green. Leaf edges rough near tips.	Weak creeping stems when growing in shallow water.
Phalaris tuberosa	CU or tufted	White, 12mm long tapers to a blunt end.	Absent	Absent	Sometimes Pink	Rolled	Leaf is long, soft, limp and smooth except on margins.	Very pronounced ligule.
Barley grass	Tufted	Short and blunt	Present	Present	White	Rolled	Leaf hairy on both surfaces. Upper leaf sheaths may be hairless.	Auricles, hairy leaves.
Tall Oat grass	Tufted	Blunt, medium length	Absent	Present	White	Rolled	Leaf long and narrow with hairs in parallel lines. Leaf sheath may be sparsely hairy.	Roots chrome yellow.
Ratstail	CU tufted	Absent	Absent	Present	White	Rolled	Leaf sheath hairy on upper part. Leaf still, inrolled dark green and narrow, hairy on lower margins.	Two tufts of hairs where auricle normally rises.
Chewings fecue	CU tufted	Absent or short and blunt.	Absent	Absent	Pink	Folded	Leaves permanently rolled.	
Coarse grass	Tufted	Thin, short and slightly ragged.	Absent	Present	White	Rolled	Leaf thin and covered with fine hairs. Leaf sheath covered with long soft hairs.	

11.1.2 Identification of Clovers

* Reference: Healy 'Identification of Weeds and Clovers'.

Name of Clover	Growth	Stipule	Hairs	Leaf Shape and Markings	Flower	Special Botanical Features	Look for these Points
Red Clover or Cowgrass	Mainly upright	Large and attached to the stem for most of its length conspicuously veined.	Usually very hairy	Leaflets oval with white markings on upper surface.	Reddish Purple	Leaflet veins much branched towards edge of leaf.	Oval leaflets, densely hairy on the back.
Alsike	Erect	Green, with free ends drawn out to a long point.	Absent	Leaflets toothed and obtuse at the apex.	Pink or almost white.	Veins on leaflets sparinly branched near the edge of the leaf.	Upright growing clover without hairs.
White Clover	Prostrate	White, Membranous	Absent	Leaflets heart shaped.	Usually white turn brown on fading.	Moderate branching of leaflet veins at ends	Spreading over ground stems rooting at the nodes.
Suckling Clover	Generally prostrate except where supported by other vegetation.	Broad green and pointed. Hairy on the margin.	Stem and leaves slightly hairy.	Leaflets broadest near the tip. Central leaflet is stalked.	Small yellow flowers with 12 or more florets which turn brown on fading.	Veins in leaflets unbranched.	Slender small leafed clover much branched at the base, central leaflet stalked.
Strawberry Clover	Prostrate	Similar to white clover but larger and veining more prominent.	Absent or only sparsely present on upper part of leaf stalk.	Leaflets usually oval.	White with pinkish tinge becomes swollen after flowering.	Leaflet veins much branched near the edge and arched.	Strong overground stems rooting at the nodes.
Subterranean Clover	Prostrate	Broad with membranous edges indistinctly veined	Present on leaves and stems particularly on under side leaflets.	Leaflets usually heart shaped and frequently with black markings on upper surface.	Usually 2–3 florets, white or pale pink. After flowering turn down to the soil.	Leaflet veins few in number but branched slightly towards edges.	Hairy, prostrate clover with dark leaf markings.

Identification of Clovers continued

Name of Clover	Growth	Stipule	Hairs	Leaf Shape and Markings	Flower	Special Botanical Features	Look for these Points
Clustered Clover		Short but long pointed and toothed.	Usually hairless.	Leaflets egg shaped.	Small and pink flower stalk absent.	Leaflet veins unbranched.	A slender hairless clover with egg shaped leaflets and toothed stipules.
Striated Clover	Prostrate to ascending	Broad but ending in a fine point.	Conspicuously hairly	Leaflets egg shaped.	Small and pink stalkless heads at end of stems in angles of leaf stalks.	Leaflet veins branched.	A slender hairy clover with egg shaped leaflets.
Haresfoot Trefoil	Erect	Narrow, long pointed, reddish	Hairy	Leaflets long and narrow.	Silky round or elongated flower head.	Little or no branching in leaflet veins.	An upright stemmy and hairy clover with narrow leaflet.
Sweet Clover	Erect	Narrow and Sharp pointed	Almost hairless	Leaflets egg shaped, longest stalk on central leaflet margin toothed.	Flower head spike like cultivated type white, wild varieties yellow.	Veins straight and almost unbranched.	Upright clover with narrow stalked leaflets.
Lotus major	Weak partly erect growth	Replaced by two leaflets with mid ribs	Sparsely hairy	Oval and pointed middle leaflet stalk the longest.	5–12 florets in the flower rich yellow.	Few leaflet veins Rather straggly, branching clover with paired stipules.	
Lotus hispidus	Mainly erect	Similar to *Lotus major.*	Very hairy	Usually smaller than *Lotus major.*	2–4 florets in the flower yellow.	Leaflet veins few and straight.	Very hairy clover with paired stipules

Identification of Clovers continued

Name of Clover	Growth	Stipule	Hairs	Leaf Shape and Markings	Flower	Special Botanical Features	Look for these Points
Burr Clover	Prostrate to ascending	Large with fine conspicuous teeth.	Usually hairless.	Leaflets egg shaped. Sometimes a black brown spot on each leaflet. Margin toothed at free end.	2–9 florets yellow.	Leaflet veins straight with very little branching.	Rather propstrate clover, central leaflet on longer stalk and stipule finely divided.
English Trefoil or Black Medic.	Prostrate with ascending tips	Broad and tapering and generally toothed.	Hairy	Leaflets heart shaped. Mid rib extends beyond leaf tip.	Round flower head. Yellow petals fall on fading.	Leaflet veins straight, with very little branching.	Prostrate hairy clover with leaflet mid rib extending beyond edge of leaflet.

11.2 NEW ZEALAND HERBAGE SEEDS

(from M.A.F. Seed Certification Publication).

OECD SEED CERTIFICATION
NUCLEUS SEED OF BRED VARIETIES
Supplied by Grasslands Division of D.S.I.R.

To be sown out for further seed production under contract to Department of Agriculture.

produces

CERTIFIED BREEDERS SEED

Which is distributed by the M.A.F. through Mercantile channels to selected seed producers.

To be sown out primarily for further seed production

produces

CERTIFIED BASIC SEED

Which is marketed in N.Z. through Mercantile channels (cannot be exported)

To be sown out largely for further seed production

produces

CERTIFIED FIRST GENERATION (BLUE LABEL)

Which is marketed in N.Z. and overseas through Mercantile Channels

To be sown out in N.Z., largely on areas likely to be used for further seed production.

produces

CERTIFIED SECOND GENERATION (RED LABEL)

Which is marketed in N.Z. and overseas through Mercantile Channels

11.3 N.Z. HERBAGE VARIETIES AND THEIR CHARACTERISTICS.

8.3.1 'Grasslands Ariki' Ryegrass:

Origin	Bred from crosses between 'Grasslands Manawa' and 'Grasslands Ruanui'.
Seasonal Growth	Annual yield is almost as high as Nui. A perennial ryegrass with a wide seasonal spread of production. Good in summer and winter.
Establishment	Vigorous early growth, thus frequent grazings are necessary to prevent suppression of associated clovers.
Persistency	Flourishes and persists under severe grazing.
Quality	Medium.
Use	Vigorous perennial ryegrass requiring high fertility conditions for maximum performance. More resistant to Argentine Stem Weevil and Leaf Rust than other ryegrasses. Has been superceded by 'Nui'.

11.3.2 'Grasslands Manawa' Ryegrass:

Origin	Hybrid produced by selection from crosses between Ruanui and Paroa. Previously known as H1 or short rotation ryegrass.
Seasonal Growth	Annual yield is lower than perennial ryegrasses. Winter production is very good. Autumn and spring growth is good. Liable to severe check under dry summer conditions.
Establishment	Autumn sowings give rapid establishment and good early winter growth.
Persistency	Where soil fertility is high, moisture adequate and summer grazing lenient, Manawa can persist for years. Under severe summer grazing it may lack persistency and can be vulnerable to stem weevil attack.
Quality	High.
Use	Is only suitable for permanent pastures where these are rotationally grazed by cattle in high summer rainfall areas of N.Z. Otherwise, suitable as a winter greenfeed.

11.3.3 'Grasslands Paroa' Italian Ryegrass:

Original	Developed by selection from N.Z. and overseas lines.
Seasonal Growth	The main period of high production is in winter and early spring.
Establishment	Rapid under good fertility and moisture conditions.
Persistency	Regarded as an annual species, however under good growing conditions and lenient grazing it may persist for two years. Its' main use should be as temporary greenfeed pasture. Has been superceded by Tama.
Quality	High
Use	Mainly as a winter greenfeed.

11.3.4 'Grasslands Ruanui' Ryegrass

Origin	Developed by selection from ecotypes which had developed under N.Z. conditions.
Seasonal Growth	Annual yield lowest but one of the perennial ryegrasses.
Establishment	Rapid. Care is needed to prevent suppression of associated clovers.
Persistency	Very persistent. Capable of withstanding severe grazing and treading. Under heavy stocking and high fertility conditions it can become the dominant grass.
Quality	Not as high as the annual ryegrasses.
Use	Requires medium to high fertility and adequate moisture. Production is the lowest of any of the perennial ryegrasses.

11.3.5 'Grasslands Nui' Ryegrass:

Origin	Selected from ecotypes surviving in old permanent pasture near Auckland.
Annual Yield	Highest of any of the perennial ryegrasses
Seasonal Yield	Higher yielding ryegrass in all seasons except winter where it is only lower yielding than Tama and Manawa.
Establishment	Fast.
Persistence	Excellent, especially in areas with dry summers.

Quality	Unknown.
Use	Should be sown in all permanent ryegrass pastures.

11.3.6 'Grasslands Tama' Ryegrass:

Origin	A tetraploid derived from a distinctly annual population of **Lolium multiflorum.**
Annual Yield	Higher than 'Grasslands Paroa' or cereal greenfeeds but may be exceeded by 'Matua' Prairie grass.
Seasonal Yield	Late winter, early spring growth rates are higher than any other commonly used species.
Establishment	Fast but very dependant on good moisture supply at sowing and during the autumn.
Persistence	Killed by grazing closely in spring.
Quality	The highest of any grasses.
Use	Winter greenfeed and for overdrilling into lucerne where irrigation is available to help establishment.

11.3.7 'Grasslands Moata' Italian Ryegrass

Origin	Selected from crosses between induced tetraploids of truly biennial froms of 'Grasslands Poroa' - Released 1979
Annual Yield	Greater than Tama and Paroa.
Seasonal Yield	Superior to Paroa in winter.
Establishment	Rapid - sow at 30 kg/ha.
Persistence	A true biennial.
Quality	High
Use	As a two year high quality-high autumn-winter yielding greenfed.

11.3.8 'Grasslands Apanui' Cocksfoot:

Origin	Bred from selections made from N.Z. ecotypes.
Annual Yield	Lower than ryegrasses.
Seasonal Yield	Lasts well into the summer on shady faces.
Establishment	Slow. At the seedling stage is vulnerable to competition from ryegrasses.
Persistency	Once established, persistency is good especially where grazing is lenient. Under close sheep grazing both survival and yield are reduced.

Qualitry	Only average.
Use	Not recommended as a component of intensive pasture mixes. Cocksfoot can make a valuable contribution where the grazing regime is not severe, or where rainfall and soil fertility are less than is needed for good growth of ryegrass. It is very suitable for over-sowing hill country.

11.3.9 'Grasslands Kahu' Timothy:

Origin	By breeding and selection from Welsh S48 and N.Z. varieties.
Annual Yield	Low.
Seasonal Yield	Moderate production in summer. Favours soils of high moisture content.
Establishment	Slow. Can suffer from competition from ryegrasses.
Persistency	Under suitable conditions e.g. heavy damp soils it can be persistent and makes a small contribution where fertility is high. On lighter droughty soils performance is poor.
Quality	Flowers later than ryegrasses therefore quality is higher later in the season.
Uses	Is very palatable to all stock so under close grazing tends to be eaten out of the sward. It is out-produced by all of the ryegrasses.

11.3.10 'Grasslands Matua' Prairie Grass:

Annual Yield	Trials have shown Matua to be higher yielding than most other grasses under rotation growing.
Seasonal Growth	Superior yield to other grasses including Tama, particularly in winter (under cutting, not grazing).
Establishment	Fast but needs to be allowed to seed the first year to increase the density from the low seed rates normally sown.
Persistence	Yield and persistence both poor under close and frequent sheep grazing. Must be rotationally grazed.
Quality	Equal to 'Tama' ryegrass.
Use	Possibly as a permanent autumn and early spring greenfeed.

11.3.11 'Grasslands Marie' Phalaris

Origin	Slected from seedlines obtained from Argentina - Released 1979.
Annual Yield	Higher yielding than perennial ryegrass in summer drought prone areas where the rainfall is less than about 700 mm per year. Should be rotationally grazed for maximum yield.
Seasonal Yield	Very cool-season active. Probably equivalent to "Grasslands Nui" in autumn winter yield.
Establishment	Sensitive to competition. Should be sown at about 5 kg ha with a legume but no other grass. Slow establishing.
Persistence	Very persistent under dry conditions and where winter pugging is severe. Tolerate black beetle and grass-grub infestation.
Quality	Marginally lower digestibility than the perennial ryegrasses except when flowering, when it has a higher proportion of leaf to stem.
Use	As a permanent pasture in areas having very dry summers and total rainfall of less than 700 mm.

11.3.12 'Grasslands Raku' Paspalum

Origin	Selected from ecotypes originating in Uruguay - Released 1979
Annual Yield	Some 20% to higher yielding than unselected New Zealand ecotypes.
Seasonal Yield	Nil in winter; slow and late in spring - end of October before growth is substantial. Summer and autumn are main seasons of active growth.
Establishment	Very sensitive to competiton. Should be sown alone at 5 kg viable seed with turnips in spring, then rest of mixture overdrilled in autumn.
Persistence	Close sheep grazing in spring reduces persistence. Otherwise very persistent and more so than ryegrasses in drought conditions.
Quality	Not as good as ryegrass.
Use	In summer drought-prone areas which do not have sever frosts. Combines well with Nui ryegrass and clover to give increased yield.

11.3.13 'Grasslands Roa' Tall Fescue

Origin	Selected from crosses between North African, Mediterranan, Australian and American ecotypes of tall fescue - Released 1979
Annual Yield	Equivalent to that from 'Grasslands Ariki'.
Seasonal Yield	Very similar to 'Grasslands Airki' in seasonal yield, and is as early to start active growth in the spring also. Must be rotationally grazed to yield at maximum.
Establishment	Slow, and must not be sown with anything other than clover otherwise establishment is severely reduced.
Persistence	Very persistent, surviving drought and grass-grub attack. Salt tolerant. Tolerates wet soils.
Quality	Selected for high digestibility but an alkaloid contained in the plant limits cellulose digestion in the rumen.
Use	For pasture use on soils of high salt content or where soils are very wet at times.

11.3.14 'Grasslands Huia' White Clover:

Origin	Selected from ecotypes grown in N.Z.
Annual Yield	Highest of any legume under set-stocking.
Seasonal Growth	Good growth from spring through to autumn and extending well into early winter.
Establishment	Slower than ryegrass, and may be smothered if grass growth is not controlled.
Persistence	Highly persistent and remains vigorous.
Quality	Very high.
Uses	Huia is a large-leafed, densely growing variety. When well established in pasture it is tolerant of competition and may become dominant in summer when grass growth diminishes. Should be used as the legume in all permanent pastures.

11.3.15 'Grasslands Pitau' White Clover:

Origin	Selected from crosses between Huia and a Spanish ecotype.
Annual Yield	Higher than Huia in the North Island only.

Seasonal Growth	Winter growth especially is superior to Huia but only in the Northern half of the North Island.
Establishment	Same as for Grasslands Huia.
Persistence	Not as persistent as Grasslands Huia under very close grazing.
Quality	High.
Use	North Island permanent pasture as the main legume especially for dairying.

11.3.16 'Grasslands Turoa' Montgomery Red Clover:

Origin	Breeding and selection of Montgomeryshire clover introduced into N.Z. 30 to 40 years ago.
Annual Yield	Very high under hay or spelling type management.
Seasonal Growth	Spring growth commences some three weeks later than Hamua but has higher summer and early autumn growth.
Establishment	Seedling vigour is greater than white clover but smothering danger still exists.
Persistency	More suited for permanent pasture than Hamua. Tolerates drier areas better.
Quality	High.
Uses	Production is only good where the sward is rotationally grazed. Can make a valuable to the summer production of short term or hay pastures, particularly in areas of low summer rainfall, especially where there is little growth from white clover. Especially useful for over-sowing of hill country.

11.3.17 'Grasslands Hamua' Broad Red Clover:

Origin	Breeding and selection from N.Z. lines of cow-grass.
Annual Yield	Similar to Turoa.
Seasonal Yield	Winter and early spring production less than Huia but summer growth is greater.
Establishment	Similar to Turoa.
Persistency	Not as persistent as Turoa under dry conditions. Tends to decline after 2 to 3 years due to fungal diseases and eelworms.

Quality	Good.
Uses	A valuable component of pasture mixes for hay crops. In areas with no severe summer drought, gives higher yields than Turoa.

11.3.18 'Grasslands Pawera' Red Clover:

Origin	Selected from crosses between tetraploid Turoa, and Swedish material.
Annual Yield	Total is higher than other red clovers.
Seasonal Growth	Summer and autumn yield is the highest of any of the N.Z. red clovers although out produced by Hamua in the spring.
Establishment	Slow and will not establish if in competition with ryegrasses at high sowing rates.
Persistence	More persistent than other red clovers because of resistance to fungal diseases and eelworm.
Quality	Typical legume.
Use	Should be used for over-sowing or for special purpose hay pastures in place of other red clovers.

11.3.19 'Grasslands Maku' Lotus:

Origin	Selected from the results of a cross between the tetroploids of a Portuguese ecotype and a N.Z. **Lotus pedunculatus** ecotype.
Annual Yield	Higher than Huia only where soil phosphate levels are low and the soil is acid (pH less than 5.0).
Seasonal Yield	Higher yield at each season than white clover where fertility is low, especially summer-autumn.
Establishment	Very slow. Takes up to one year to establish properly.
Persistence	Will not survive frequent close grazing or competition from white clover.
Quality	Better than grasses but not as good as the other common pasture legumes.
Uses	Should be used as the legume for permanent pasture on very low fertility wet acid soils and for over-sowing similar high altitude soils. Resistant to grass grub and is non-bloating.

11.4 SEASONAL RANKING, RYEGRASS – CLOVER SWARDS

(Smetham, M.L. Pers. Comm.)

Winter	Tama	> Manawa	> Paroa	> Nui	> Ariki	> Ruanui
Spring	Tama	> Paroa	> Manawa	> Nui	> Ariki	> Ruanui
Summer	Nui	> Ariki	> Ruanui	> Manawa	> Paroa	> Tama
Autumn	Nui	> Ariki	= Ruanui	> Manawa	> Tama	= Paroa

11.5 PASTURE PRODUCTION IN NEW ZEALAND

The seasonal pattern of pasture production is measured by a uniform cutting technique at a number of sites throughout New Zealand by staff of the Ministry of Agriculture and Fisheries.

The pasture is harvested regularly every 2 or 3 weeks by the "rate of growth" cutting technique described by Lynch and Mountier (1954).

It is important to realise that yields measured in this way do not express maximum or potential pasture growth because of the limitations imposed by the cutting technique and pasture management. Nor do they necessarily represent growth in a district, because the sites are not replicated in space. However they do give a guide to the seasonal distribution of growth at the trial sites.

The following points on Problems of Interpretation are direct excerpts from a paper 'Herbage Production Data and Its Use in Feed Programming Studies' by M.L. Smetham (Lincoln College).

Problems of Interpretation

11.5.1 Utilisation

Growth rates are almost always obtained by cutting down to "mower height" which is roughly 2.5cm. However figures for pasture utilisation % are almost invariably based on herbage cut right to ground level. This means that you cannot apply the latter utilisation figures to the former data. Unless of course you make an arbitrary allowance for the herbage left below "mower height" and adjust the utilisation % accordingly. Herbage left could reasonably be taken to be 1000kg (see Smetham 1975). Allowance for this shows that the utilisation percentages to be applied to "above mower height" yield data can and should be increased by half as much again. This will give the same level of animal performance as the lower figures for utilisation applied to herbage yield data obtained by cuts to ground level.

In feed programme computations it is probably safer and more realistic to specify the levels of residual DM below which animals should not be expected to graze for a given level of performance (live weight gain etc.) This method of making allowance, and the quantities to be left for given animal performance, are discussed by Smetham (1975) and Scott (1976).

11.5.2 Spelling Period

Growth rates obtained from cuts at regular 2 to 3 week intervals e.g. Radcliffe (1974, 75, 76) and to a lesser extent rates obtained from areas cut when herbage has reached a given height (e.g. Watkin 1975), underestimate actual growth rates when pastures are spelled for longer periods. As for instance when grass-wintering. There is limited evidence that rates in autumn and winter are two to three times greater than those obtained by Radcliffe (1976) in Canterbury. Lynch (1954) found that pastures spelled for 6 weeks between cuts gave almost twice the yield of those spelled for only 2 weeks. Consequently, in a feed budget, growth rates need modification according to the spelling time involved.

11.5.3 Extrapolation

In the absence of really local data you will have to fall back on the nearest site for which there are growth rate figures. However this may result in considerable error. Between one flat site and another, climate and water holding capacity ofthe soil are together responsible for the majorityof differences in productivity. Between flat sites, from which the majority of data has been obtained; and hill sites, soil fertility is probably responsible for the majority of difference. This difference too is not only one of a reduction in DM yield because of relatively low soil N levels etc., but also one of seasonability, which is affected because of differences in pasture composition. Hill country pastures contain a high proportion of browntop. These pastures are therefore considerably less winter active than those on the flat which contain relatively more ryegrass.

Short of a very sophisticated computer model, making allowance for aspect, soil fertility, climate, and species differences it is not possible to apply a simple correction to data obtained at (superficially) similar sites and get an accurate (i.e. ± 10%) answer. Simple corrections may however (I guess) come within ± 25% of the actual production.

The variability in pasture growth from year to year is often not fully appreciated. Some data from South Island sites illustrate this point (see Table 1.) Likewise Table 2 shows the variability in dry matter production between the sunny and shady faces at selected sites throughout New Zealand.

References

Lynch, P.B.; Mountier, N.A. 1954; Cutting techniques in grassland experiments, N.Z.J. Science & Technology 36A: 375-85.

Table 1. The variability of pasture yields at South Island Sites* Yields in kg Dry Matter/ha

LOCATION	No. of yrs of measurement	ANNUAL YIELD	Standard error over all yrs	Range of Annual Yield Lowest		Highest
Southland						
Mona Bush	6	14 610	2760	10 170	–	17 290
Winton	11	12 010	2290	8 870	–	16 000
Central Otago						
Arrowtown irrigated	6	10 850	1230	8 880	–	12 180
Cromwell irrigated	11	8 320	1590	5 820	–	11 260
Ida Valley dryland	10	2 800	1430	770	–	4 570
irrigated	12	8 740	2250	6 350	–	11 660
Otago						
Invermay hill	19	8 890	2230	3 240	–	13 500
Invermay flat	11	10 390	1600	7 520	–	12 760
Canterbury						
Winchmore dryland	13	5 870	1110	4 240	–	7 750
irrigated	13	10 150	1020	9 050	–	12 020
Westport	4	10 150	1920	8 760	–	11 490

Table 2. Annual Dry Matter Yields from Improved Pasture On North & South Aspects (kg/hectare)

Site	Rainfall (mm)	North (Sunny)	South (Shady)
Whatawhata, Hamilton (Radcliffe 1971)	1600	9960	9940
Te Kuiti, (Radcliffe 1971)	1450	4530	3880
Te Awa, Palmerston North (Suckling 1959)	1060	9740	9070
Coopers Creek, Oxford (Radcliffe 1971)	1070	2370	4220
Hunua, North Canterbury (White, unpubl.)	650 – 750	2100	4190

SECTION 12

CASH CROP
AND
SMALL SEED PRODUCTION

12. CASH CROP AND SMALL SEED PRODUCTION

12.1 VARIETIES

12.1.1 Wheat

(a) Canterbury – Karamu, Oroua, Rongotea ..... Spring
– Hilgendorf, Kopara ..... Winter

(b) Southland – Takahe..... Spring

(c) North Island – Karamu, Rongotea, Oroua..... Spring

12.1.2 Barley

(a) Malting – Manapou, Mata, Zephyr

(b) Feed – Kaniere, Manapou, Julia (Canterbury); Hassan, Pirouette, (Sth North Is); Kakapo (Nth North Is); Universe (Otago, Southland).

12.1.3 Oats

(a) Milling – Makuru, Ohau

(b) Feed grain and chaff – Makuru, Taiko, Amuri, Omihi.

(c) Greenfeed – Amuri, Algerian, Winter grey, Duns.

12.1.4 Ryecorn – Rahu

12.1.5 Linseed – Redwood, Norstar, Hinu.

12.1.6 Maize – Double hybrids (numerous)

12.1.7 Peas

(a) Maple – Tasmanian Partridge, Whero

(b) Blue – Blue Prussian (67), Rondo, Rovar

(c) White – Pomaro, Huka

(d) Garden – Greenfeast, Ajax, C39, Poha, Pania, Patea, Puke, Tere, Kuru.

12.1.8 Lupins – Uniwhite, Uniharvest, Unicrop

12.1.9 Potatoes – Ilam Hardy, Rua, Sebago, Katahdin, Iwa

12.1.10 Rape – Rangi, Moana, Wairangi, Giant (Winter feed)

12.1.11 Swedes – Doon Major, Doon Spartan (aphid resistant), Wilhelmsburger (late), Calder and Sensation (drought and aphid resistant), Wye and Kiri (clubroot resistant), Rewa.

12.1.12 Turnips – Purple and Green Top (yellow), Green and York Globe (early), Kapai (aphid resistant)

12.1.13 Kale – Maris Kestrel, Medium Stemmed (sheep), Giant (cattle)

12.1.14 Fodderbeet – Monoblanc, Monobomba.

12.1.15 Lucerne – Wairau, College Glutinosa (creeping), Saranac A.S. 13. (wilt resistant), Washoe (nematode resistant), Rere (aphid resistant)

12.1.16 Ryegrass – Ruanui, Nui, Ariki, Manawa, Paroa, Tama

12.1.17 Cocksfoot – Apanui

12.1.18 Clovers

(a) White – Huia, Pitau

(b) Red – Montgomery, Turoa, Pawera, Hamua (broad red clover or cow grass)

12.1.20 Lotus – Maku

12.2. SOWING AND HARVESTING OF CROPS

(Source: Pers. comm. Dr. J. White, Plant Science Dept., Lincoln College)

* Refer to Section 9.1 for varieties of these crops

Crop*	Sowing Rates kg/ha		Row Width & Depth	Sowing Dates	Harvesting Dates
Wheat	Autumn Spring Southland	100–135 135–170 135–200	15 cm row 5 cm deep	May–June August–September	January–February February–March (Southland)
Barley		110–170	15 cm rows 5 cm deep	March for greenfeed; September October normally; November on heavy land	January–February
Oats	Autumn Spring Southland N.I.	90–110 110–135 135–180 110–160	15 cm rows 5 cm deep	February–March for greenfeed; May–June or August–September	January–February February–March (Southland)
Ryecorn	Greenfeed Seed With grass	135–200 110–135 70	15 cm rows 5 cm deep	February for greenfeed April–May for crop	January
Maize	Seed 30 (= 6 pl./m²)		60 cm rows 5 cm deep	October–early November	April–June (seed) February–March (silage)
Linseed	50– 70		15 cm rows 2–2.5 cm deep	September–November	February–March
Field Peas	160–200		15 cm rows 5–6 cm deep	May–June September–October	January–February
Garden Peas	dryland 270 irrigated 320		15 cm rows 5–6 cm deep	September–November	December–early February for processing. January–February for seed crops.
Lupins	Seed: 135–200 With forage crops: 35–100		15 cm rows 5 cm deep	April or September –October for seed January–February for forage	December–February

* Refer to Section 9.1 for varieties of these crops.

Crop*	Sowing Rates kg/ha	Row Width & Depth	Sowing Dates	Harvesting Dates
Potatoes	1500 of 30–55g seed 2500 of 55–95g seed	75 cm rows 10 cm deep 30 cm apart	October for main crop in S.I. May–August in Nelson; August–October in Manawatu; May–July in Pukekohe	May–June in S.I. January–February in Nelson February–May in Manawatu; August–November in Pukekohe
Rape	Forage: 3 alone or 1 in mixtures. Seed: 4.5–5.5	15 cm rows 2.5 cm deep	October–December for forage; March for seed	When required for forage; mid–late December for seed
Swedes	400–700g ridged 700–1100g drilled	15 cm rows 2.5 cm deep	October–December	
Turnips	alone: 400-600g with Tama: 100g plus 22kg Tama	15 cm rows 2.5 cm deep	January–February	early winter
Kale	Forage: 3 for Maris Kestrel, 2 for Giant and Medium Stemmed. Seed:4.5–5.5	15 cm rows for Maris Kestrel 65 cm for other	October for summer grazing; December–January for seed	Late December–early January for seed.
Fodder Beet	1.7–2.3	Precision drilled in 35 cm rows & 2.5 cm deep	September–October	
Lucerne	10	15 cm rows 1.5 cm deep	September–October	
Ryegrass	20 for most; 25–30 for Tama	15 cm rows 1–2 cm deep	Late February–March	Late December–early January
Cocksfoot	4.4–5.5	15 cm rows 1–2 cm deep	January–March	Early January
White & Red Clover	3.0 White 4–6 Red	15 cm rows 1–2 cm deep	February–March with rye-grass; May with wheat; August into wheat; August–October with spring crops	January–Februaryfor white; March–May for red.

12.3 STANDARDS FOR MARKETING CASH CROPS AND SMALL SEEDS.

12.3.1 Wheat

As determined by Wheat Board Regulations 1965 Amendment No. 4 1969/282.

"Milling standard wheat means wheat which –

(i) Is sound and sweet, free from smut, free from decay, free from damage by insect pests injurious to baking quality, and free from any other blemish or damage; and

(ii) When gristed yields flour with a baking score of 30 or higher as determined by a testing method equivalent to that used by the Wheat Research Institute in the year 1969; and

(iii) Does not have a sprout index of greater than S1 as determined by the Wheat Research Institute test; and

(iv) Does not contain –

(a) More than 0.5% by weight of weed seeds; or

(b) More than 5% by weight seeds and other extraneous matter and broken, immature or shrivelled grains; or

(c) More than 15% by weight of moisture; or

(d) More than 5% of visibly sprouted grains."

12.3.2 Barley

Acceptable grade barley shall be dry, sound, clean, suitable for malting and free from other grains, seeds, vermin and disease.

Maximum allowances permitted by weight shall be:

Screenings 2.37mm (6A screen)	5.0%
Skinned, broken and sprouted	5.0%
Foreign matter (weeds, chaff, straw, etc.)	0.5%
Moisture: bulk	14.0%
bags	15.0%

Feed:

Screening 2.37mm (6A screen)	20%
Foreign matter	0.5%
Moisture	14%

Min. Bus Wgt - 50 Ib.

12.3.3 Oats

Milling	
Screening 2.37 (6A screen)	10%
Moisture	14%

12.3.4 Peas

(i) **Field Peas:-**

To be machine dressed.

New Zealand Standard Grade altered to read:

Maple Standards	Grade No. 1.	Grade No. 2.
Minimum Size	92% to be over ¼ inch (6.35) in diameter .8% tolerance down to 14/64 inch (5.55 mm) in diameter.	85% over 13/64 (5.16 mm) 15% tolerance down to 5/32 inch (3.97mm) in diameter.
Splits	Not to exceed 0.5%	Not to exceed 2%
Damaged & Sprouted	Not to exceed 1.5%	Not to exceed 2%
Foreign Matter	Not to exceed 0.5%	Not to exceed 2%
Condition	Sound, dry and in good keeping condition at time of shipment.	As for No. 1.
Colour	F.A.Q. of season and samples to be dispatched by first class airmail to the G.A.F.T.A. before 30th April each year.	As for No. 1.
Moisture	Not to exceed 15%	Not to exceed 15%

Prussian Blue Standards

	Grade No. 1.
Size	85% over 14/64 (5.55mm). 15% tolerance down to 5/32 (3.97mm)
Splits	Maximum 1%
Foreign Matter	Very odd partridge &/or garden peas, odd piece of dirt and very odd piece of pea pod, very odd thistle head, very odd sprung pea, free from weeds, small seeds, and oats, tares etc.
Colour	To be determined each season. Must be of Blue Colour and contain not more than 10% (by count) bleached. (Definition of bleached - A bleached pea is one of light colour &/or with an orange centre)
Moisture	Not to exceed 15½%

Rondo Blue Standards	Grade No. 1.
Size	92% to be over ¼ inch (6.35 mm) in diameter .8% tolerance down to 14/64 (5.55 mm)
Splits	Not to exceed 1%
Foreign Matter	As in Grade No. 1. Prussian Blue.
Colour	F.A.Q. for season, must be of blue colour and not more than 10% (by count) bleached.
Moisture	Not to exceed 15½%

White Prolific Standards	Grade No. 1.
Size	92% to be over ¼ inch (6.35 mm) in diameter. 8% tolerance down to 14/64 (5.55 mm)
Splits	Not to exceed 1%
Foreign Matter	As in Grade No. 1. Prussian Blue
Colour	F.A.Q. of season
Moisture	Not to exceed 15%

Prussian Blue, Rondo Blue, and White Prolific Peas.

Standards	Grade No. 2.
Minimum size	85% to be over 13/64 (5.16 mm) .15% tolerance down to 5/32 (3.97 mm)
Splits	Not to exceed 2%
Damaged & sprouted	Not to exceed 2%
Foreign Matter	Not to exceed 2%
Condition	As in grade No. 1. Prussian Blue
Colour	F.A.Q. for season must be of blue colour and contain not more than 20% (by count) bleached.
Moisture	Not to exceed 15.5% for Blue Rondo, and Blue Prussian Peas; 15% for White Prolific Peas.

N.B. All percentages are calculated by weight.

Field peas may be grown either contract to seed firms or Stock and Station Agents, or they may be sold on the free market. Most of the crop is exported.

(ii) **Garden peas:-**

The standards for garden pea seed are –

Machine Dressing Loss	– not greater than 7.5% by weight
Moisture Content	– not greater than 15.0% by weight.
Foreign matter, earth etc.	– deduction by weight.

Most of the garden peas are grown on contract. A large proportion is exported but part of the crop is used as seed for the production of processed freezing peas, a sub-section of the garden pea trade.

The process freezer peas are graded on the basis of a tenderometer reading. The peas are sampled in the field and undergo a crushing test. The amount of force required to crush a pea is related to the quality of the pea. The greater the force required, the lower the grade and the payout.

There are 8 grades for freezer peas. They are –

Grade	Tenderometer Reading
0	not exceeding 90
1	over 90, not over 95
2	over 95, not over 100
3	over 100, not over 105
4	over 105, not over 110
5	over 110, not over 115
6	over 115, not over 120
7	over 120

12.3.5 Beans

Beans grown on contract for process freezing are graded on the average length of the seed, as there is a correlation between this and quality. There are 11 grades. They are –

Grade	Average Seed Length
0	not exceeding 8.5mm
1	over 8.5mm, not over 9mm
2	over 9mm, not over 9.5mm
3	over 9.5mm, not over 10mm
4	over 10mm, not over 10.5mm
5	over 10.5mm, not over 11mm
6	over 11mm, not over 11.5mm
7	over 11.5mm, not over 12mm
8	over 12mm, not over 12.5mm
9	over 12.5mm, not over 13mm
10	over 13mm

12.3.6 Potatoes

The New Zealand Potato Board submitted the following as regulations to be passed by the Government. They were not made mandatory, but still stand as a suggested standard. These are:-

Maincrop Potatoes:

(i) A lot may not contain more than 5% of rejectable material. This accounts for green potatoes, second growth, cut (not more than 2mm deep), bruised, scabby (no more than 25% of the surface area may be covered with common scab) and rot-infected (no more than 1% of the lot may have wet rot of any nature) tubers.

(ii) Undersize potatoes are those less than 40mm in diameter – they are rejectable tubers.

(iii) A lot may not contain an excessive amount of earth–this is subject to interpretation e.g. an early crop dug on a wet day in Pukekohe is expected to carry more earth than a crop dug later in the season from a sandy soil.

New Potatoes:

(i) All requirements as above, except that the minimum size is 25mm. Under the new M.Q.S., the existing graders appointed by the merchants and approved by the Government, will be contracted to the N.Z. Potato Board to ensure the standards are upheld.

The Food and Drug Regulations contain requirements in relation to potato packaging and labelling. The bag must be labelled with the packer's name and address, the word "Potato", and the nett weight when packed. In addition, the M.Q.S. will require the label to show the registered number of the grower, and to what grade the potatoes have been graded or dressed to.

There are no regulations regarding the size or weight of seed potatoes, but it is general trade practice not to sell seed potatoes that are below 28.4g in weight. However, if a grower wants seed potatoes under this weight, there will no doubt be someone willing to sell.

SECTION 13

VEGETABLE PRODUCTION

13. VEGETABLE PRODUCTION

13.1 AREA AND PRODUCTION STATISTICS

13.1.1 Market Garden Vegetable Production

The following table shows vegetable production by area and total sales by variety from surveyed market gardeners for 1976 and 1977.

	1976		1977	
Vegetable	Area hectares	Total Sales kg(000)	Area hectares	Total Sales kg(000)
Beetroot	331.1	5 811.4	158.4	3,246.1
Cabbage	917.5	18 293.2	888.4	17,409.0
Carrot	983.0	28 878.4	1,062.8	30,095.4
Cauliflower	926.5	14 650.8	938.0	15,304.5
Celery	103.0	3 591.5	92.0	2,891.7
Kumara	494.0	4 973.6	585.3	6,533.6
Lettuce	561.0	8 776.3	575.6	9,380.7
Onion	1 438.5	38 181.9	1,616.3	46,481.6
Parsnip	264.4	3 918.8	207.0	3,407.5
Peas	6 800.7	24 394.7	7,645.9	29,142.5
Tomato	864.4	28 921.2	982.2	41,517.8
Asparagus	855.1	2 009.5	811.3	1,470.9
Bean (broad and green)	1 043.4	5 383.6	1,403.4	8,916.6
Brussels sprouts	136.9	1 481.8	135.3	1,445.2
Cucumber	40.9	896.9	53.6	1,474.1
Melons (jam, rock, pie, water)	90.1	1 382.8	97.5	1,646.7
Mushrooms	13.4	1 059.7	14.9	1,744.2
Pumpkin (including squash)	841.8	9 087.7	1,209.6	15,598.3
Silverbeet (including spinach)	65.5	827.3	66.7	615.5
Swedes	51.4	795.6	150.3	2,693.0
Sweetcorn	1 078.7	12 065.6	1,885.8	20,434.1
Other	208.8	2 126.3	216.0	1,930.2
TOTAL, All Vegetables	18 110.1	217 508.7	29,796.3	263,379.2

There has been a marked increase in recent years in the quantity and variety of crops grown for processing together with a rapidly expanding processing industry. Peas and tomatoes are the two main crops followed by sweetcorn, beans, carrots, onions, beetroot and asparagus.

Of the 2673 surveyed market gardeners in 1976, 62 percent were in the North Island, while of those surveyed in the South Island, 57 percent were in the Canterbury area.

In October 1978 outdoor vegetables (excluding potatoes) covered a total net area of 26 550 hectares. The aggregate area of fresh-market crops was estimated at 13 400 hectares, process-vegetables at 15 150 hectares.

13.1.2 Potatoes

The production of potatoes is usually adequate to meet the home market demands. Potato yields have risen to such an extent that a population of 3 million is now supplied from the same acreages as were 1¾ million people 30 years earlier. Most of this increased production has been achieved through new varieties and better farming practice based on research results.

Figures for area and yields of potatoes for the latest available 3 years are as follows:

Year	Area	Total Yield	Yield per Hectare
	hectares	tonnes	tonnes
1974–75	8 854	225 522	25.47
1975–76	9 495	248 321	26.15
1976–77	9 867	270 497	27.41

13.1.3 Onions.

Areas and yields of onions for the latest available 3 years are as follows:

Year	Area	Total Yield	Yield per Hectare
	hectares	tonnes	tonnes
1974–75	1 316	29 013	22.05
1975–76	1 439	38 182	26.53
1976–77	1 616	46 482	28.76

13.2 VEGETABLE VARIETIES

Artichoke (Globe)	(i) Green Globe (ii) Purple Globe
Artichoke (Jerusalem)	(i) Jerusalem
Asparagus	(i) Mary Washington (ii) Mary Washington 500 (iii) Mary Washington 500 W (iv) U.C.72 (v) Paradise (vi) New Jersey Improved (vii) U.C.77 (viii) New Jersey 101 and 103.
Broad Beans	**Process** (i) Serville extra early (ii) Tripple White (iii) Coles early dwarf **Market** (i) Exhibition long pod (ii) Coles early dwarf (iii) Aquadulce (iv) Early long pod (v) Seville long pod
Brussel Sprouts	(i) Cambridge No. 1 (ii) Cambridge No. 5 (iii) Jade cross (iv) Cambridge No. 3 (v) Fillbasket (vi) Early pick improved

Cabbage	**Spring Sown** (i) Golden acre (ii) Green acre (iii) Golden acre hybrid (iv) Winter cross. **Summer Sown** (i) Green acre (ii) Savoy drumhead (iii) Winter cross (iv) Green acre hybrid (v) Savoy omega. **Autumn Sown** (i) Diadem Conical (ii) Green acre (iii) Spring crop hybrid (iv) Flower of Spring (v) Savoy King (vi) Winter-cross. **Winter Sown** (i) Derby day (ii) Summer cross (iii) Golden acre early.
Capsicum (Pepper)	**Process** (i) Californian wonder (ii) Bell boy **Market** (i) Californian wonder (ii) Large bell (iii) long red caynenne (iv) Bell boy (v) Red devil (vi) Bullnose (vii) Mola Wonder (viii) Wonder giant F.1 hybrid (ix) New hybrid.
Carrot	**Process** (i) Red cored chantenay (ii) King emperator **Market** (i) Touchon (ii) Manchester table (iii) Red cored chantenay (iv) Dividend (v) Tiptop (vi) Early (vii) Top weight (viii) Spring Market (ix) Selection 198 (x) Maxi crop.
Cauliflower and Broccoli	**Spring Grown** (i) All year round (ii) Snow-ball (iii) Ruapehu (iv) Perfected deepheart (v) July Queen (vi) Snow White 4 month (vii) Y4 and 40 4 (viii) June Queen (ix) Phenominal 4 month (x) American 1,2,3. **Summer Growth** (i) Y5 (ii) Whiteacre (iii) Snow White 4 month (iv) Snowdrift (v) Ruapehu (vi) Phenominal 6 month (vii) White mountain (viii) All year round (ix) Phenominal 4 month (x) Snowball (xi) Y4 and 40 4 (xii) American 1,2,3. (xiii) Perfected deepheart (xiv) Australia XXXX **Autumn Sown** (i) White acre (ii) Phenominal 4 month (iii) Snow drift (iv) All year round (v) Snowball (vi) Walcheren. **Winter Sown** (i) All year round (ii) Walcheren (iii) Phenominal 4 month
Celery	**White Varieties** (i) Golden self blanching (ii) Salad days (iii) Golden Supreme. **Green Varieties** (i) Utah No. 12 Slow

	bolting. (ii) Tall Utah 52-70 (iii) Slow bolting green rex. (iv) Tall Utah 52-70 H (v) Tall Utah 15.
Cucumbers	(i) Burpee F1 Hybrid. (ii) Marketer (iii) Supermarket (iv) Short green prickley (v) Burpee Hybrid (vi) Money maker (vii) Polaris (viii) Crystal apple
Egg Plant	(i) New York Purple (ii) Winstones hybrid (iii) Black beauty.
Kumera	(i) Owairaka red (ii) Gisborne red
Leeks	(i) Musselburgh (ii) Walton mamoth (iii) London flag (iv) Giant Caretan (v) Captan (vi) Titian (vii) A.F.W. giant italian
Lettuce	**Cabbage Types (a) Summer** (i) All year round (ii) Yatesdale (iii) Summer gem. (iv) Great lakes summer (v) Webbs wonderful summer
	(B) Winter (i) Imperial 615 (ii) Webbs Wonderful Winter, (iii) Triumph B.S. (iv) Winterlake.
	Leaf types (i) Green mignonette (ii) Red Mignonette
	Cos types (i) Champion white (ii) Paris green.
	Bush (i) Long green bush (ii) Long white bush (iii) Cozini black bush (iv) Glowgreen hybrid (v) Black zuccini
	Trailing (i) Long green trailing
Onion	**Early Market** (i) Californian Red (ii) Porter's early globe (iii) Ailsa Craig (iv) Californian early red.
	Main Crop (i) Pukekohe long keeper (ii) Australian brown (iii) hybrid No. 1 (iv) Early harvest hybrid. (v) Brown Spanish (vi) Hybrid No. 30.
	Bunching (Spring Onions) (i) Evergreen bunching (ii) White Spanish (iii) White lisbon.
Peas	**Process** (i) Victory freezer (ii) Poha (iii) Frosty (iv) Emblem (v) Ajax (vi) Puget (vii) C 39 (viii) Patea (ix) Puke (x) Piri (xi) Pania (xii) Greenfeast
	Market (i) Greenfeast (ii) W.F. Massey (iii) Victory freezer (iv) Onward (v) Stratagem

Parsnip	(i) V.I.P. (ii) Hollow crown (iii) Silver crown (iv) Smoothie (v) Yatesnip (vi) White hollow crown.
Potatoes	**Process - Main Crop** (i) Ilam hardy (ii) Rua (iii) Auckland Short Top **Market - Early Crop** (i) Arran banner (ii) Katahdin (iii) Ilam hardy **Market - Main Crop** (i) Aucklander short top (ii) Setago (iii) Chippewa (iv) Arran banner. (v) Ilam hardy (vi) Glen Ilam (vii) Katahdin (viii) Rua (ix) Arran Chief (x) Majestic.
Pumpkin and Squash	**Pumpkin** (i) Royal Crown (ii) Kumi Kumi (iii) Whangaparoa crown (iv) Triamble (v) Queensland Blue. **Squash** (i) Buttercup trailing (ii) Butternut (iii) Green hubard (iv) Supermarket
Radish	(i) Scarlet globe (ii) White icicle (iii) long scarlet
Red Beet	**Process** (i) Detroit Dark red (ii) Early wonder **Market** (i) Detroit dark red (ii) Garnet (iii) Early wonder (iv) Cylinda (v) Derwent globe
Rhubarb	(i) Giant victoria (ii) Topps winter (iii) Crimson winter
Silverbeet	(i) Fordhook dark green (ii) Medium green broadrib (iii) Mastergreen (iv) Compacta slow bolting.
Spinach	(i) Prickly long standing (ii) Viking (iii) Hybrid No. 11 (iv) King of Denmark (v) Hybrid No. 7 (vi) Hybrid D.G.U.
Swedes	(i) Laings garden swede (ii) Superlative
Sweetcorn	**Process** (i) Golden cross bantam (ii) NK195 (iii) NK965 (iv) Nucross hybrid **Market** (i) Golden cross bantam (ii) Camelcross hybrid (iii) Golden nucross (iv) Marcross (v) Iochief
Tomatoes	**Process (A) Hand harvested** (i) Scoresby dwarf (KY1) (ii) VF 145 - B7879 (iii) Stoners dwarf gem. **(B) Machine harvested** (i) VF 145 - B7879 (ii) 142 (iii) 24P (iv) Merit

	(C) Potential Machine harvested varieties Early season (i) UF - 42 Mid Season (ii) Heinz 1706 (iii) Petanech (iv) VF134 - 1-2 (v) Cal - J. Late season (i) Mechanical harvester VF145 - 21-4P (ii) Fireball "878L" **Market (A) Early Market** (i) Scoresby dwarf KY1 (ii) Eurocross BB (iii) Shoners moneymaker (iv) Potentate **(B) Main crop** (i) Scoresby dwarf KY1 (ii) Adelaide dwarf (iii) Best of all (iv) U548 (v) Stones dwarf gem (vi) Beet steak (vii) Potentate (viii) Stoners moneymaker. **(C) Late Market** (i) Potentate (ii) V548 (ii) Stoners moneymaker
Turnips	(i) Early white milan (ii) Milan white flat purple top (iii) Goldenball orange jelly (iv) Snowball (v) White stone (vi) Snowball (vii) White globe purple toy (viii) Tokyo Hybrid
Water Melon	(i) Candy red (ii) Charleston grey (iii) Ice-cream (iv) Early Canada (v) Cannon ball (vi) Congo (vii) Sugar baby (viii) Dixie Queen.

13.3 VEGETABLE CROP HUSBANDRY

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Artichoke (Globe) 3.5 - 5.5 t/ha	approx 2500 plants/ha	August to October	Preferred **soil type** - medium friable loam. **Root section required** - 2200-2800/ha **Plant Spacing** (i) In row = 1.5-2.0 m (ii) Between rows = 2.0-2.5m **Method of propergation** - roots cut into sections and set out in situ.	**Base dressing** (kg/ha) N=100.0 P=50.0 K=100.0 Base dressing is applied at planting and in each spring. **Side dressing** (Kg/ha) N=100.0 Apply as 2 - 3 split applications during growing period. **Optimum pH range** 5.8-6.5 **Lime requirement** - Correct pH only.		200-300 days	Globes are removed from plant by hand. **Containers** packed into apple or pear cases.
Artichoke (Jerusalem) 7.5-15.0 t/ha	35,000 (approx) plants/ha	August to September	**Preferred soil type** - medium friable loam. **Tubers required** - 600-650 kg/ha Emergence time **(optimum)** - 14 day **Plant spacing** (i) In row =30.0-40.0 cm (ii) Between rows =75.0-90.0 cm	**Base dressing** (kg/ha) N=65.0 P=65.0 K=30.0 Fertiliser is applied in a band prior to planting. **Side dressing** - This is not considered necessary.		240 - 270 days	Tubers are lifted by hand **Containers**- crop is packed into apple or pear cases or sugar bags.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Artichoke (Jerusalem) cont.			**Method of Propergation** - mature tubers cut into sets and set out in situ.	**Optimum pH range** - 5.8-6.5 **Lime requirement** - to correct pH only.			
Asparagus light soils = 5.0-7.5 t/ha heavy soils 3.0-5.0 t/ha	**(i) Conventional transplanting** = 20,000 - 30,000 (approx.) **(ii) Direct** seeded = 100,000-175,000 (approx.)	**(i) Conventional transplanting** - Sown - Sept - Oct. (planted out-Aug-Sept.) (ii) Direct Seeded - Sown Sept. -Oct.	**Prefered soil type** - well drained, deep, slit loams, sandy loams, and fine sandy loams. **Optimum soil temp. for germination** - 20°C - 30°C. **Emergence time (Optimum)** - 15 days (3 weeks for early season sowings). **Plant Spacing** - (i) Conventional transplanting = In Row = 40.0-50.0 cm Between beds = 1.5-1.75 cm **Method of Propergation** - (i) Conventional transplanting - seed is sown in seed beds and planted out as one-year-old plants into prepared trenches.	**Base dressing** (kg/ha) (i) seed bed N = 0.0 P = 20.0 K = 0.0 (ii) Established plantings N = 0P = 70.0 K = 70.0 **Side dressing** (kg/ha). (i) Seed bed N = 20.0 (ii) Estab. plantings N = 40.0 On estab. beds the base dressing is made in August prior to spear emergence and the side dressing. Applied when harvesting is over and before the beds are closed up. Because of the	Irrigation is not normally required but could be useful for washing in fertilisers after closing up of the beds or for activating herbicides on dry ground. During the fern stage, application is impracticable.	(i) Transplanted beds - full maturity 4 years after sowing. (ii) Direct seeded beds - full maturity 3 years after sowing.	Spears are cut by hand and put loosely into boxes or tins. Mechanical aids to transport the pickers along the rows are used. Selective cutting by machines has not yet been proved practical. **Containers** - (i) Process-packed into factory dumps (16 kg approx.) (ii) Market-packed into cherrycases (9 kg approx.)

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Asparagus cont.				high pH requirement of asparagus sulphate of amonnia should be avoided as a nitrogen source. Urea is preferable to use as a nitrogen supply. **Optimum pH range** - 6.5-7.5 **Lime requirement** - asparagus prefer the higher pH levels to produce maximum yields. Lime should be applied until a pH min. of 6.5. is attained. To raise the pH level by 0.5 the following applications of farmers grade lime is required. Silts and Sandy Silts - 1.25 t/ha Silts loams and Sandy loams - 2.5 t/ha Clay and clay loams - 5.0 t/ha.			Size Grade 1 - 13-18 cm of green spear, min. diameter of 1.0 cm. Grade 2 - less than 13 cm of green spear, and/or less than 1.0 cm in diameter 13 cm from tip. **(ii)** Maturity - seedy spears 2nd grade. **(iii)** Defects ie spears affected with botrytis, frost damaged, diseased, and water applied will not be accepted. Slug insect damaged, bent-2nd grade.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Broad Beans Machine harvested-3.5 t/ha (seed) Hand harvested - 10.20 t/ha (pods).	85-120 kg/ha (seed) (i) Machine harvesting- 110000 ap (ii) Hand harvesting = 75,000 approx.	(i) Process - May - July (ii) Market - May to Aug.	**Prefered soil type** - well drained, well structured loam. **Optimum soil temp. for germination** - 12° - 30°C. **Emergence time (optimum)** - 11 days **Plant Spacing** (i) Machine harvesting In row = 10.0-20.0 cm Between rows = 45-75 cm (ii) Hand Harvested in row = 15 - 20 cm. Between rows = 60-90 cm. **Method of Propergation** - Sown in situ. with either seed drills or potato planters.	**Base dressing** (kg/ha) N = 0.0 P = 18.0 K = 70.0 **Side dressings** (i) Process-not normally applied. (ii) Market-in some cases an application is made of N at a rate of N 50 kg/ha. The base fertiliser is best applied as a placement dressing alongside the rows at sowing. **Optimum pH range** - 5.8-6.5 **Lime requirement** - only required to correct pH levels.		120-140 days	**Process Crops** are generally machine harvested i.e. pea combine mills. **Markt Crops** are hand harvested usually 2 or 3 successive picks. **Containers- Process** = Steel Bins (machine) harvested. Wooden Bins (hand harvested). **Market** = apple cases. **Canney specifications** - Colour should be green tinge, free from browning, no black rot or discolouring,

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Broad Beans cont.							no bruising or damage, and bins overfull returned to grower.
Brussel Sprouts 7.5-12.5 t/ha	250-500 g/ha	August to September.	**Preferred soil type**- deep well drained soils, high in organic matter. Early crops - light warm. **Optimum soil temp. for** germination - 7°-35°C. **Emergence time (Optimum)** - 6 days **Plant Spacing (i)** In row -45-60 cm **(ii)** between rows - 60-90 cm. **Method of Propergation** - Sown in beds, transplanted after 30-60 days approx. 15 cm high.	**Base dressing.** (kg/ha). N = 40.0 P = 40.0 K = 40.0 **Side dressing** (kg/ha) N = 100.0 **Trace Elements** - **(i)** Boron-where deficiency shows 20-40 kg/ha borax will correct this in following seasons. **(ii)** Molybenum - corrected by raising pH levels. **Optimum pH range** = 6.0-6.8 **Lime requirements** = high requirement to reduce molybdenum deficiency. Produce incidents of clubroot disease.	**Soil moisture level** not less than a 2.5 cm deficit in soil. Frequent light irrigations beneficial especially for summer crops. Critical periods for irrigation - just before and at transplanting and when sprouting begins.	100-130 days.	Hand picked when they reach suitable size. **Containers (i)** Process - into factory dumps **(ii)** Market - apple and pear bushel cases, plastic bags 9-10 kg (approx.0

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Cabbage Spring-harvests = 15.20 t/ha Summer Harvests = 20.25 t/ha Autumn Harvest = 20.25 t/ha Winter Harvests = 15.20 t/ha	250-500 g/ha	(i) Spring-sown-Aug-Nov. (ii)Summer-sown-Nov-Feb. (iii) Autumn-sown-Feb-May. (iv) Winter-sown-May-July.	**Preferred soil type**-deep, well drained, high in organic matter. Early crops-light and warm. **Optimum soil temp. for germination**-70°-350°C **Emergence time (Optimum)** - 6 days **Plant spacing** (i) In rows = 30-45 cm (ii)Between rows = 45-90 cm. **Plants/ha** = 36,000 approx. **Method of Propergation** sown in beds then transplanted after 30-60 days, 15 cm high.	**Base dressing** (kg/ha). (i) Maincrops - N = 40 P = 40 K = 40. (ii) Spring crops and hybrids - N = 40 P = 40 K = 80 Base dressings normally broadcast prior to planting out. **Sidedressing** (kg/ha). (i) Main crops - N = 100.0 (ii) Cool cond. - N = 100.0 Should be made in 2 or 3 split applications. **Trace Elements** - (i) Boron - deficiency corrected by 20-4.0 kg/ha of borax. (ii) Molybdenum-corrected by raising pH levels. Alkaline soils low rainfall = 250 g/ha sodium molyrate.	**Soil Moisture level** not less than a 2.5 cm deficit in soil. Frequent light irrigations beneficial espec. for summer crops. Critical periods for irrigation just before and at transplanting and when hearting begins.	Spring Harvests =75-100 days Summer Harvests =65-75 days Autumn Harvests = 70-80 days Winter Harvests =80-100 days	heads cut by hand, trimmed when mature. **Containers**- Process-harvested directly into bins. Market-crates and banana cases and plastic bags 36kg.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Cabbage cont.				Acid soils high rainfall = 3 kg/ha sodium molybate **Optimum pH range** - 6.0-6.8 **Time requirement** - high requirements to reduce molybdenum deficiency and reduce incident of clubroot.			
Capsicum (pepper) 8.0-17.0 t/ha	400-450 g/ha.	August-September (sowing) late October early November (planting).	**Preferred soil type**-well structured deep loam. **Optimum soil temp. for germination**-18°-35°C **Emergence time (Optimum)** - 8 days. **Plant spacing.** In rows-45.5-60.00 cm Between rows-90-120 cm **Plants/ha**-18,000 approx. **Method of Propergation** - raised under glass boxes, transplanted out in the ground.	**Base dressing** (kg/ha) N = 0.0 P = 56.0 K = 67.0 **Side dressing** (kg/ha) N = 112.0 Side dressing for market crops is split in two applications, banded down the row. **Optimum pH range** - 5.5 - 6.8 **Lime requirement** - for correction of pH only.	If adequate soil moisture is present at planting and a normal rainfall cond. Irrigation is not necessary. A soil moisture level of below 25% field capacity can seriously affect growth and fruit.	130-200 days.	Picked by hand when sized as green or coloured. **Containers** - peach or pear cases.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Carrot (i) Process - 56 t/ha. (ii) Market - 25 t/ha (iii) Baby carrots - 10.15 t/ha	(i) Precision seeding 1.0-1.5 kg/ha. (ii) Conventional seeeding - 2.0-5.0 kg/ha. (iii) Baby carrots precision seeding - 2.5-5.0 kg/ha.	(i) Early Spring harvest - March-May. (ii) Main-crop-Aug-Nov. (iii) Late crop-December -Feb.	**Preferred Soil type** - well structured, free draining alluvial soils, sands, peat, volcanic soil. **Optimum soil temp. for germination**-7.0°-29°C. **Emergence time (optimum)** - 6 days. **Plant Spacing** - (i) in row conventional - 2.57.5 cm, baby carrots - 40.0-45.0 cm. (ii) Between rows conven. - 15-30 cm, baby carrots - 10-12 cm. (iii) No. of rows/bed, conventional - 4-8 Baby carrots - 8-12. (iv) Between beds baby and conventional carrots - 40-45 cm. **Plants per hectare** - conven. = 800,000 baby carrots - 3 000,000. **Method of Propergation** sown in situ. with gang seed sowers.	**Base dressing** - (kg/ha) (i) Nth Island - N= 75 P= 75 K= 75. (ii) Sth Island - N = 100. P = 45 K = 135. NB. - High rates of phosphorus may be required in high phosphate fixing soils. Fertiliser applied as a blood -cast application prior to sowing, well mixed with soil to avoid forked roots. **Optimum pH range** 5.5-6.8 **Lime Requirements** - better crops produced from higher side of pH range.	Not normally required, except in drought. Use during early stages of growth treat carefully. Adequate moisture necessary for ensuring good germination.	(i) Early spring crops - 90-120 days. (ii)Main crop - 70-90 days. (iii) Late crop-80-100 days. (iv) Baby carrots 60-80 days.	Root harvesters used for process crops. Market crops, ploughed out or undercut and lifted by hand. **Containers**- (i) Process-bins. (ii) Market mainly plastic bags 18-27 kg. **Carnery specifications -(does not apply to baby carrots).** Must be free of excessive green, free of woody texture, free of rot or collapse, and free

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Carrot							of defects, i.e. rust fly, slugs insects etc. Min length-10cm. Min. diameter - 4 cm. Max. diameter - 4 cm. Min. diameter 2.5 cm whole canned.
Cauliflower and Broccoli (i) Summer and Autumn harvests - 22.5-27.5 t/ha (ii) Winter-spring harvests - 17.5-22.5 t/ha	600-800 g/ha	(i) Spring sown - Aug - Nov. (ii) Summer sown - November-February. (iii) Autumn Sown - Feb-May. (iv) Winter-sown - May-July.	**Preferred soil type** - (i) Early crops, light, warm soils. (ii) Main crop - heavy soils with good water holding capacity. (iii) Winter crops - light, well drained soils. **Plant Spacing**-(i) in row-50cm. (ii) Between row-60-100-cm. **Plants per hectare**-17 000 approx.	**Base dressing**-(kg/ha) (i) Autumn and winter crops - N = 115.0 P = 45.0 K = 150.0 (ii) Spring and early Summer crops - N =100.0 P = 50.0 K = 35.0. **Sidedressing** (kg/ha). (i) Main crops N = 100.0. (ii) Cool	Soil moisture level not less than a 2.5 cm deficit in soil. Frequent light irrigation for summer crops. Crucial time for irrigation just before and at transplanting and when curd forms.	(i) Spring Harvests - 160-190 days. (ii) Summer Harvests - 120 -160 days (iii) Autumn harvests - 85-120 days. (iv) Winter harvests - 100-140 days.	Curds-cut and trimed by hand when mature. **Containers**- (i) Process-bins (ii) Market-crates and banana cases.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Cauliflower and Broccoli cont.			Optimum temp. for germination-7°-30°C. Emergence time (optimum) - 5 days. Method of Propergation - sown in beds, transplanted after 30-60 days, approx 15 cm high.	conditions N = 100.0. Should be made in 2 or 3 split application. Trace Elements (i) Boron - 20-40 kg/ha of borax will be sufficient to correct this deficiency. (ii) Molybdenum-corrected by raising pH levels. Optimum pH range - 6.0-6.8 Lime requirement - high requirement to reduce deficiency and clubroot disease.			
Celery 37.5-62.5 t/ha	280-420 g/ha.	Sowing dates - September-January. Planting dates-late October to March.	Preferred soil type-well cultivated, well drained, high in organic matter. Optimum soil temp. for germination - 15.5°-21.0°C. Emergence time (Optimum)-9 days. Plant Spacing-(i) In rows-20.0-30.0cm	Base dressing (kg/ha) N = 45.0 P = 70.0 K = 5.0 Side dressing (kg/ha)	Requires adequate water supply throughout full growing period to prevent bolting occuring. First 2 months of growth at least 2.5 cm water/week.	110-160 days.	Cut by hand with long bladed knife just below ground level. Containers- (i) process - bins and cases. (ii) Market-banana cases, bushel cases, crates.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Celery Cont.			(ii)Between rows-20.0-30.0.cm (iii) No of rows /bed = 6-7 (iv) Between beds = 60 cm **Method of propergation** - seedlings raised under glass, transplanted out when approx. 15cm high.	N = 70.0. Base dressing applied broadcast prior to planting. Side-dressings applied split applications. Extra nitrogen may be required during winter growing period. **Optimum range (pH)** 6.0-6.8 **Lime requirement**- for pH correction only.			**Carnery specifications** - Must be free from a) dry or pithy texture b) sephoria leaf spot brown heart, rot discolouration c) copper or spray residue, slug damage. Water must not be added after cutting. Both green and white varieties accepted.
Cucumbers 5.0-10.0 t/ha.	1.1-1.7 kg/ha.	(i) Early crop-Sept-early October. (ii) Main-crop-Late October-late Nov. (iii) Glass-house propergation-August.	**Preferred soil type**- well structured free draining soils. **Optimum soil temp. for germination**-15.5° -35.0°C **Emergence time (Optimum)**- 3 days. **Plant spacing** (i) In row-30-60 cm. (ii) Between rows- 150 -180 cm.	**Base dressing** (kg/ha) N = 30.0 P = 50.0 K = 75.0 **Side dresing** (kg/ha) N = 25.0. Base fertiliser applied in bands prior to sowing. Side dressing applied when plant begins to	Frequent light applications needed to supplement natural precipitation. Especially important in droughts. Excess water can be harmful.	85-120 days.	Removed from vine by hand. **Containers** -cardboard cartons and fruit trays.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Cucumbers cont.			**Method of Propergation**-Sown *in situ* 2-3 seeds/hill. Early prop. plants can be raised under glass in Jiffy Pots and transplanted cut.	run. Early crops, extra nitrogen for inital boost immediately after germination may be required **Optimum pH range**-5.5-6.8 **Lime require -ment** - only to correct pH.			
Egg Plant 7.5-10.0 t/ha	250-300 g/ha	August-September. (Sowing dates). Planting dates-late October-early Nov.	**Preferred soil type**-well structured, deep alluvial, or volcanic loam. **Optimum soil temp for germination**-24°-32°C **Emergence time (Optimum)**-8 days. **Plant spacing**-(i) In row-50-60 cm (ii) Between rows-50-60cm. **Plants per hectare**-33,000 aprrox **Method of Propagation**-raised glassboxes transplanted out.	**Basedressing.** (kg/ha). N = 0.0 P = 55.0 K = 70.0. **Side dressing.** (kg/ha) N = 110.0 Base dressing applied as banded application at planting side dressing split in 2 applications. **Lime requirement**- to correct pH only.	Not necessary providing rainfall conditions are normal and soil is adequately moist at planting.	150-160 days	Picked by hand when purple. **Containers**-cardboard cartons and peach cases.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Garlic 5.0-7.5 = t/ha	90-120 kg cloves /ha	late Autumn	Preferred soil type- well structued loam. **Optimum monthly temperature for growth**-12.5°-24.0°C. **Plant Spacing**(i) In row-5.0-7.5 cm. (ii) Between rows-38.0 -40.0 cm. **Plants/ha**-400,000 approx. **Method of Propergation**-cloves usually brought, can be raised by seed. Planted out singly.	**Base dressing** (kg/ha) N = 85.0 P = 35.0 K = 80.0 **Side dressing.** (kg/ha) N = 30.0 Base dressing applied as a broadcast application immediately before planting side dressing applied when crop is 20-30 cm high. **Optimum pH range**-6.0-6.8 **Lime requirement**-to maintain pH levels.	Adequate supplies of water required during growth period. Required to suppliment natural precipitation.	180-200 days	Small areas dug by hand. Large areas ploughed out. **Containers**- Open mesh sacks.
Kumera 20-30 t/ha	Seed tubers required per ha - 375 kg.	Propagation dates- August to September **Planting dates** - late October to early November.	Preferred soil type- rich, well structured, well drained alluvial and volcanic soils. **Optimum monthly temperature for growth**-21°-29° C. **Plant Spacing**-(i) In row-30-38cm (ii) Between rows-90-106 cm. Approx. 30,000 plants/ha. **Method of**	**Base dressing** (kg/ha) N = 35 P = 135 K = 90. Base dressing is broadcast before final cultivation and moulding up of rows prior to planting. **Optimum pH range**-5.0-6.9	Beneficial during dry growing seasons. Quantity of water should be reduced prior to harvest or ripen ing of tubers may be affected.	90-120 days.	Special Kumara and pototoe harvesters are used to remove tubers. Hand sorting and bagging required.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Kumera cont.			**Propagation** - Seed tubers placed in propagated beds. Use only disease free tubers. With 500 g tubers 7.5 m^2 of propagation frame need/ha to be planted out. Plants pulled from tubers when 15-20 cm high. Either directly planted or grown in boxes. Hygene essential.	**Lime requirement**-for pH correction only.			**Containers**-cartons, boxes, sugar bags.
Leeks 22.5-30 t/ha	2.25-4.5 kg/ha	October-April. (sowing dates). Planting dates - November-May.	**Preferred soil type** - Well structured, free draining, friable loam. **Optimum soil temperature for germination**-10°-35° C. **Emergence time (Optimum)**-5 days. **Plant Spacing (i)** In row-10-15 cm, **(ii)** Between rows - 45 - 60 cm. **Plants/ha**-150,000 (approx). **Method of Propergation**-sown in beds, transplanted out when 15-20 cm high.	**Base dressing** (kg/ha) N = 85 P = 35 K = 80. **Side dressing** (kg/ha) N = 30. Base dressing applied broadcast immediately before planting out. Side dressing applied when crop is 25-30 cm high. **Optimum pH range**-6.0-6.8 **Time requirements**-maintain pH levels.	Important in early growing period. approx. 2.5 cm per week When irrigation is used to supplement natural precipitation use sprinkles for best results.	110-120 days	Mainly dug by hand. Can be ploughed out with deep plough settings. **Containers**- (i) Process-bulk bins. (ii) Market-apple and pear cases.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Lettuce 20.0-32.5 t/ha	Trans-planted-1.7-2.2 kg/ha. Direct Seeded-3.5 kg/ha	(i) Summer varieties-September-February. (ii) Winter Varieties-March-August.	**Preferred soil type**-moist, well drained, fertile **Optimum soil temp. for germination.** 4°-27°C. **Emergence time (optimum)**-3 days. **Plant Spacing (i)** In row-25-30cm (ii) Between rows-25-40 cm. **Plants/ha**-100,000 approx. **Method of Propergation** - sown *in situ*, thinned at a later stage. Seeds sown in beds. Precision seeding can be used.	**Base Dressing (kg/ha)** N = 25 P = 80 K = 100. **Side Dressing** (kg/ha) N = 55 Base dressing applied broadcast applications prior to sowing. Side dressings applied split applications at 40-70 days after sowing. Extra nitrogen may be applied during winter growing period.	Flavour improved by irrigation, necessary in hot dry conditions. Should be applied at 2.5 cm each application when soil moisture deficit reaches 2.5 cm. Soil should never be wet for any length of time after application.	(i) Summer varieties - 60-90 days. (ii) Winter varieties - 80-90 days.	Individual heads cut by hand. **Containers**-banana cases crates.
Marrow Fully grown-15.25 t/ha Baby marrows-5-10 t/ha	2.25-2.75 kg/ha	(i) Early Crops-Sept-October. (ii) Main crops-late October-late Nov. (iii) Glass-house propagation-August.	**Preferred soil type** - well structured, free draining. **Optimum soil temperature for germination** - 21°-32° C. **Emergence time (optimum)** - 5 days. **Plant Spacing (i)** In row-bush = 90-105 cm trailling - 60-90 cm.	**Base dressing (kg/ha)** N = 30 P = 50 K = 75. **Side dressing** (kg/ha). N = 25 applied broadcast prior to sowing or planting out. Side-dressing applied immediately	Respond best to conditions of nil moisture stress. Frequent light applications needed to supplement natural precipitation. Too much water can be harmful.	100-150 days	**Hand cut** from vine. Leaving 2-3 cm stalk attached. **Containers** - cardboard cartons, various sized wooden cartons.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Marrow cont.			(ii) Between Rows - 150-180 cm. **Plants per hectare** = (i) Bush-6250 approx. (ii) trailing-8000 approx. **Method of propagation** - sown *in situ* 2-3 seeds hill, hand planted. Early production plants grown under glass in 'Jiffy Pots' and transplanted out.	plant begins to run or bush out. For early crops some extra nitrogen may be needed to boost after germination. **Optimum pH range** - 5.6-6.8 **Lime Requirement**-for pH correction only.			
Onion (i) Early crop 20-25 t/ha (ii) Main crops- 25-30 t/ha	(i) Precision seeding - 3.5-5.5. kg/ha. (ii) Conventional seeding - 4.5 - 6.75 kg/ha.	(i) Early main crop - May. (ii) Main-crop, keepers - Aug-Sept. (iii) Bunching-August.	**Preferred soil type** - well structured, free draining, friable loam. **Optimum soil temp. for germination** - 10°-35° C. **Emergence time (optimum)**-5 days. **Plant Spacing-(i)** In row, bulbing 5.0-7.5 cm, bunching - 1.25 cm. (ii) Between rows - 10-30 cm. (iii) No rows/beds - 5-9 (iv) Between beds - 40-45 cm. **Plants/ha** - 650,000 approx. **Method of**	**Bse dressing** (kg/ha) N = 85 P = 35 K = 80. **Side dressing** (kg/ha) N = 30. Base dressing applied as banded application either immediately before or after planting. Side dressing applied when crop is 20-30cm high. **Optimum pH range** - 6.0-6.8	Require adequate water supply, approx 2.5 cm per week especially during early growing period.	(i) Early crops - 180-200 days. (ii) Main crops - 120-150 days. (iii) Bunching 60-90 days.	Onions are undercut windrown and allowed to cure in paddock. Topping done with special machinery. Bunching onions-hand pulled. **Containers-** (i) Bulbing into 3,5,30 and 50 kg mesh bags.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Onions cont.			**Propagation** - sown *in situ* with gang seed sowers.	**Lime requirement** - required regularly to maintain pH levels. If using sulphuric acid for weed control annual applications of time required.			(ii) Bunching packed into handful sized bunches packed into apple cases. (iii) Processed into Bins
Parsnip (i) Process - 40 t/ha (ii) Market - 26 t/ha	(i) Precision seeding - 1.5-2.0 kg/ha (ii) Conventional Seeding 4-5 kg/ha	(i) Early spring harvest - Jan-March. (ii) Main crop-July to October.	**Preferred soil type**- well structured, free alluvial soils, sands, peats, heavier volcanic **Optimum temperature for germination** 10°-21°C. **Emergence time (Optimum)**-14 days. **Plant Spacing** (i) In row - 5-10 cm (ii) Between rows - 30-35 cm. **Plants/ha** - 270,000 approx. **method of propagation** - sown *in situ* using either plant junior or stanhay equipment seeding rate adjusted to eliminate thinning.	**Base dressing** (kg/ha) (i) Nth Island N = 80 V = 80 K = 80. (ii) Sth Island N = 100 P = 45 K = 135. Fertiliser applied as a broadcast application prior to sowing and well mixed to avoid forking. **Optimum pH range** - 6.0-6.8 **Lime requirement** - attractive roots produced from higher soil pH level.	Use during early stages of growth should be treated cautiously. Not normally required.	(i) Early Spring crops - 100-120 days. (ii) Main Crops - 90-100 days.	Either ploughed or undercut lifted, sorted by hand. Process crops - machine harvested. **Containers** (i) Process-bins. (ii) Market - apple and pear cases and plastic bags of 18-27 kg.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Peas (i) Process- 3.75-5 t/ha (seed). (ii) Market- 2.5-3.75 t/ha (complete pods).	(i) Process - 150 -250 kg/ha (ii) Market - 90-120 kg/ha	(i) Early crop -August to September. (ii) Main-crops-Sept. to October.	**Preferred soil type** - well drained alluvial soils. **Optimum soil temperature for germination** - 4.5° - 24.0° C. **Emergence time (Optimum)** - 7 days. **Plant Spacing** (i) In row - 5.0-8.0 cm (Process) (ii) Between rows - 45-75 cm. **Plants/ha** - (i) process - 970,000 approx. (ii) Market - 265,000 approx. **Method of propagation** - Process and Market sown, *in situ*. Process with conventional grain drills. Market with planet jnr. or similar equipment.	**Base dressing.** (kg/ha) N = 0 P = 25 K = 50-75. When base dressing is sown with the drill lower rates of K should be used. **Optimum range** - 5.5-6.8 **Lime Requirement** - pH correction only	**An application of 2.5 cm when first flowers appear and another 1.25 cm when pods are swelling cause a 40% yield increase. Irrigation applicable to Market crops only.**	**72-112 days.**	**Harvested with mobile viners.** **Containers** (i) Process- bins (ii) Market- apple/pear cases, sacks polythene bags. **Cannery specifications.** Peas are graded at harvest according to maturity and payment is made accordingly. The more mature seeds will not bring in as much as the younger ones. Calculated by tenderometer readings.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Potatoes (i) Early crop 10-20 t/ha (ii) Main-crop - 30-45 t/ha	(i) 30 g seed = 900 kg/ha (ii) 50g seed = 1500 kg/ha	(i) Early crop June to August. (ii) Main crop-late Oct-early Nov.	**Preferred soil type** - Well structured medium friable loam **Optimum monthly average temperature for growth** 15-5° - 18.5° C **Emergence Time** - 12 days **Plant Spacing** (i) Early crop. In row 30-40 cm between rows 90-105 cm. (ii) Main Crop. In row 40-45 cm. Between row 90-105 cm. **Plants/ha** - (i) Early crop - 30,000 approx. (ii) Maincrop-25,000 approx. **Methods of propagation** - tubers are set out with commercial potato planters.	**Base dressing.** (kg/ha) (i) Early crop N = 55 P = 45 K = 45 (ii) Main crop N = 25 P = 40 K = 45. **Side dressing.** (kg/ha) (i) Early crop - N = 55 (ii) Main crop N = 23 (base dressing) Applied banded application at planting side dressing applied prior to final moulding. **Optimum pH range** - 5-6 **Lime requirement** - seldom required for potato crops.	Potatoes - highly sensitive to moisture fluctuations. Greater returns are obtained from fewer irrigations at a 25% available soil moisture than more frequent irrigation at a 50% level.	(i) Early crop 90 to 120 days (ii) Main crop - 112-130 days.	Harvested with machines. **Containers** (i) Process-bins (ii) Market-polythene Bags. **Cannery Specifications.** Must be 5 cm or over in diameter, and have a firm skin without disease or rots of any-kind they must be free from slugs insect damage, bruising and badly mis-shaped tubers.
Pumpkin and Squash (i) All varieties except Buttercup,	2.75 - 3.5 kg/ha.	(i) Early crop - Sept. to early October. (ii) Main crop - late	**Preferred soil type** - well structured free draining. **Optimum soil temp. for germination** - 21°-32° C.	**Base dressing** (kg/ha). N = 28 P = 50 K = 75. **Side dressing** (kg/ha).	Only applied during initial stages of plant growth. Excess water can be harmful.	(i) Pumpkins - 100-120 days. (ii) Early Squash - 65-85 days.	Hand harvested leaving a 3-5 cm stalk on fruit **Containers** (i) Pumpkins

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Butternut and Supermarket - 25-38, t/ha (ii) Buttercup and Butternut - 15-26 t/ha (iii) Supermarket - 18-30 t/ha.		October - late Nov. (iii) Glasshouse prop.- August.	**Emergence time (optimum)** - 5 days. **Plant Spacing (i)** Pumpkin. In row - 2.5m. Between rows - 2.5m. (ii) Warren Hubbard Squash - In row - 2.5m. Between rows - 2.5m. (iii) Butternut and Buttercup, and Supermarket - In row - 1.5-1.8. Between rows - 1.5-1.8m. (iv) Buttercup, bush. In row 1.2-1.5m. Between rows - 1.5-1.8m. **Plants/ha** - (i) Pumpkin - 1600 approx. (ii) Warren Hubbard squash - 1600 approx. (iii) Butternut, Buttercup and Supermarket - 3700 approx. (iv) Buttercup - bush, - 4500 approx. **Method of Propagation** - Sown *in situ* hand, (2-3 seeds/hill). Early produce hot house.	N = 25. Base fertiliser applied broad cast before sowing. Side dressing applied immediately before plants begin to run. **Optimum pH range** - 5.5 - 6.8 **Lime requirement** - pH correction only.		(iii) Late Squash - 120-160 days	into sacks and plastic bags. (ii) Large squash - sacks and plastic bags. (iii) Early-squash, buttercups butternuts and supermarket - crates and bushel cases.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Radish 10-15 t/ha	10.0 kg/ha	Sept - February.	**Preferred soil type** - rich friable loam **Optimum soil temp. for germination** - 7°-32° C. **Emergence time (opt)** = 3 days. **Method of Propagation** - sown *in situ.* **Plant Spacing** (i) In row - 5.0-7.5 cm. (ii) Between Rows - 30-35 cm. **Plants/ha** 490,000 approx.	**Base dressing.** (kg/ha). N = 0 P = 20 K = 40. Applied broadcast prior to sowing. **Optimum pH range** - 5.5-6.8. **Lime requirement** - for pH correction only.	Crop responds well when moisture levels are maintained at approx. 75% above available moisture.	30-45 days.	Pulled and Bunched in Paddock. **Containers** - Apple, Pear cases.
Red Beet (i) Process (Machine harvest) - 25 t/ha (ii) Market (hand harvest) - 30-35 t/ha	(i) Process, Convent. seeding - 6.75 kg/ha. (ii) Process, precision seeding - 5.5 kg/ha (iii) Market convent. seeding - 11 kg/ha	(i) Main crop - September - October. (ii) Late crop - mid January.	**Preferred soil type** - well structured, free draining loams **Optimum soil temp. for germination** - 15.5° - 29.5°C. **Emergence time (Optimum)** - 5 days. **Plant Spacing** - (i) Process In row - 5-10 cm. Between rows - 35-40 cm. (ii) Market In row - 5-10cm. Between rows - 30-35 cm.	**Base dressing.** (kg/ha). N = 0 P = 20 K = 40. Base dressing applied as banded application at planting. **Optimum pH range** - 6.0- 6.8. **Lime Requirement** - correct pH and for optimum boron release.	Not normally required. Dry seasons 2.5 cm. Water applied at start of root swelling, beneficial.	(i) Main crop - 65-75 days. (ii) Late crop. 70-80 days.	(i) Market crops - hand picked. (ii) Process crops - machines. **Containers** (i) Process-bins (ii) Market - apple cases. **Preferred sizes.** (i) Process - 5.5-9.5 cm

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Red Beet cont.	(iv) Market precision seeding - 9 kg/ha.		Plants/ha - (i) Process - 360,000 approx. (ii) Market - 410,000 approx. **Method of Prop.** Sown *in situ* with gang seed sowers. Either planet Jnr or Stannzy equipment.				diameter (ii) Market - 4-6 cm diameter **Cannery Specifications** - Beet must be free from: severe white internal zoning, all fungi, rot, dry discoloured pitting, defects i.e. insect damage, Tops must be removed close to crown.
Rhubarb 20-25 t/ha	2.25 kg/ha	Sept - October. (Sowing dates). July-August. (Planning Dates).	**Preferred soil type** - Well structured, free draining loams and peats. **Min. Air temp. for growth** - 1°C. **Plant Spacing** (i) In row - 45-90 cm. (ii) Between rows - 90-150 cm. **Plants/ha** - 12,500 approx. **Method of Propagation** - trans-	**Base dressing** (kg/ha) N = 65 P = 110 K = 90. **Side dressing** (kg/ha) N = 90. Base dressing applied as banded application before growth begins. Side dressing split into 2 application. ½ applied after.	Responds well to irrigation especially on light country.	(i) From seed 2 years. (ii) From transplant divid. crown - 6-12 mths.	Stalks hand pulled, bundled and packed in paddock. **Containers** - banana/ apple cases.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Rhubarb cont.			planting divided crowns. (Can be raised from seed).	each of 2 main pullings. **Optimum pH range** - 5.0-6.8 **Lime requirement** - If acid forming fertilisers used, heavy lime application necessary to maintain pH levels.			
Silver Beet 7.5 - 12.5 t/ha	5.5 - 6.5 kg/ha		**Preferred Soil type** - well structured free draining loam. **Optimum Soil temp. for germination** - 10°-29.5° C. **Emergence Time (Opt).** 5 days. **Plant Spacing** - (i) In row - 20 - 30 cm. (ii) Between rows - 45-60 cm. **Method of Propagation** - Sown *in situ.*	**Base dressing.** (kg/ha). N = 25 P = 20 K = 40. Base dressing as banded application at sowing. **Optimum pH range** - 6.0-6.8. **Lime requirement** - for pH collection only.	Apply in dry seasons at a rate of 2.0 cm per week	80-100 days.	Cut by hand. Packed in paddock **Containers** - crates, apple, pear, banana cases

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Spinach 5.0 - 7.5 t/ha	10.5-11.5 kg/ha.	(i) Spring sowing September - November. (ii) Autumn Sowing - March to May.	**Preferred Soil type-** medium heavy rich loam. **Optimum soil temp. for germination -** 7° - 24°C. **Emergence time (Optimum)-**6 days. **Plant Spacing (i)**In Row - 5-10 cm (ii) Between rows - 30-35 cm. **Plants/ha -** 410,000 approx. **Method of Propagation -** Sown *in situ,* either precision seeding or conventional equipment.	**Base dressing** (kg/ha) N = 30 P = 30 K = 15. **Side dressing.** (kg/ha) N = 40. B/d applied as a banded application before sowing. S/d - split applied as 2 application during growing seasonal. **Optimum pH range -** 6.0 - 6.8 **Time Requirement -** Will only grow well on high pH soils lime is essential to maintain pH within optimum levels.	Treat with caution during early stages of growth. Advantages in drought conditions.	50-60 days.	Pulled bundeled in paddock. **Containers -** Apple and Pear cases.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Swedes 25-50 t/ha	2.0 - 2.25 kg/ha	Autumn to early Spring.	**Preferred Soil type** - medium to light loam. **Opt. soil temp. for germination** - 15.5° 40.5°C. **Emergence time (opt)** = 2 days. **Plant Spacing (i)** In Row - 10 - 15 cm. **(ii)** Between Rows - 37.5 - 45 cm. **Plants/ha** - 195,000 approx. **Method of Propagation** - sown *in situ.*	**Base dressing.** (kg/ha) N = 0.0 P = 20 K = 40. Applied broadcast prior to sowing. **Optimum pH range** - 5.5-6.8 **Time Requirement** - for pH correction and control of club-root.	Irrigation beneficial under dry conditions.	65-90 days.	Pulled, trimmed, hand packed in field. **Containers** - crates and apple cases. **Preferred sizes** - 7.5 - 10 cm. diameter.

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Sweet Corn (i) Process - 10.0 - 12.5 t/ha. (ii) Market - 12.5 - 15.0 t/ha	11-17 kg/ha	November - December	**Preferred soil type** - warm, rich, well-drained, friable loam. **Optimum soil temp. for germination** - 15.5° - 35.0°C. **Emergence time (opt)** = 4 days. **Plant Spacing (i)** Process. In rows - 15-22.5 cm. Between Rows - 90.0 cm **(ii)** Market In Rows - 22.5-30 cm. Between Rows = 60-90 cm. **Plants/ha** (i) Process = 60,000 (approx). (ii) Market = 50,000 (approx). **Method of Propagation** - sown *in situ*.	**Base dressing** (kg/ha) (i) Process and Market. N = 15 P = 15 K = 25. **Side dressing** (kg/ha) (i) Market - N = 50.5. B/d applied broad cast at sowing. S/d applied as a banded application when crop reaction 15-25 cm high. **Optimum pH range** - 5.5 - 6.8 **Time Requirement** - for pH correction only.		(i) Early sowing in frost free areas - 100 - 120 days/ (ii) Main Crop - 95-105 days.	Process - Machine Market-hand **Containers** - (i) Process - bins, hopper truck. (ii) Market - apple cases.
Turnips 15-38 t/ha	2.0-2.25 kg/ha	Autumn - Early Spring	**Preferred soil type** - light well drained 10 cm. **Optimum soil temp. for germination** - 15.5°-40.5° C. **Emergence Time (optimum)** - 1 day **Plant spacing** - (i) In row - 7.5 - 10.0 cm	**Base dressing** (kg/ha) N = 0.0 P = 20.0 K = 40.0 Applied broadcast prior to sowing. **Optimum pH range** - 5.5-6.8	Irrigate under dry conditions. Responds well to water 10-20 days before harvest.	60-70 days.	Pulled trimed packed by hand. **Containers** - young roots sold bunched. Mature roots

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
turnips cont.			(ii) Between Rows - 37.5 - 45.0 cm **Plants/hectare** - 275,000 approx. **Method of Propagation** - sown *in situ.*	**Lime requirements** - pH correction - control of clubroot.			packed in crates and sacks. **Preferred sizes** - 5-7.5 cm diameter
Water Melon 7.5 - 12.5 t/ha	1.5 - 1.75 kg/ha	(i) Early crop- September (ii) Main crop - Late Oct. to early November. (iii) Glass-house propagation- August.	**Preferred soil type** - Well structured free draining soil **Optimum soil temp. for germination** - 24°-35° C. **Emergence time (opt)** = 3 days. **Plant Spacing** (i) In row - 1.5 - 1.8 m. (ii) Between rows - 1.5-1.8 m. **Plants/hectare** - 3600 approx. **Method of propagation** - Sown in situ. Early production- hot house seedlings can be used.	**Base dressing** (kg/ha) N = 28 P = 50 K = 75. **Side dressing** (kg/ha) N = 75 B/d applied broadcast prior to sowing. S/d applied immediately before plants begin to run. **Optimum pH range** - 5.5 - 6.8 **Time requirements** - for pH correction only.	Frequent light irrigations beneficial. Excess water can be harmful.	120-140 days.	Hand cut leaving 2-3 cm stalk on fruit. **Containers**- crates, sometimes sold loose.
Tomato (i) Early dwarf = 40-50 t/ha (ii) Early tall = 35-50 t/ha	(i) Transplanted (box grown) = 210-420 g/ha. (ii)	(Sowing dates). (i) Early Market Crops - July to August.	**Preferred Soil type** - Well structured, deep alluvial or volcaic loam. **Optimum soil temp. for germination** - 15.5° 29.5° C.	**Base dressing** (kg/ha) (i) Early Market Crops - N = 40 P = 55 K = 65.	Provided there is adequate soil moisture present at sowing irrigation is generally not needed.	(i) Early Market Crops 100-120 days. (ii) Main crop = 90-120 days	Most crops handpicked. **Containers** (i) Process-factor dumps (25 kg) factory bins (⅔ full = 400 kg).

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Tomato cont. (iii) Main crop dwarf= 47.5-88 t/ha (iv) Maincrop tall = 45-63 t/ha. (v) Late crop tall = 30-36 t/ha. (vi) Machine harvest dwarf = 38-60 t/ha	Direct seeded = 1.0-1.2 kg/ha.	(ii) Main Crops- August-September. (iii) Late Crops- September. (iv) Machine harvest crops- Late October to early Nov. (Planting out dates). (i) Early Market crops- September to early October (ii) Main Crops- late October to early November. (iii) Late Crops- January to February.	**Emergence time (optimum)**= 6 days. **Plant Spacing (i) Early market dwarf.** In row- 45-60 cm Between rows- 105-150 cm. **(ii) Early market tall.** In row- 30-45 cm. Between rows- 120-150 cm. **(iii) Main Crop Dwarf-** In Row 45-60 cm. Between row 150-180 cm **(iv) Main Crop tall** In Row - 45-55 cm. Between row - 120-150 cm. (v) Late crop tall. In row-45-60 cm. Between row 120-150 cm **(vi) Process (hand harvest)** In row-45-60 cm. Between rows-150-180 cm **(vii) Process (machine har)** In row-15-30 cm. Between rows- 90-150 cm. **(viii) Machine harvest** In Row- 10-12 cm. Between Rows- 10-15 cm. No Rows/bed- 3. Between beds= 150 cm.	(ii) Main and Late Crops- N = 0.0 P = 55 K = 65. (iii) Process Crops- N = 0.0 P = 55 K = 50. B/d appied as banded application at planting. On high phosphorus fixings soils more P may be needed. **Side dressing** (kg/ha) (i) Early market crops. N = 70 (ii) Main and Late Crops N = 110 (iii) Process crops -(hand and machine harvested). N = 105. S/d for Market crops split into 2 applications, banded down row. S/d applications on dwarf crops should be tempered according to conditions		(iii) Late Market Crops-90-100 days. (iv) Direct seeded crops- 100-110 days. Particularly applicable to machine harvested crops in order to increase amount of ripe fruit on process crops, chlorethephon, plus surfacant can applied- 15-17 days before harvest.	(ii) Market- wooden or cardboard containers holding 5.7 or 9 kg. **Cannery Specifications-** Minimum size 3.8 cm diameter. Must be a full deep red free from excessive green back. Must be firm ripe and withought disease or defects Care should be taken as to the qunatity packed into cases. Overfilled cases may be returned to grower due to damaged fruit

Crop and Expected Yield	Seeding rate per hectare	Sowing time Planting Dates	Sowing and Planting	Fertilisers	Irrigation	Time to Maturity	Harvesting
Tomato cont.			Plants/ha-(i) Early Market Dwarf = 15,000 approximately. (ii) Early Market Tall= 20,000 approx. (iii) Main crop Dwarf= 11,50000 approx. (iv) Maincrop Tall - 15,000 approx. (v) Late Crop Tall-14,000 approx. (vi) Process (hand harvested) = 11,500 approx. (vii) Process (Machine harvested) = 37,000 approx. (viii) Machine harvest (suggested spacing) = 160,000 approx. Method of Propagation- All plants except machine harvested plantings are nursery raised and then transplanted out. Seed sown in situ. with precission seeding and equipment.	in any particular area. Optimum pH range. 5.5-6.8 Time Requirement. pH correction only.			

References

New Zealand Official Yearbook 1979
New Zealand Vegetable Growers Handbook - Evan Wallace (Published by Henry H. York and Company Ltd).

SECTION 14

FRUIT AND NUT PRODUCTION

14. FRUIT AND NUT PRODUCTION

14.1 FRUIT PRODUCTION STATISTICS

14.1.1 Orchards and Subtropical Fruits

The following table gives estimated 1978 orchard areas with the main producing areas for the various fruits.

Fruit	Hectares	Main Districts
Pip Fruit		
Apples	5603	Nelson, Hawkes Bay
Pears	440	Hawkes Bay, Nelson
Stone Fruit		
Apricots	555	Otago
Cherries	110	Otago, Marlborough
Nectarines	368	Otago, Hawkes Bay
Peaches	1027	Hawkes Bay, Auckland, Otago
Plums	328	Hawkes Bay, Auckland
Citrus		
Grapefruit	442	Bay of Plenty
Lemons	113	Bay of Plenty
Mandarins	303	Bay of Plenty, Northland
Oranges (sweet)	513	Northland, Poverty Bay
Tangelos	496	Bay of Plenty, Northland, Poverty Bay
Subtropicals		
Kiwifruit	2206	Bay of Plenty
Passionfruit	30	Bay of Plenty,
Tamarillos	192	Northland, Bay of Plenty
Avocados	133	Bay of Plenty, Poverty Bay
Feijoas	77	Bay of Plenty

14.1.2 Berryfruits

The following table gives the estimated net areas of the various berryfruits for the fruiting seasons shown and shows the main producing areas.

Fruit	Hectares			Main Districts
	1975/76	1976/77	1977/78	
Strawberries	159	174	213	Auckland, Canterbury, Hawkes Bay.
Raspberries	172	156	150	Nelson, Canterbury
Brambles (other than those listed).	21	18	50	Waikato, Horowhenua
Boysenberries	174	174	187	Nelson, Hawkes Bay
Blackcurrants	176	187	194	Canterbury, Otago, Southland
Redcurrants	1	1	1	Waikato, Wairarapa
Blueberries	4	4	6	Waikato
Gooseberries	15	11	11	Wairarapa, Horowhenua

14.1.3 Apple and Pear Production

Over 700 orchardists sell apples and pears to the New Zealand Apple and Pear Marketing Board. Over 80 percent of the crop received comes from Nelson and Hawkes Bay. The following table shows the quantities of the main varieties of fresh apples and pears received by the Apple and Pear Marketing Board during the 1977/78 season.

Variety	Hawkes Bay	Nelson	Other Districts	Total
		cartons (000)		
Apples—				
Granny Smith	1 683	751	423	2 857
Sturmer Pippin	205	506	134	845
Golden Delicious	267	430	113	810
Delicious	60	199	111	370
Red Delicious	777	197	120	1 094
Jonathan	6	130	41	177
Dougherty	180	138	20	338
Cox's Orange Pippin	83	430	77	590
Others	370	287	139	796
Total Apples	3 631	3 068	1 178	7 877
Pears—				
Winter Cole	61	35	9	105
Winter Nelis	47	11	20	78
Packham's Triumph	26	54	5	85
Others	50	26	8	84
Total Pears	184	126	42	352

14.1.4 Fruit Disposal

Estimated production and methods of disposal of the various fruit crops in 1978 are shown in the following table.

Fruit	Disposal			Total Production
	Export (fresh)	Local Market (fresh)	Processing	
		tonnes		
Pip Fruit				
Apples	83 555	67 018	34 771	185 144
Pears	1 424	7 451	5 361	14 236
Stone Fruit				
Apricots	-	3 025	2 001	5 026
Cherries	-	442	56	498
Nectarines	-	2 468	17	2 485
Peaches	-	11 551	5 083	16 634
Plums	-	2 373	266	2 639

Citrus Fruit				
Grapefruit	-	2 030	3 453	5 483
Lemons	-	1 293	1 610	2 903
Oranges	-	4 862	940	5 802
Mandarins	-	2 120	-	2 120
Tangelos	-	3 788	900	4 688
Subtropical Fruit				
Kiwifruit	7 992	469	1 115	9 576
Tamarillos	-	1 003	150	1 153
Passionfruit	-	85	11	96
Avocados	-	73	-	73
Feijoas	-	149	184	333

Estimated production and disposal of the various berryfruits is given in the following table.

Fruit	Market (fresh)		Processing		Total Production	
	1976/77	1977/78	1976/77	1977/78	1976/77	1977/78
			tonnes			
Strawberries	2818	3 292	736	1 148	3554	4 440
Raspberries	640	542	628	815	1268	1 357
Brambles (other than those listed)	68	170	45	55	113	225
Boysenberries	523	454	970	1 333	1493	1 787
Blackcurrants	149	66	371	619	520	685
Redcurrants	5	3	–	-	5	3
Blueberries	5	7	–	1	5	8
Gooseberries	65	31	7	5	72	36

14.2 FRUIT PRODUCTION AND MANAGEMENT

14.2.1 Berryfruits

Botanical, Anatomical, Physiological

BLACK CURRANT

Common Name:
Blackcurrant

Botanical Name:
Ribes nigrum
(mainly)

Related species
Red and Whitecurrant
Ribes sativum

Gooseberry
Ribes grossularia
or
Ribes rusticum

Types of plant
Bush up to 1.5 m in height and width.

Sexuality
Hermaphrodite

Pollination
Self fertile, but cross pollination in poor weather improves set. Bees recommended.

Flower buds
Mixed buds produced laterally on last season's shoots with some fruit spurs on older wood. Each bud produces one bunch of fruit.

Climate, Geography, Soils, Water

Temperature needs
Temperate climate.
Short days and chilling required for flower bud initiation.

Frost tolerance
-20°C dormant
-2.3°C grape bud stage
-0.5- -1°C flower and young fruit

Drought tolerance
Water essential for cutting establishment in situ. Growth and next season's fruiting seriously affected by drought.

Water tolerance
Will tolerate heavier soils but affected by poor drainage.

Humidity tolerance
Disease problems particularly during ripening in high humidity.

Wind tolerance
Growth and cropping affected by wind. More tolerant than *Rubus* sp.

Cultural

Propagation
Normally hardwood cuttings. Modern method is to plant in situ late winter with cuttings 25-30 cm.

Rootstocks
Not required.

Spacing
2.5 m between rows
20-25 cm between plants.

Training & pruning
Short term cropping method becoming common, (5-6 yrs). Little or no pruning necessary until renewal. Some prefer selective removal of old wood to promote new growth.

Tillage
If cultivated, only to 5-10 cm depth.
Grass/clover sward between rows becoming more popular where irrigation is adequate. Use chemicals along rows in 0.5-1 m band.

Marketing & Statistics

1978 World Production (tonne)
Total: 427 181
Poland: 132,100
Germany (Fed): 125,357
USSR: 50,000
Austria: 23,577

Local Production 1978
Total: 685 tonnes
Processed: 619 tonnes
Fresh 66 tonnes

Varieties

Magnus
Costwold Cross
Daniels
Goliath
New var. and selections showing promise include:

Topsy
Kimberley
Millest
Pinelands

Older var. worth considering:
Baldwin
Wellington XXX

1979 N.Z. area
650 ha (mainly Magnus) Canty and S. Canty - 300 ha
S'land 200 ha
Otago 140 ha

Botanical, Anatomical, Physiological	Climate, Geography, Soils, Water	Cultural	Marketing & Statistics	Varieties
Growth of fruit Double sigmoid growth curve. **Time of bud burst** 2-3 weeks before apples early September. **Time of flowering** 3rd-4th week of September **Time of maturity** 3rd week December until 4th week January.	**Edaphic features** Undulating ground can cause mechanical harvesting difficulties. Slight slope can aid air drainage (frost). **Soils** Tolerant of a wide range of soils provided adequate irrigation and drainage. Deep, fertile soil preferable pH 6.0-6.5 (not below 5.5). **Nutrients** 500-600 kg/ha of mixed N.P.K. fertilizer is normal with high N to promote growth.	**Time to full production** 3rd or 4th season. **Method of harvest** Mechanical harvesting apart from small areas close to cities. **Pathogens** Aphids - spring Root Weevil Bud eelworm Currant clearwing *Botrytis sp.* *Sphaerotheca sp.* Silver leaf **Storage** Fresh sales insignificant. Normally frozen. **Yields:** (tonnes/ha) yr 1 = - yr 2 = 2 yr 3 = 4 yr 4 = 7.5 yr 5 = 7.5		

Botanical, Anatomical, Physiological

BLUEBERRY

Common Name:
Highbush Blueberry

Botanical Name:
Vaccinium corymbosum

Botanical name of related useful spp.
Vaccinium augustfolium
Vaccinium ashei
Vaccinium myritillus
Bilberry
Vaccinium vitis idaea
Cowberry
Vaccinium macrocarpa
Cranberry
Complex polyploidy is common. Cultivated highbush blueberries are mainly Tetraploid.

Type of plant and size
Woody perennial.
Very variable in size.
Hybridises freely with low bush blueberry.
Normally 1-4 m in height and 2 m wide.

Sexuality
Hermaphrodite.

Pollination
Although self fertile, crop yields have been increased by encouraging cross pollination.

Climate, Geography Soils, Water

Temperature Needs:
Require winter chilling 600-700 hrs below 7°C. Hardy but avoid winter temperatures below -20°C. Length of growing period required similar to grapes.

Frost tolerance
Late spring frosts reduce yield.

Drought tolerance:
Common name is swamp berry. Will not tolerate drought conditons.

Water tolerance
Do not plant in wet poorly aerated soil. The fine fibrous roots prefer moist soil, high in peat or other organic matter.

Humidity tolerance
Full sunlight preferred. Fungus diseases may be troublesome in humid conditions.

Wind tolerance
Shelter preferred but not critical.

Edaphic factors
Light blue bloom on the berries may be lost in poorly sheltered areas.

Cultural

Propagation
From cuttings taken in the winter. Can be produced under controlled mist, propagation from softwood cuttings. One year rooted cuttings will be less expensive but 2 year old planting material is preferred.

Rootstocks
Not used.

Training and pruning
Flowers are borne at the terminal of current season's growth. Remove spindly growth and prune to balance growth and cropping. Remove old wood whenever possible.

Tillage
Shallow clean cultivation normal to provide adequate aeration. Sod culture with chemical weed control along the rows can be used where soil moisture is adequate.

Time to first harvest
Some fruit on 3 year old plants but establishment of a strong bush is the first requirement.

Marketing and Statistics

North America produces most of the world's blueberries (about 8000 ha).

Total North America production is about 30 000t.

German prodn. is stable about 250 ha. The Netherlands 80 ha. There has been a marked change from 75% utilisation of the crop in fresh form in the early 1970's to 60% processed now, mainly frozen.

Firm berries can travel well. Suitable for freezing and canning. Wide range of other uses in jelly, jam, jucie and yoghurt. Blueberry pie is a very popular dessert in the U.S.A. or used in pancakes and tarts.

Varieties

Selection of cultivars still being researched in N.Z.

Those under test include

Atlantic
Burlington
Dixi
Jersey
Stanley
Berkeley
Blueray
Darrow

Cultivars recommended in the USA include

Earliblue
Bluetta
Collins
Blueray
Bluecrop
Berkeley
Herbert
Darrow
Coville
Lateblue

Botanical, Anatomical, Physiological

Flower buds
Produce fruit on the previous season's growth. Flower initials formed during the summer preceding the fruiting season.

Growth of fruit
Double sigmoid growth curve.
Berry increases in volume very rapidly in 3rd growth stage. (65% of time from flowering to maturity is for the 1st third of the berry volume).
A berry may increase 25% in volume after it has turned blue. Fruit size is related to number of seeds (effective pollination is important).

Time of flowering
Wide variation between varieties from end August (Atlantic) to early October (Dixi).

Time of maturity
Mid December to late January.

Climate, Geography Soils, Water

Edaphic factors cont'd
Avoid areas with poor air drainage to minimise frost risk.

Soils
A pH of 4.2-5.2. Acid soils are essential with peat preferred. Mineral soils within the recommended pH range are suitable provided high soil moisture levels are maintaned.

Nutrients
Respond to nitrogen. Do not apply excessive nitrogen. Generally an evenly balanced NPK mixture is required. Balanced growth and cropping depend on careful soil test evaluation.

Cultural

Time to full production
6 - 7 years.

Method of harvest
Dessert fruit with a desirable "bloom" is still picked by hand but machine harvesting is common for mainly processing fruit (75%). Selective harvesting important for dessert fruit. Berries continue to enlarge for 3-6 days after turning blue. Hand held vibrating units often used.

Pathogens
Not a serious problem. Botrytis and leaf roller may need control measures. Birds are the most serious problem and netting may be required.

Storage
Can be held in punnets for 7-10 days at temps. of 1 to 2°C.

Yields: tonnes/ha
Yr 1 = -
Yr 2 = -
Yr 3 = .25
Yr 4 = 1.5
Yr 5 = 3.0
Yr 6 = 7.0

Marketing and Statistics

Local production
1979
total production 7 t
area: 6 ha

Varieties

Botanical, Anatomical, Physiological

BRAMBLES

Common Names:

Boysenberry	Olallie
Loganberry	Dewberry
Marionberry	Blackberry
Youngberry	
Auroraberry	

Botanical Name
Rubus sp.

The sub genus *Eubatus* is a very heterogeneous series of species and species hybrids, with polyploidy ranging from diploids to dodecaploids.
Chromosome numbers are in multiples of 7. (diploid 14). Boysen. and Young berries have 49 chromosomes.

Type of plant
Biennial canes, primocanes in the first year florocanes in the second year. Vigour varies between hybrids but may produce canes up to 4m. May be erect or semi erect (some blackberries) or trailing (Boysen. Young berries etc.)
Usually thorny canes but thornless hybrids have been bred and are in cultivation (e.g. Smoothstem

Climate, Geography, Soils, Water.

Temperature needs
Require winter chilling. Normally grow best in a temperate climate although some will crop well in sub tropical regions (e.g. Boysen.).

Frost tolerance
Will stand -20°C when dormant. Later flowering than raspberries and not usually damaged by frost at the flowering stage.

Drought tolerance
Will not tolerate drought or excessive periods of low humidity. Prefer soils kept near field capacity with good water holding capacity.

Wind tolerance
Very susceptible to wind and cannot be grown successfully without adequate shelter.

Humidity tolerance
Berries very susceptible to *Botrytis* sp. at maturity. Downy mildew (dry berry) will almost eliminate the crop if not controlled in high R.H. conditions.

Cultural

Propagation
Normally by tip layering
Root suckers and root cuttings can be used for rapid increase. Also stem cuttings. Care is necessary with thornless types, when thornlessness is due to a chimera the central tissue has thorny characteristics and shoots from roots will have thorns (use tip layering).
Where thornlessness is genetic (recessive gene) root cuttings and shoots can be used.

Training and pruning
Trained on 2m high post & wire fences in a variety of ways. Espalier or fan methods. Also 'rope' methods. Remove fruiting canes at ground level after harvest. Remove unwanted and weak primo canes before training on the fence.

Tillage
As for raspberries.

Time to 1st harvest
2nd season

Time to full prodn.
3rd or 4th season.

Marketing and Statistics

World Production
Not available

Main uses
Jam, canning, freezing, yoghurt, ice cream, fresh.

1978 N.Z. crop

Block frozen	730 t
I.Q.F.	400 t
Canned	120 t

Local Production 1978
Prodn. Boysens. =
Total: 1787 tonnes
Proc. 1333 tonnes
Fresh 454 tonnes

Prodn. Loganberries
Total: 50 tonnes
Fresh = 25 tonnes
Processing = 25 tonnes

Varieties

Apart from hybrid names quoted in column 1, there are mainly seedling selections. Cherokee and Comanche under test in comparison with Boysen. Also Black Satin and Dirksen Thornless in comparison with Thornfree.

Production has been increasing steadily 1978 figs. show a Boysen. crop of 1800 t Nelson 970 t, Hawkes Bay 360 t and other Brambles totalling 225 t Estimated production 1980 = 3000 t.

Botanical, Anatomical, Physiological	Climate, Geography Soils, Water	Cultural	Marketing and Statistics	Varieties
and Thornfree blackberries, thornless boysen. and young berries). **Sexuality, Flower buds, Pollination, Growth of Fruit** similar to raspberries. In raspberries the 'core' of the fruit remains on the bush when the berry is picked but with brambles the core is picked with the fruit and is edible. **Time of bud burst, flowering and maturity** varies with the hybrid. Normally flower about the same time as apples or 2-3 weeks later. Flowering period may be extended according to the position of the flower in the truss and on the cane. Youngberry is 7 to 10 days earlier than Boysen. & Boysen. is 3-4 days earlier than Marion. Harvesting range mid or late Dec. to early Feb. Blackberries are normally later maturing Feb. - March.	**Edaphic factors** Not important unless machinery useage affected. Slopes exposed to drying winds should be avoided. **Soils** Ideal soil is a deep silt loam with a high water holding capacity. Will stand heavier soils than raspberries but impervious subsoils should be avoided. Slightly acid soil preferable, pH 5.8-6.3. **Nutrients** Similar to raspberries.	**Method of harvest** Dessert fruit hand harvested. Mechanical harvesting increasing for processing fruit. **Pathogens** Dryberry, *Botrytis,* cane spot, cane blight. Raspberry bud moth, leaf roller, 2-spotted mite. **Storage** As for raspberries. **Growth regulators** 4 C.P.A. commonly applied at fruit set to increase berry size. **Yields** (Boysenberries) (tonnes/ha) Yr 1 = - Yr 2 = 2 Yr 3 = 6 Yr 4 = 10 Yr 5 = 10		

Botanical, Anatomical, Physiological

GOOSBERY

Common Name:
Gooseberry

Botanical Name:
Ribes grossularia
and
Ribes rusticum

Related species
Black Currants
Ribes nigrum
Red & Whitecurrants
Ribes sativum

Type of plant
Woody shrub to 1 m. Branches upright and reclining with spikes.

Sexuality
Hermaphrodite

Pollination
Self fertile but setting improved with cross pollination.

Flower buds
Mixed buds produced laterally on last season's wood and on spurs on older wood.

Time of bud burst
Late August (1 month earlier than apples)

Climate, Geography, Soils, Water.

Temperature Needs:
Temperate, similar to Blackcurrants.

Frost tolerance
Early flowering causes susceptibility to late spring frosts.

Drought tolerance
Early fruit maturity avoids main period of summer drought. Flower bud development and growth affected by prolonged dry periods. May suffer premature defoliation with some sun scorch on fruits.

Water tolerance
More tolerant of water than raspberries. Similar to Blackcurrants.

Humidity tolerance
Not severely affected by high humidity. Subject to fruit cracking with excessive rainfall at maturity.

Wind tolerance
Hardy apart from young growth subject to breakage and damage to fruit from wind rub against thorns.

Cultural

Types of Propagation:
Hardwood cuttings. Root formation may be slower than with Blackcurrants particularly if long cuttings are used for semi standard production. Best rooting with only 2-3 buds left above ground level.

Rootstocks
Not required.

Training and Pruning
Prune to eliminate old and weak wood and to encourage new growth. Prune to top buds in weeping varieties to avoid contact of fruiting wood with the ground.

Tillage
Surface rooting. Avoid deep cultivation. Grass/clover sward common where adequate irrigation available.

Time to 1st harvest
2nd year from cuttings.

Time to full production
3rd-4th year.

Marketing & Statistics

World Production
Not available.

Local Marketing 1978
total production 36 tonnes.
31 tonnes = fresh
5 tonnes = process
Area: 11 ha.

Yields
yr 1 = tonnes/ha
yr 1 = -
yr 2 = 2.5
yr 3 = 5
yr 4 = 7
yr 5 = 7

Varieties

Farmers' Glory
Levin Early

Other varieties
Green
Overall
Gregories
Perfection
Yorkshire
Champion
Roaring Lion

Local selections such as Hinds Choice under test.

Botanical, Anatomical, Physiological	Climate, Geography Soils, Water	Cultural	Marketing and Statistics	Varieties
Time of flowering 4-6 weeks after bud burst. **Time of maturity** 8 weeks after flowering.	**Edaphic factors** No specific requirements. **Soils** Tolerant of a wide range of soil types. **Nutrients** Similar to Blackcurrants.	**Method of harvest** Still predominantly hand picked. With upright, hedgerow training, mechanical shakers can be used but thorns may puncture the fruit during shaking. Usually harvested in 'green' condition and not allowed to produce a deep red skin colouration. **Pathogens** *Botrytis sp.* and Anthracnose leaf spot. Mites and scales sometimes troublesome. **Storage** Usually harvested in green condition for culinary use. Can be frozen but may crack with rapid reduction in temperature. Longer storage life in temps. of 1-2°C than other berryfruit. **Yields (tonnes/ha)** Yr 1 = - Yr 2 = 2.5 Yr 3 = 5 Yr 4 = 7 Yr 5 = 7		

Botanical, Anatomical, Physiological

RASPBERRY:

Common Name:
Raspberry

Botanical Name
Rubus idaeus

Botanical name of related useful spp.

More than 400 sp. of *Rubus* have been described, some alpine and arctic but mainly found in temperate regions.

Rubus idaeus is the European raspberry but many cultivated types have been developed from *Rubus occidentalis* (black raspberry) and *Rubus strigosus* (North American raspberry) *Rubus neglectus* (purple raspberry).

Sub genus *Eubatus* contains a very heterogeneous collection of species and hybrids including the Blackberry, Marion, Boysen., Young and Logan and also the trailing type of blackberry, the dewberry.

Type of plant & size
Biennial canes
1st year canes = primocanes.

Climate, Geography, Soils, Water

Temperature Needs:
Temperate, with winter chilling. Does not do well in sub-tropical and tropical climates.

Frost tolerance
Stands low temp. -20°C in winter if growth hardened but subject to frost damage at flowering and small fruit stage. Variation between cultivars.

Drought tolerance
Dry soil prevents development of primocanes and affects sizing of fruit.

Water tolerance
Roots are sensitive to poor soil aeration. Avoid poorly drained areas.

Humidity tolerance
Subject to *Botrytis sp* when fruit ripening. Fungus diseases on the cane are troublesome in high R.H.

Wind Tolerance
Crop reduced by hot dry winds during fruit ripening. Fruiting laterals are subject to breakage. Primocane growth affected by wind.

Cultural

Propagation:
Normally propagated by lifting root suckers. Possible to build stock more rapidly from root cuttings in glasshouse mist conditions.

Rootstocks
Not required.

Training & Pruning
Remove florocanes after fruiting and thin out excess primocanes. Normally trained in a hedgerow maintained to a width of < 0.4m Alternative methods developed for mechanical harvesting. Support necessary (post and wires).

Tillage
Shallow rooting. Avoid cultivation deeper than 10cm. Grass/clover sward common interrow with chemical weed control at base of canes.

Time to 1st harvest
2nd season

Time to full production
3rd or 4th season

Marketing & Statistics

Main uses
Jam
Canning
Quick freezing
Yoghurt
Fresh

>50% of the N.Z. crop is processed.

1978 World Production (tonnes)
Total: 236 382
USSR: 100,000
W. Germany: 22,110
U.K.: 21,700
Poland: 21,600

Local Production 1978
Total: 1357 t
Fresh: 542 t
Proc: 815 t
Area: 150 ha

Varieties

Marcy
Taylor
Lloyd George
Willamette & Fairview are increasing in popularity.

1979 productn. was about 1300t of which 700t were grown in Nelson and 390 t in Canterbury.

Botanical, Anatomical, Physiological

2nd yr canes = florocanes
Height 1 1/2-3 m.
Width depends on extent to which primocanes are allowed to develop from adventitious root buds.

Sexuality
Hermaphrodite

Pollination
Bees aid in complete drupelet set.

Flower buds
Flower formation takes place late summer-early autumn preceding the cropping year. Fruiting shoots or laterals from buds on the primocanes in the spring.

Growth of fruit
Aggregate fruit consisting of a collection of drupelets. Three definite growth stages (double sigmoid).

Time of bud burst
2 weeks earlier than apple.

Time of flowering
3-4 weeks after bud burst.

Time of maturity
8 weeks after flowering.

Climate, Geography Soils, Water

Edaphic factors
Not important unless mechanical harvesting affected.

Soils
Ideal soil is a deep sandy loam, well supplied with humus, with good water-holding capacity but well drained.

Avoid compact impervious subsoils.
Slightly acid soil preferable 5.8-6.3.

Nutrients
Balanced application of N.P.K. mixture according to soil tests.

Cultural

Method of harvest
Hand picking slow and expensive. Mechanical harvesting increasing.

Pathogens
Regular bud moth control essential.
Leaf roller and mites.
Botrytis cinerea attacks ripening berries under humid conditions. Cane spot, cane wilt, silver leaf, virus.

Storage
Fresh berries will store for several days at 0 to 1°C. Commonly frozen in block or IQF form for long storage.

Raspberries for jam can be preserved in SO_2.

Yields (tonnes/ha)
yr 1 = -
yr 2 = 2
yr 3 = 4
yr 4 = 7.5
yr 5 = 7.5

Marketing and Statistics

Varieties

Botanical, Anatomical, Physiological

STRAWBERRY:

Common Name:
Strawberry

Botanical Name:
Fragaria chiloensis ananassa

Botanical name of related useful spp.
Fragaria vesca
(alpine and perpetual strawberries)
F. virginiana
F. moschata

Type of plant & size
Herbaceous perennial
15-20 cm high.
20-40 cm wide.

Produces runners up to about 2m in length in propagation bed.

Sexuality:
Hermaphrodite.

Pollination
Self fertile but bees advisable.

Flower buds
Formed within crown of plant

Growth of fruit
Sigmoid. Size at maturity depends on the primary, secondary or tertiary positions on the flower truss.

Climate, Geography, Soils, Water.

Temperature needs
Grown under a wide range of temperature conditons throughout the world but needs a period of colder conditions to initiate flowers. High temps. >30°C may cause fruit damage. Selection of varieties to suit temperatures is important.

Frost tolerance
Will stand -15 to -20°C while dormant. Flowers and young fruit damaged by -1 to -3°C. Often grown under plastic tunnels to counteract low spring temperatures.

Drought tolerance
Need good water holding capacity soils to maintain growth and ensure adequate fruit size.

Water tolerance
Intolerant of poor drainage Particularly subject to Red Core *(Phytophthora sp)* in free water conditions.

Humidity tolerance
Highly susceptible at ripening stage to *Botrytis* sp. under humid conditions.

Cultural

Propagation
Separation of adventitiously rooted runners from parent plant. Meristem propagation is receiving increased attention.

Rootstocks
Not required.

Training & pruning
Necessary to restrict runner growth in fruiting areas by hand or weedicides such as Diquat. Removal of old leaves and plant residue during winter if plants are to be retained for a further season.

Tillage
Normally grown on ridges (10-15 cm high) at 0.8-1.0 m centres. Ridges covered with black plastic laid by machine. Straw mulch used between rows. Must be free of perennial weeds.

Spacing
Single or double rows. Depending on the intended life of the crop. Grown as an annual in warmer climates up to 130 000 plants/ha in double rows.

Marketing & Statistics

Marketing
Major trend is in the frozen product either in block form or individually quick frozen (IQF)

Used in jam, cans yoghurt.
Fresh fruit air freighted in punnets after pre-chilling.

Local productn:
Total: 4440 t.
Fresh: 3292 t.
Proc: 1148 t.
Area: 213 ha.

World Production:
1978 (tonnes)
Total: 1564423
USA: 293,926
Italy: 203,790
Poland: 189,800
Japan: 184,300

Varieties

Tioga has increased in popularity from 6 to 41% in 5 yrs while Red Gauntlet areas have decreased from 71 to 44%. Red Gauntlet is grown mainly in colder districts where it produces more autumn crop fruits.

Total strawberry area 1978 213 ha.
Christopher York new promising variety under test.

1978 crop
4440 t of which 2650 t were produced in Auckland.

Botanical, Anatomical, Physiological

Time of flowering
In northern areas flowering may be in August especially under polythene tunnels. In southern areas flowering may be end of Sept. or later (2-3 weeks earlier than apple).
First sign of growth about 2-3 weeks prior to flowering.

Time of maturity
6 weeks after flowering depends on district.

Climate, Geography Soils, Water

Wind tolerance
Shelter essential. Fruit distortion may result from strong winds during flowering. Marked reduction in plant growth and yield in poorly sheltered areas.

Edaphic factors
Gradual slope facing the equator useful for early production.

Soils
Avoid heavy, poorly drained soils, and light stony soils. Friable silt loam with good water holding capacity is preferable.

Nutrients
Responds to high level of balanced fertilizer. 1 1/2-2 1/2 t/ha of an NPK fertilizer is common at planting time.

Cultural

Spacing Cont'd.
Grown for 2 or more years in colder climates in single rows 65,000 plants/ha.

Time to 1st harvest
Depending on climate 3-6 months after planting.

Time to full production
In cooler climates higher production occurs in the 2nd year.

Method of harvest
By hand with calyx for desert, without calyx for processing. Some areas in the USA are machine harvested for jam.

Pathogens
Virus free plants essential. Aphids, mites, root weevils, slugs, birds, *Botrytis,* root rots and wilts.

Storage
High respiration rate fruit. Rapid deterioration if field heat is not removed quickly. Fruit free from botrytis will hold 7-10 days at 1-2°C.

Yields = tonnes/ha

yr 1 = 5	yr 4 = 15
yr 2 = 25	yr 5 =replant
yr 3 = 20	

Marketing and Statistics

Varieties

14.2.2 Citrus

Botanical, Anatomical, Physiological Aspects

NEW ZEALAND GRAPEFRUIT

Common Name:
Goldfruit, N.Z. Grapefruit, Poormans Orange.

Botanical Name:
C. sinensis x C. grandis

Botanical Name of Related and Useful species:
See sweet orange.
Note:- Poormans Orange is a hybrid probably purmmeol (*C. grandis*) with sweet orange or mandarin. Wheeny grapefruit also related.

Type of Plant and Size:
Small tree, evergreen up to 10 m, maintained in orchard 3-7 m height.

Sexuality:
Usually hermaphrodite.

Pollination:
Usually insect agency. Cross and self pollination possible.

Flower Buds:
See sweet orange.

Climatic, Geographic, Soil and Water Requirements

Temperature Needs:
See sweet orange. Similar to sweet orange and mandarin requirements. Wheeny grapefruit is less hardy than N.Z. grapefruit.

Frost Tolerance:
See sweet orange.

Water Needs:
See sweet orange.

Water Tolerance:
See sweet orange.

Drought Tolerance:
See sweet orange.

Humidity Tolerance:
See sweet orange.

Wind Tolerance:
See sweet orange.

Edaphic Features:
See sweet orange.

Soil Needs:
See sweet orange.

Nutrient Requirements:
See sweet orange.

Cultural Aspects

Propagation:
See sweet orange.

Rootstocks:
Sweet orange
Trifoliate orange
Rought lemon is not recommended.

Spacing:
Variable, depending on rootstock. 3.5-5m square.

Training and Pruning:
See sweet orange.

Tillage:
See sweet orange.

Time to First Harvest:
3-4 seasons after planting.

Time to Full Production:
8-12 seasons after planting.

Method of Harvest:
See sweet orange.

Storage:
See sweet orange.

Main Pathogens
See sweet orange.

Marketing and Statistics

World Production:
no figures available

Local Production:
(1978)
Total production:
6,554 tonnes
Processing: 2,985t
Fresh: 3,569t
Area 535 ha
Main areas: Bay of Plenty.

Main Products and Their Uses:
Fresh fruit and marmalade (may use immature fruit.)

Cultivars

Main Cultivars Grown in New Zealand
Selected high yielding strains are used but these not named as cultivars.

Botanical, Anatomical, Physiological answers	Climatic, Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
Growth of Fruit. Sigmoid growth curve. **Time of Bud Burst:** (relative to apple) See sweet orange. **Time of Flowering:** See sweet orange **Time of Maturity:** Fresh fruit matures Aug - Dec.				
LEMON **Common Name:** Lemon **Botanical Name:** *Citrus limon* (L) Burn. f (2n = 18) **Botanical Name of Related and Useful species:** See sweet orange. **Type of Plant and Size:** Small tree, evergreen, up to 10 m, usually 3-7 m height. Spiny branches, vigorous early growth, relative to other citrus species.	**Temperature Needs:** See sweet orange. Lemons are more tolerant of cool summer temperatures then sweet orange. **Frost Tolerance:** See sweet orange. Lemons are more frost sensitive than sweet orange. **Water Needs:** A well distributed rainfall of 800-950 mm (approx). **Water Tolerance:** Poor - sensitive to water-logging. Fruit quality becomes coarse and juice	**Propagation:** Selected scions are budded/grafted onto nucellar stocks. **Rootstocks:** Trifoliate orange is not acceptable. Sweet and sour orange are suitable, also rough lemon (citronelle). **Spacing:** Variable, trees may become large 3-7.5 m squares. **Training and Pruning:** See sweet orange. Tree tends to make long shoots that with fruit	**World Production:** (Statistics include limes) (000 tonnes.) 1978 Total Production = 1546. Greece = 652 Vietnam = 330 Yugoslavia = 239 (tonnes) 1978 **Local Production:** Total = 2903 processing = 1601 fresh = 1302 Total area = 114 ha **Main Products and Their Uses:** Lemonade, squash,	**Main Cultivars Grown in N.Z.** Lisbon, Eureka Villa Franca Genoa Meyer lemon is a hybrid, probably *C. limon x C. sinensis*

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
Sexuality: Usually insect agency, cross and self pollination possible. Parthenocarpic fruit may develop if fertilisation does not occur. **Flower Buds:** See sweet orange. **Growth of Fruit:** Sigmoid growth curve. **Time of Bud Burst (relative to apple):** No bud burst as such. Several growth flush per year. Flush period longer and timing less synchronised relative to other citrus fruits. **Time of Flowering:** May continue over most of the year, main season Sept - Nov. **Time of Maturity:** May be harvested through year as fruit matures. Main crop season June-Sept.	quality reduced with high water levels. **Drought Tolerance:** Varies with rootstock but generally fair, with fruit and leaf fall increased, small fruit produced. **Humidity Tolerance:** Fair - unsuited to high humidity tropics. Disease incidence increases, fruit quality reduces. **Wind Tolerance:** Fair, wood may be brittle and damage likely in high winds. Shelter is desirable. **Edaphic Features:** Slopes and gullies for air drainage may be utilised. Use equator facing aspect in cool districts. Sheltered location from cool and prevailing winds. **Soil Needs:** Rootstock choice will affect soil range. A reasonably drained aerated soil, 1 m in depth is preferred. **Nutrient Requirements:** See sweet orange.	weight hang and tangle. However it is probable that costs of pruning to keep a clear frame work would be too costly. Hedging and topping to keep trees to required size is practised. **Tillage:** See sweet orange. Clean soil surface may be of assistance in reducing frost hazard. **Time to First Harvest:** Small yields in 3-4 seasons. **Time to Full Production:** Varies with climate and rootstock. Full yield 8 - 12 seasons after planting. **Method of Harvest:** handpick. Base harvest readiness on size and full colour. May test for acid content, but fruit on same tree may have very variable levels. Handle with gloves. Clipping (see sweet orange.) **Storage:** See sweet orange. **Main Pathogens:** See sweet orange. Lemons very susceptible to citrus diseases.	culinary and confectionary preparations. Also may produce essential oils, citric acid and pectins.	

Botanical, Anatomical Physiological Aspects.

MANDARIN AND HYBRIDS

Common Name:
Mandarin, also Tangerine, Naartijie, Satsuma.

Botanical Name:
Name principal spp.
Citrus reticulata Blanco
(2n = 18)
syn. **C. mobilis** Andrews

Botanical Name of Related and Useful species.
See sweet orange, also a number of hybrids.
C. reticulata x C. sinensis
Tangelo
C. reticulata x C. paradisi
Tangors

Type of Plant and Size:
Small tree, evergreen up to 10m. Usually 2-8m height. Sometimes has spiny branches. Some variability in habit and appearance.

Sexuality:
Usually hermaphrodite.

Pollination:
A range of situations may be found, self pollina-

Climatic, Geographic, Soil and Water Requirements

Temperature Needs:
See sweet orange. Probably intermediate between lemon and sweet orange in response to cool summer temperatures. Fruit quality and sweetness is improved by warm summers.

Frost Tolerance:
More frost resistant than lemon and sweet orange but is frost tender (see sweet orange.

Water Needs:
See sweet orange.

Drought Tolerance:
See sweet orange.

Humidity Tolerance:
See sweet orange.

Wind Tolerance:
See sweet orange.

Edaphic Features:
See sweet orange.

Soil Needs:
See sweet orange.

Nutrient Requirements:
See sweet orange.

Cultural Aspects

Propagation:
See sweet orange.

Rootstocks:
See sweet orange.

Spacing:
Variable depending on cultivar, rootstock and climate. 3-5 m squares.

Training and Pruning:
See sweet orange.

Tillage:
See sweet orange.

Time to First Harvest:
Small yield in 3-4 seasons.

Time to Full Production:
Yields near maximum at 8-12 years.

Method of Harvest:
See sweet orange.

Storage:
See sweet orange.
Usually expect poorer keeping ability than sweet orange.

Main Pathogens:
See sweet orange.

Marketing and Statistics

World Production:
(1978)
Statistics include clementine and satsuma.
(000 tonnes)
Total = 1419
Yugoslavia = 852
Portugal = 305
Turkey = 135 F

Local Production:
(tonnes)
Mandarins 1978
Total = 21201 all fresh
Area = 278 ha
tangelo = 4688
processing = 900
Area = 489 ha

Main Products and their Uses:
Fresh fruit
and canned fruit segments.

Cultivars

Main Cultivars Grown in New Zealand
Satsuma group (Unshiu) generally considered very cold resistant and hardy. Cultivars, Wase, Siverhill.
Mandarin types
skin yellow/pale orange, include thorny, Kara.
Tangerine types skin deep orange/red, Clementine, Burgess Scarlet.
Tangelo group
(see related species)
main introductions
Tiniura, Seminole.

Other Important World Cultivars.
Dancy (Tangerine group) important in U.S.A .
Emperor (Mandarin group) large fruited cultivar grown in Australia also used as rootstock.
Cleopatra (Mandarin group) used as rootstock.
Ugli (Tangelo group) used in W. Indies. Orlando, Mineola and Seminole (Tangelo group) widely planted in Florida.

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
tion is usually the main mechanism. Cross pollination may occur. Seedless fruit may be produced after weak and aborted ovule growth, after fertilisation failure from incompatible pollen. **Flower Buds:** See sweet orange. **Growth of Fruit:** Sigmoid growth curves. **Time of Bud Burst:** **(relative to apple)** No bud burst as such, several growth flushes per year. **Time of Flowering:** May occur at more than one time per year with each growth flush. Main period Oct-Nov. **Time of Maturity:** June-Nov depending on cultivar, rootstock and locality.				

Botanical, Anatomical, Physiological Aspects.

ORANGE

Common Name:
Sweet Orange.

Botanical Name:
Citrus sinensis (L) Osbeck (2n = 18)

Botanical Name of Related and Useful species.
Citrus aurantifolia lime
Citrus aurantium sour orange.
Citrus limon lemon.
Citrus paradisi grapefruit.
Citrus reticulata manadarin
Poncirus trifoliata, trifoliate orange.

Type of Plant and Size:
Small tree, evergreen, up to 10m, maintained in orchard between 3-7 m.

Sexuality:
Usually hermaphrodite.

Pollination:
Usually insect agency. Cross and self pollination possible. Some cultivars do not produce viable pollen e.g. Parthenocarpic seedless fruits may develop.

Climatic, Geographic, Soil and Water Requirements.

Temperature Needs:
Growth may occur between 13-40°C. Summer months should have average temperature in excess of 15.5°C.

Frost Tolerance:
In an inactive growth condition may tolerate - 5°C (some hardening in winter months) in active growth condition 0°C causes severe damage.

Water Needs:
A well distributed rainfall of approx 857 mm.

Water Tolerance:
Poor - see also Humidity Tolerance - sensitive to waterlogging.

Drought Tolerance:
Varies with rootstock but generally fair.

Humidity Tolerance:
Fair - unsuited to high humidity tropics, as quality low and disease incidence high.

Wind Tolerance:
Fair, shelter belts usually required.

Cultural Aspects

Propagation:
Budding and grafting of selected scions onto seedling stocks is usual. Seedling stocks may be true to type if nucellar embryo is used.

Rootstocks:
Sour orange, rough lemon trifoliate orange, troyer citrange, Celopatra mandarin. Choice depends on local conditions and availability.

Spacing:
Variable, approx 3-5 m square.

Training and Pruning:
Shape to form framework head. Light or no pruining of bearing trees. Remove dead wood and water shoots. At picking, may cut fruited growth back to new lateral. Pruning and hedging used to cut back and regulate tree size.

Tillage:
Normally clean, bare surface (herbicide or cultivate) If soil moisture adequate, cover crop and green manure used, tree base should be kept clean.

Marketing and Statistics.

World Production (t)
Total = 32,000,000
32,000,000 (1978)
USA = 961,200
Brazil = 7,058,000
Spain = 1,662,000
Italy = 1,650,000

Local Production (1978)
Total = 5,902 (tonnes)
Processing = 940
Area = 519 Ha.

Main Products and Their Uses:
Fresh fruit, juice, confectionary, flavouring, marmalade, some essential oils.

Cultivars

Washington Navel (Aug-Oct)
Carters Navel (Aug-Oct)
Bests Seedless (Aug-Oct)
Ruby Blood (Sept-Nov)
Valencia
Various strains (Sept-mid-Dec)
H (harvest period indicated)

New or Promising Cultivars in New Zealand:
Hamlin, Jaffa, Shamauti.

Other Important World Cultivars:
Hamlin, Jaffa, Shamauti, Joppa.

Botanical, Anatomical, Physiological Aspects

Flower Buds:
Bud initiation occurs in mid summer, floral initiation a short period prior to the growth flush that produces flowers.

Growth of Fruit:
Sigmoid growth curve.

Time of Bud Burst:
(relative to apple)
no bud burst as such, may be several growth flushes per year.

Time of Flowering:
May continue over a prolonged period, main flowering flush Oct/November.

Time of Maturity:
August - Nov, depending on cultivar.

Climatic Geographic, Soil and Water Requirements

Edaphic Features:
Slopes and gullies for air drainage utilised. Equator facing aspect used in cool districts. Sheltered location from prevailing winds desirable. Otherwise flats preferred.

Soil Needs:
Preference for light, well drained soils. Choice of rootstock may extend soil range. pH range 5-8.

Nutrient Requirements:
Leaf analysis increasingly used to determine mineral needs. Nitrogen requirement is high. Application split into ⅔ and ⅓ in Aug and Feb respectively.
Rate interpreted for tree age, vigour and soil.
General recommendation for each mature tree:
N 0.40 kg
P 0.45 kg
K 0.25 kg

Cultural Aspects

Time to First Harvest:
Small yields in third season.

Time to Full Production:
Varies with climate and rootstock, 8-12 seasons after plant in N.Z.

Method of Harvest:
Hand pick after sampling for sugar content.
Handle with care (gloves).
Clip fruit from tree and then close to stem button.

Storage:
Ventilated cool temperature conditions may be used to keep fruit 3-10 weeks. Ethylene may be used to degreen fruit.

Main Pathogens:
Large pest and disease range.

e.g. Black aphid	scale insects (various)
mites	Brown rot
thrips	Collar rot

Bacterial and viral diseases also occur e.g. Tristeza. Specific problems may occur in particular regions e.g. Fruit fly-Australia, S. Africa, Citrus borer - N.Z.

Marketing and Statistics

Cultivars

14.2.3 Pip and Stone Fruit

Botanical, Anatomical, Physiological Aspects

APPLES

Common Name:
Apple

Botanical Name:
Malus domestica

Type of Plant and Size:
Tree between 1.5 and 7 metres in size - depending on rootstock. Under natural conditions varies from cylindrical to pyramid in shape. Basal diameter 1-4.5 m.

Sexuality:
Hermaphrodite

Pollination:
Normally self fertile or partly so. Cross pollination normally improves set. Some, especially triploids, are incompatible. Consult Ministry of Agriculture for compatibility charts. Pollen trees should be no more than 2 rows from cultivar to be pollinated. Insect pollination.

Flower Buds:
Formed on tips of

Climatic, Geographic, Soil and Water Requirements

Temperature Needs:
Needs cool winter.
Those in districts where winters are mild, experience extended flowering. No winter damage occurs in N.Z. Some cultivars like Granny Smith do better in warmer North Island areas, others like Delicious and Cox's orange may have better shape and flavour in the South.

Frost Tolerance:
Fruit will be damaged or lost by temperatures below - 2°C after open cluster.

Water Needs:
Lack of water reduces crop but fruit may store better. Excessive watering or rain may produce fruit with poor keeping ability. Maintain adequate water with irrigation in dry districts.

Water Tolerance:
Moderate.

Cultural Aspects

Propagation:
Budded on a range of rootstocks which are propagated by mound layers. Some limited success has been achieved in propagating rootstocks using cuttings.

Rootstocks:
In N.Z. the following are recommended:
Dwarf - M9
Semi-dwarf - MM106
Standard - Northern Spy
- M793
Large - MM115
A N.Z. selected "Aotea Range" is under evaluation.

Spacing:
Mostly 4.5-5.0 m between rows 2.8-4.3 m between plants, depending on scion vigour, for semi-intensive orchards.

Training and Pruning
The semi-intensive, centre-leader system at the above spacings is the most common. Many older orchards were

Marketing and Statistics

World Production:
(1978)
(1000 tonnes)
Total = 31,280
USSR = 7,000
USA = 3,417
France = 3,022

Local Production:
(tonnes)
Total = 185,144
Processing = 34,771
Local Market = 8,471
Export (fr) = 66,632
Main districts
Nelson/Hawkes Bay.
Area = 5450 ha

Main Products and Their Uses:
By far the most are sold as fresh fruit, but juices, pie fillings and concentrates are becoming more important. A limited number are used for cider.

Special Marketing Requirements:
The N.Z. Apple and Pear Marketing Board organises all marketing in N.Z. and overseas, except for a limited quantity sold at orchard stalls.

Cultivars

Main Cultivars Grown in N.Z.:
Granny Smith
Red Delicious
Golden Delicious

New or Promising Cultivars in N.Z.:
Gala
Splendour

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
branches (tip bearers), or on spurs formed on two-year or older wood, occasionally, lateral buds of one-year-old shoots are fruitful. Buds are mixed with 5-8 flowers and a similiar numbers of leaves, central flower is larger and earlier and is called the king flower. Growth of shoot or spur continued by bourse shoot in axil of one of lower leaves in the bud. Flowers contain 5 sepals, 5 petals, 5 pistils and about 20 stamens. **Growth of Fruit:** Grows with a single sigmoid growth curve. **Time of Bud Burst (relative to apple):** Early to mid October. **Time of Flowering:** Early to mid October. **Time of Maturity:** Very early cultivars ripen about Christmas, latest ones April, May. Main season cultivars commence February.	**Edaphic Features:** Flat land normally preferred providing drainage is, or can be made, adequate. **Soil Needs:** Tolerate wide range of soil types. Avoid heavy wet clays unless structure and drainage can be improved. **Nutrient Requirements:** The best pH range is 5.5-6.5 but grow, in some circumstances, from 4.5-8.0. Create good nutrient regime but avoid excessive nitrogen fertilizers, which will reduce storage quality and sometimes reduce flower-bud initiation.	trained as 'vase' or 'open-centre' trees. 'Chunk' and renewal pruning now more common than detailed attention to individual spurs or laterals. **Tillage:** Mostly sprayed under the trees in the rows with paraquat/simazine and grass mown between trees. **Time to First Harvest:** Semi-intensive: 2-3 years. **Time to Full Production:** Semi-intensive: 6-8 years. **Expected Yields:** semi-intensive:- 4 years - 10 t/ha 6 years - 30 t/ha 8 years - 50-70 t/ha **Normal Productive Life:** 40 Years. The most productive years are 10-25. **Method of Harvest:** Hand harvest into bulk bins. Mechanical methods have yet to be proved economic.		

Botanical, Anatomical, Physiological Aspects	Climatic, Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
		Storage: Keeps well in cool and in controlled atmosphere storage, but big variation between cultivars. **Main Pathogens:** Blade spot Leaf roller Powdery mildew Codling moth Mites		
APRICOTS **Common Name:** Apricot **Botanical Name:** *Prunus armeniaca* **Type of Plant and Size:** Tree 4-6 m high, 3-5 m in diameter at base, round and bushy. **Sexuality:** Hermaphrodite **Pollination:** Self-fertile, insect pollinated. Prefers dry weather at blossom. **Flower Buds:** Produced laterally on one-year-old shoots or, in	**Temperature Needs:** Temperate fruit. Very demanding and prefers Mediterranean or Continental climate. Suited to Central Otago, and to a lesser extent drier parts of the east coast. Warm moist summers result in poor flower initiation. **Frost Tolerance:** A problem due to early flowering. -4°C will damage swelling buds, -2°C flowers and -1°C small fruit. **Water Needs:** Provide adequate moisture during growing season.	**Propagation:** Propagated by budding. **Rootstocks:** Peach seedlings are most commonly used. Apricot seedlings are satisfactory in the orchard but more difficult to produce in the nursery. Myrobalan plum sometimes recommended for heavy soils. **Spacing:** Usually planted on the square at 5-6 m. **Training and Pruning:** Trees adapt well to vase or open-centre training. Areas prone to silver leaf or gummosis prune either	**World Production (1978)** **(000 tones)** Total - 1584 W. Europe - 483 Far East - 320 USSR - 280 **Local Production: (t)** Total - 5026 Processed - 2001 local market (fr) - 3025 Main area - Otago Total area - 552 ha **Main Products and Their Uses:** Sold fresh, canned or used for jams or flavouring. Drying	Moorpark is the main cultivar.

Botanical, Anatomical, Physiological Aspects

colder districts and older trees on spurs on older wood. Two flower buds, each with one flower, normally surround one vegetative bud on laterals. On spurs large numbers of lower buds are grouped together.
Flowers have 5 petals, 4 sepals, a single carpel and numerous stamens - sessile.

Growth and Type of Fruit:
Drupe with double-sigmoid growth curve, stone hardens in second stage of growth and is not attached to the flesh.

Time of Bud Burst (relative to apple):
Early, about second week in September, 3-4 weeks before apples.

Time of Flowering:
First buds to open are flower buds. Leaf buds open several days later.

Time of Maturity:
Most ripen between mid December and mid January.

Climatic Geographic, Soil and Water Requirements

Water Tolerance:
Avoid excessive exposure of roots to 'wet feet'.

Drought Tolerance:
Prefer dry areas especially with low rainfall at blossom and at maturity.

Wind Tolerance:
Moderate.

Edaphic Features:
Since the major growing area is Central Otago frost - free sites are especially valuable.

Soil Needs:
Prefer good deep soils. Avoid heavy wet areas.

Nutrient Requirements:
Fairly demanding for nutrients and nitrogen is considered to be very important for promoting good crops.

Cultural Aspects

after cropping or with minimum cuts in winter.

Tillage:
Normally orchards have grass between the rows and are strip-sprayed under the trees.

Time to First Harvest:
2-3 years

Time to Full Production:
4-6 years.

Expected Yields:
2 years - 5 t/ha
4 years - 10 t/ha
6 years - 18 t/ha

Normal Producture Life:
25-40 years - less in areas with severe disease problems.

Marketing and Statistics

under polythene has produced an excellent article in Central Otago.

Special Marketing Requirements:
No organised marketing systems exists. Sold through the auction system, on contract to processors or exported via specialist firms.

Cultivars

Botanical, Anatomical, Physiological Aspects

CHERRIES

Common Name:
Cherry, sweet cherry.

Botanical Name:
Prunus avium

Botanical Name of Related and Useful species.
sour cherry - *Prunus cerasus*
Wild cherry - *Prunus mahaleb.*

Type of Plant and Size:
Bushy tree 3.5-5.5 m high, 3-5 m diameter. Individual shoots branch less than other stone fruit and tree is naturally more open than others.

Sexuality:
Hermaphrodite.

Pollination:
Mostly self incompatible, and choice of pollinators is important. Poor set can be a problem and contributes to poor yields.

Flower Buds:
Produced laterally and terminally on one-year-

Climatic Geographic, Soil and Water Requirements

Temperature Needs:
Temperate, but fairly tolerant of a wide temperature range. Not successful in warm humid areas.

Frost Tolerance:
Bud swell - 2°C, small fruit - 1°C. Relative lateness of flowering an advantage.

Winter Needs:
Since cropping normally is finished before the major summer drought in dry areas, can be grown with minimum water. However drastic changes in water availability may aid cracking, and uniform water supply is advantageous.

Water Tolerance:
Moderate; rain at blossom is serious for set and disease. Rain at or just before maturity causes splitting.

Drought Tolerance:
Moderate to good.

Cultural Aspects

Propagation:
Budded.

Rootstocks:
Mazzard selection of sweet cherry most common Mahaleb also used. Dwarfing rootstocks are becoming used overseas but are not yet common in N.Z.

Spacing:
Normally planted on the square at 6 m.

Training and Pruning:
Grown as open-centre tress, after formation of the desired framework little pruning is required.

Tillage:
Orchards normally grassed, with weed control by paraquat/simazine under trees.

Time to First Harvest:
4-5 years.

Time to Full Production:
7-10 years.

Expected Yields:
4 years - 2 t/ha
6 years - 5 t/ha
8 years - 10 t/ha

Marketing and Statistics

World Production:
(000 tonnes)
1600 (1975)

Local Production:
(1978) (tonnes)
Total = 498
Processing = 56
Local market = 442
Export = 0
Main areas:
Otago/Marlborough
Area = 110 ha

Main Products and Their Uses:
Currently sold locally as fresh fruit. Considerable interest in export to Japan.
Some interest in sour cherries.

Special Marketing Requirements.
No organised marketing system. Normally sold at farm gate or at auction.

Cultivars

Main Cultivars Grown in New Zealand.
Dawson.

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
old shoots and on spurs. Flower buds are separate from leaf buds and contain three or more flowers. Flowers have 5 sepals, 5 petals, one carpel, and numerous stamens. **Growth of Fruit:** Fruit is a drupe, born on long pedicels. Double-sigmoid growth curve with stone hardening in Stage II. Flesh yellow to dark pink, firmly attached to stone. Fruit can be yellow or red/black. Growth is rapid. **Time of Bud Burst (relative to apple):** Latest of stone fruit. Late Sept to mid Oct depending on cultivar. **Time of Flowering:** Flowers open slightly before leaves. **Time of Maturity:** Earliest of stone fruit, earliest is mid November latest about Christmas or very early January.	**Humidity Tolerance:** Poor - see under water tolerance. **Wind Tolerance:** Moderate. **Edaphic Features:** Flat land preferred. **Soil Needs:** Most particular of all stone fruit. Do best in deep rich loams. **Nutrient Requirements:** Need good nutrition and respond to nitrogen.	**Normal Productive Life:** 25-35 years. Less where blast or silver leaf is a problem.		

Botanical, Anatomical, Physiological Aspects.

PEARS

Common Name:
Pear

Botanical Name:
Pyrus communis

Botanical Name of Related Species:
Pyrus serotina - the Misunasti, Oriental, Asian or Water Pear.

Type of Plant and Size:
Generally larger than apples, 5-8m high and 3-5m in diameter at base. Cylindrical or pyramid in shape under natural conditions.

Sexuality:
Hermaphrodite

Pollination:
Mostly self-incompatible choice of pollinators critical. Pollinated by insects especially bees.

Flower Buds:
Formed on tips of branches (tip bearers), or on spurs formed on two-year or older wood, occasionally, lateral buds of one-year old shoots are fruitful. Buds are mixed, with 5-8 flowers and a

Climatic, Geographic, Soil and Water Requirements.

Temperature Needs:
Needs cool winter, and extended flowering can be a problem in areas with little winter chilling.

Frost Tolerance:
Fruit will be damaged or lost by temperatures below -2°C after open cluster.

Water Needs:
Maintain adequate water levels.

Water Tolerance:
Reputed to tolerate wetter soils than many other tree fruit.

Drought Tolerance:
Moderate

Wind Tolerance:
Moderate

Edaphic Features:
Flat land preferred, don't choose frost pockets or undrained sites.

Soil Needs:
Fairly tolerant of a wide range of soil types. Sometimes planted in the heavier soils in an orchard because of this tolerance.

Nutrient Requirements:
The best pH range is 5.5-

Cultural Aspects

Propagation:
Budded on rootstocks which are either seedlings (often of William's bon Chretien) or Quince rootstocks propagated by cuttings or mound layering.

Rootstocks:
Normally pear seedings are used but these produce very large trees. Quince rootstocks are becoming more widely used - especially BAC 29. These produce a tree equivalent in size to MM106.

Spacing:
Up to recently, planted on the square at 5-6 m. Use of BAC 29 will change planting to 3-4. 5x4.5-5m.

Training and Pruning:
Still grown as opencentre trees or in the Hawkes Bay system. Some being trained as centre-leaders particularly in conjunction with BAC 29. Renewal and 'chunk'. pruning most commonly used.

Tillage:
Normally orchards are grass and sprayed with

Marketing and Statistics.

World Production: (000 t) 1978
7651
Italy 1140
China 1048
USA 660

Local Production: (t) 1978

Total	= 14 236
Processing	= 5 361
Local market	= 8 875
Export(fr)	= 1 532

Main areas = Hawkes Bay and Nelson.
Total area = 446 ha.

Main Products and Their Uses.
Mostly sold as fresh fruit. Moderate amount canned, little for juices or perry.

Special Marketing Requirements:
Mostly taken by Apple and Pear Board except those sold at the gate.

Cultivars

Main Cultivars Grown, in N.Z.
William's bon Chretien
Packham's Triumph
Winter Cole.

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
similar number of leaves, central flower is larger and earlier and is called the king flower. Growth of shoot or spur continued by bourse shoot in axil of one of lower leaves from bud. Flowers contain 5 sepals, 5 petals, 5 pistils and about 20 stamens. **Growth of Fruit:** Grows with single sigmoid growth curve. **Time of Bud Burst (relative to apple):** Early to mid-October **Time of Flowering** Early to mid-October **Time of Maturity:** February to May.	6.5 but grow, in some circumstances, from 4.5-8.0. Create a good nutrient regime but avoid excessive nitrogen fertilizers which will reduce storage quality and sometime reduce flower-bud initiation.	paraquat/simazine under trees. **Time to First Harvest:** Seedling rootstocks - 5-6 years. BAC 29 - 3-4 years. **Time to Full Production:** Seedlng rootstocks - 8-10 years. BAC 29 - 6-8 years. **Expected Yields:** Seedling rootstocks:- 5 years - 8t/ha 7 years - 20t/ha 10 years - 50-60t/ha **Normal Productive Life:** 40-50 years. **Method of Harvest:** Hand harvest into bulk bins. **Storage:** Store well in cool store, or in controlled atmosphere storage, but big variation between cultivars. **Main Pathogens:** Black spot Powdery mildew Fireblight Codling moth Leaf roller Mites Pear slug		

Botanical, Anatomical, Physiological Aspects.

PEACHES AND NECTARINES

Common Name:
Peaches and Nectarines

Botanical Names:
Prunus persica
Prunus persica var. nectarina.

Type of Plant and Size:
Tree 4-6 m high, 3-4 m diameter at base. Round and bushy.

Sexuality:
Hermaphrodite.

Pollination:
Self-fertile, insect pollinated. Prefers dry weather at blossom.

Flower Buds:
Produced laterally on one-year-old shoots. Normally two flower buds surround a leaf bud. Flower has 5 sepals, 5 petals a single carpel and numerous stamens - sessile.

Growth and Type of Fruit:
Drupe, which grows with double - sigmoid growth curve. Peaches have a furry and nectarines a smooth skin. Flesh ranges from

Climatic, Geographic, Soil and Water Requirements.

Temperature Needs:
Temperate fruit, will grow in all parts of N.Z. Some cultivars, e.g. Mayflower, cannot tolerate the mild winters of the sub-tropical north.

Frost Tolerance:
Can be a problem because of the early flowering. -4°C will damage bursting buds, -3°C blossom and -1°C small fruit.

Water Needs:
Need plentiful water supply.

Water Tolerance:
Don't grow in areas where water does not drain away especially during the growing season.

Drought Tolerance:
Moderate.

Humidity Tolerance:
Prefers dry areas otherwise blast and brown rot cause serious problems.

Wind Tolerance:
Moderate.

Edaphic Features:
Flat land normally preferred but mild slopes,

Cultural Aspects

Propagation:
Budding is the normal method. Some success with cuttings has been obtained but not yet in common use.

Rootstock:
Golden Queen seedlings most commonly used. Nemaguard seedlings may become popular. Myrobalan plum sometimes used on heavier soils. No dwarfing stock currently available.

Spacing:
Usually planted on the square at 4-6m. Some interest now in very close planting.

Training and Pruning:
Trees are naturally bushy and adapt well to open-centre systems. Often minimum pruning adopted in years followed by chunk pruning to reduce damage due to silver leaf. Close planting in hedgerows or Tatura trellises being used by some growers.

Marketing and Statistics

World Production:
(1000 tonnes) 1978

World	= 6787
USA	= 1359
Netherlands	= 1150
France	= 465
Spain	= 425

Local Production 1978
Nectarines = 2485 tonnes
Processed = 17 tonnes
Local market = 2468 t

Peaches = 16,634 t
processed = 5,083 t
Local market = 11,551 t

Main areas:-
Hawkes Bay,
Auckland, Otago.
Total Area: 1082 ha
Nectarine Area: 364 ha

Main Products and Their Uses:
In N.Z. peaches and nectarines are canned. The rest are sold on the local fresh market or exported by air.

Cultivars

Main Cultivars Grown in N.Z.
Peaches:
Golden Queen
Nectarines:
Red Gold.

Botanical, Anatomical, Physiological Aspects

white to yellow. Stone hardens in second slow growth phase. There are free-stone and cling-stone peaches the latter being preferred for canning.

Time of Bud Burst:
(relative to apple)
Early, usually about mid September three weeks before apples.

Time of Flowering:
First buds to open are flower buds, leaf buds are several days later.

Time of Maturity:
Earliest ripen in December, latest in March.

Climatic Geographic, Soil and Water Requirements

especially facing North, can be valuable in cool districts to reduce frost risk and get the early market.

Soil Needs:
Prefer light, well-drained soils, providing adequate water can be maintained. Avoid heavy clay, and poorly drained soils.

Nutrient Requirements:
Good nutrition is required: peaches and nectarines are reputed to need plentiful nitrogen.

Cultural Aspects

Tillage:
Normally grass is grown between the trees, and strip spraying in the row with paraquat/simazine is carried out.

Time to First Harvest:
2-3 years

Time to Full Production:
4-6 years - earlier with close planting.

Expected Yields:
2 years 5 t/ha
4 years 12 t/ha
6 years 20 t/ha

Normal Productive Life:
10 years in north.
20 years in south.

Method of Harvest:
Hand picking - research on mechanical harvesting has not yet produced an acceptable commercial machine.

Storage:
Will not handle or store particularly well. Reduction of the temperature of the fruit after picking will assist transport and mar-

Marketing and Statistics

Special Marketing Requirements:
No organised marketing system exists. Sold through the aution system, on contract to cannaries, or exported by specialist firms.

Cultivars

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
		keting and limited cool-storage at 1-2°C is possible up to 3 weeks. **Main Pathogens:** Silver leaf is responsible for short life of many trees, especially in the north. Blast in spring and brown rot at maturity are difficult to control especially in wet climates. Other common pests and diseases are leaf curl, scab, bacterial spot, leaf roller, mites.		

Botanical, Anatomical, Physiological Aspects.

PLUMS

Common Name:
Plums

Botanical Name:
Japanese plum - *Prunus salicina*
European plum - *prunus domestica.*

Botanical Name of Related and Useful species.
Damsons - *Prunus institia*
Myrobalan or Cherry plum - *Prunus cerasifera*

Type of Plant and Size:
Vigorous, especially *P. domestica,* bushy tree, 4-8m in height, 4-5m in diameter.

Sexuality:
Hermaphrodite.

Pollination:
Mostly self-incompatible. Careful selection of pollinators essential. Not always easy to induce bees into plum orchards if other flowers are around.

Flower buds:
Produced laterally on one-year-old shoots. With European plums as they mature, spurs become

Climatic, Geographic, Soil and Water Requirements.

Temperature Needs:
Generally the European plum is not grown in warmer areas. Japanese plums are grown in all areas.

Frost Tolerance:
Damaged by -4° to-5°C at bud swell, -2 to -3°C at blossom and -1°C at small fruit stage. Due to later flowering than peaches they normally sustain less damage.

Water Needs:
Provide adequate moisture especially during final growth stage.

Water Tolerance:
Moderate, to good. European plums are probably more tolerant of 'wet feet' than other tree fruit.

Drought Tolerance:
Moderate.

Humidity Tolerance:
Grown in wet and dry areas but disease and set is less of a problem when weather is fine.

Cultural Aspects

Propagation:
Budded onto cherry plum rootstocks.

Rootstocks:
Mostly Mycobalan plum used. Overseas other rootstocks with dwarfing characteristics are used. Currently some interest in N.Z. in St. Julian A.

Spacing:
Planted in square normally at 6 m. Closer planting system can be used provided tree vigour is controlled.

Training and Pruning:
Grown as vase-shaped trees. Detailed, extensive pruning is considered less essential than in other stone fruit.

Tillage:
Grown in grassed orchards with strip weed control under the trees.

Time to First Harvest:
3-4 years

Time to Full Production:
7-9 years

Expected Yields:
3 years 3t/ha
6 years 9t/ha

Marketing and Statistics

World Production (1978) (1000 tonnes)

Total	= 5241
USSR	= 820
Yugoslavia	= 706
Germany Fed	= 512
USA	= 507

Local Production: (t)

Total	= 2639
Processing	= 266
Local market (fr)	= 2373

Total area = 351 ha
Main areas = Hawkes Bay/ Auckland.

Main Products and Their Uses;
Mostly used for fresh market. Some used for jams or for canning. Dried European plums (prunes) not grown but some interest being shown, climatically.

Special Marketing Requirements:
No organised marketing system. Most are sold by auction or at orchard stores.

Cultivars

Main Cultivar Grown in N.Z.:
Omega
(George Wilson)

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
more significant. Japanese plums tend to restrict flowering to last seasons shoots. Buds are not mixed and flower buds contain 3-6 flowers on long pedicels. Flowers have 5 sepals, 5 petals, a single carpel, numerous stamens. **Growth of Fruit:** Drupe, with double-sigmoid growth curve. Stone hardens in second stage of growth, and is firmly attached to the flesh, which is yellow to dark red. **Time of Bud Burst (relative to apple):** Between peaches and apples mid to late September. **Time of Flowering:** Flowers open first, leaves several days later. **Time of Maturity:** Variable, some are among earliest fruit to be seen in any season. Generally December to February.	**Wind Tolerance:** Moderate. Cherry plums sometimes where used as wind breaks. **Edaphic Features:** Flat land preferred. **Soil Needs:** European plums can tolerate heavier clay soils than most tree fruit. Japanese plums are less tolerant of such soils. Nevertheless deep well-drained loams are the best. **Nutrient Requirements:** Need less nitrogen than other stone fruit but nevertheless quality and yield will be enhanced by good nutrition.	9 years 18t/ha **Normal Productive Life:** 25-35 years - less where silver leaf is a problem. **Method of Harvest:** Hand harvested for fresh market. Mechanical shakers often used for plums used for drying (prunes). **Storage:** Most are sold locally for the fresh market, some can be stored for 2-4 weeks at 0-4.5°C. **Main Pathogens:** Silver leaf reduces tree life. Blast and brown rot are common in wet years. Bladder plum, aphids, pear slug and leaf roller can be a problem in poorly sprayed orchards.		

14.2.4 Subtropical Fruit

Botanical, Anatomical, Physiological Aspects.

AVOCADO

Common Name:
Avocado
Alligator pear.

Botanical Neme:
Persea americana. Mill note 3 races within species.

Botanical Name of Related and Useful species:
In family *Lauraceae,* family includes:-
Laurus nobilis - sweet bay
Cinnamomum zeylanicum - cinnamon

Type of Plant and Size.
Large evergreen tree 8-20m high and shallow rooted, young shoots succulent. Branches of fair structural strength. Leaf size 10-30x5-15 cm. Large numbers of flowers on branches crowded at the end of the shoots. Individual flowers are small.
Fruit is a large fleshy berry, skin varies in thickness, texture and

Climatic, Geographic, Soil and Water Requirements.

Temperature Needs:
Depends on genetic background. The Mexican race most cold tolerant.
The West Indies race most suited to hot tropics and least cold tolerant. Young growth, flower initials and dormant buds may be harmed by temperatures just above 0°C. Therefore frost free cool/warm winters, and warm/hot summers required. Average minimum summer not below 14°C.

Frost Tolerance:
Very susceptible to frost. Fruit on tree during winter will be harmed by frost.

Water Needs:
Ample moisture preferred providing no soil drainage problems; N.Z. rainfall in growing localities may be sufficient.

Cultural Aspects

Propagation:
Usual to graft over seedling rootstocks. Use semi ripe scion material 2-3 buds, whip and tongue or cleft graft. Care is taken to stop drying out. Topworking of mature trees is feasible, care must be taken to prevent drying out of grafts.

Rootstocks:
Rootstocks may be chosen for tolerance to cold, and root rots. Various pregermination treatments used. Selected seed is raised in a sand/free-draining medium, in protected seedbeds, scions are grafted on when stocks 30-45 cm tall.

Spacing:
Avocados are large trees. Double spacing and later tree removal feasible. Mature trees at 8-12 m spacing.

Marketing and Statistics.

World Production:
(100 tonnes) 1978
Total =1284
Domin. Rep =135F
Brazil =135F
USA =109F
F = forcast
Local Production:
1978
Total area =126ha

Special Marketing Requrements
Exported fruit to Australia must come from certified sun blotch virus free trees.

Cultivars

Main Cultivars Grown in N.Z.
Hass
(G)
Furete
(MxG hybrid)
Zutano
(M x G hybrid)
Hopkins
(G)
Hayes
(G)
M=Mexican
G=Guatamalan.

New or Promising Cultivars in N.Z.
Reed
Sharwil
Bacon

Other Important World Cultivars:
Pollock
Duke(for use as a rootstock)
Lulu
(GxW.I.)

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
colour, flesh yellowish, butter like consistency. **Sexuality:** Hermaphrodite but flower opening mechanisms separate male and female functional periods. **Pollination:** Bees principal agents. Most cultivars are self fruitful but cross pollination may be beneficial. **Flower Buds:** Avocado often exhibits biennial bearing. Floral initiation occurs a short period before full bloom. Uniform cool temperatures (20°C or less), without higher peaks promotes flower formation. Short day length may accelerate flower development but reduce the total flower number. **Growth of Fruit:** The chemical composition of the fruit is different from most	**Water Tolerance:** Poor. Excessive water may increase likelihood of root death. **Drought Tolerance:** Fair. Fruit, flower, and leaf fall (particularly) increased by high water deficit. Water stress may change normal flower and growth periods. **Humidity Tolerance:** Fair. Blossom may be affected by fungal and bacterial infections. **Wind Tolerance:** Poor. In marginal climates (NZ) warm sheltered microclimates required. Wind breaks branches and encourages flower and fruit fall as avocado growth is brittle. **Edaphic Features:** Warm, sheltered sun facing aspect with good air and soil drainage. In N.Z. this means	**Training and Pruning:** Pruning is minimal. Removal of dead, diseased, overhangs and excessively crowded branches may be practised. **Tillage:** Mulching young trees and covering crops in the rows may be practised. Large trees should shade out grass and weed under the canopy. **Time to First Harvest:** 4-6 years **Time to Full Production:** 12-18 years. **Method of Harvest:** Sample for maturity (seed coat, flesh consistency, oil content, and skin characters change) Clip from tree with stem (1-2 cm) attached to fruit. Most growers rely on experience to gauge harvesting time.		

Botanical, Anatomical, Physiological Aspects

fruit and the development features are rather different. Cell division occurs up to maturity.
Ripening occurs off the tree, with a rapid respiration rate just before flesh softening.

Time of Bud Burst:
(relative to apple)
Not applicable but growth flushes may occur in spring and late summer.

Time of Flowering:
Varies with cultivar.
Cool climate delays flowering.
Flowering in N.Z. Oct-Dec(Fuerte).

Time of Maturity:
Sample for maturity, some spread of degree of maturity in the fruit on the tree.
Maturity time varies for cultivar: in N.Z.
Fuerte: July - Nov.
Hass: Nov - March
Fruit does not ripen on the tree but 5-15 days after pick.

Climatic Geographic, Soil and Water Requirements

selecting a suitable site with a warm microclimate.

Soil needs:
Deep well drained soils essential. Root death in poorly drained and poorly aerated soils may be severe.
Light or medium texture soils of at least 1 metre depth.

Nutrient Requirements:
Nitrogen requirement is high, and phosphorus and potassium should also be applied. Levels are adjusted for soil fertility and tree age. Following levels are recommended for mature trees in most N.Z. localities:-
N 150-200 kg/ha
P 40- 60 kg/ha
K 50-100 kg/ha
Split applications (spring and midsummer) with most N in summer usual practise.

Cultural Aspects

Storage:
Fruit may be damaged by low temperature, even though this can slow respiration and ripening. Once ripe, cool store at 4.5°C, however fruit skin may brown.

Main Pathogens:
Root rots are a major cause of illhealth and death. These include *Phytophthora, Armillaria,* and *Verticillium.*
Sun blotch virus has fruit spot and streak symptoms.
Virus free material only, should be planted.
Exported fruit must come from certified virus free trees.
Pests include leaf-roller caterpillar, thrips, mealy bugs.
A *lygus* bug may cause bud drop.

Marketing and Statistics

Cultivars

Botanical, Anatomical, Physiological Aspects.

FEIJOA

Common Name:
Feijoa.
Pineapple guava.

Botanical Name:
Acca sellowiana
(syn *Feijoa sellowiana* Berg)

Botanical Name of Related Species:
In family Myrtaceae which includes
Psidium guajava guava
Psidium cattleianum Cattley or strawberry guava
Myricaria caulifora jaboticaba. Family also includes eucalyptus.

Type of Plant and Size:
2-5 m tall. Small tree or shrub, evergreen, 2-5 m tall.
Leaves 3-7 cm long, dark green top, and white felted underside.
Solitary axillary flowers showy. Fruit is ovoid, berry 4-7 cm long, dark green skin, cream flesh gelatinaus pulp.

Sexuality:
Hermaphrodite flowers but some self incompatibility in some clones.

Climatic, Geographic, Soil and Water Requirements.

Temperature Needs:
South America localities with feijoas have a wider temperature range than N.Z. Minimum temp. are comparable but N.Z. maximum temperatures are lower. Fruit quality may not be affected by lower temps. Some suggestion that chilling requirements are necessary for winter.

Frost Tolerance:
Records of survival at −11°C. Tree is relatively frost tolerant. Late Autumn frost may affect internal fruit quality.

Water Needs:
Plant has drought tolerance characters. Rainfall in South America centres is higher than in N.Z. Irrigation preferable in dry months when fruit is on tree.

Water Tolerance:
Grows in climates with rain seasons. Indications that it tolerates monthly rainfall of 125 mm at least, providing good drainage is present.

Cultural Aspects

Propagation:
Seed may be sown into boxes or nursery beds. Layers may be taken. Cuttings, 3 node lengths of semi ripe wood, taken in autumn (May-June) may be rooted in mist beds with bottom heat 21°C. Treat with 1BA 2000ppm. Root in well drained media.

Rootstocks:
Seedlings may be used as rootstocks for proven scion clones. Whip graft onto lyr stocks. Superior rootstocks have not been selected.

Spacing:
Between plants 2-4 m depending on whether hedgerow or individual tree wanted. 4-5 between rows.

Training and Pruning:
Remove suckers and low branches (especially from grafted plants). Pruning to restrict tree spread, allowing spray penetration, and prevention of undue height may be practised. However

Marketing and Statistics.

World Production:
Negligible.

Local Production:
(1978)

Total	=333 t
Processing	=184 t
fresh	=149 t
Area	=70 ha

Main Products and Their Uses.
Fresh fruit. Canned as peeled fruit (rindless) or processed into juice.

Cultivars

Main Cultivars Grown in NZ:
Triumph
Coolidge.

New or Promising Cultivars in N.Z.:
Selection for better types is underway. Different cultivars may be required for the two main outputs, fresh fruit, and canning.

Older Cultivars Being Phased out:
Coolidge
Choiseana
Superba

Pollination:
Bees and other insects.
Flower Buds:
Formed in leaf axils at base of current season growth.
Growth of Fruit:
No information available.
Time of Bud Burst (relative to apple):
Not applicable, some periods of more rapid growth and shoot extension especially Sept-Nov.
Time of Flowering:
Nov-Dec, later than most fruits.
Time of Maturity:
Fruit fall from tree when mature, 20-26 weeks after flowering.
Tree will contain fruit of varying maturity levels.

Drought Tolerance:
Plant has drought tolerance characters. Some fruit and leaf fall is probable with drought conditions.
Humidity Tolerance:
Good.
Wind Tolerance:
Wind will cause fruit bruise and marking. Brittle wood may break. Shelter would reduce likelihood of water stress.
Edaphic Features:
Sheltered, sun facing aspect, with good air drainage.
Soil Needs:
Grows on wide soil range provided drainage is satisfactory. For adequate soil moisture retention, and for producing good fruit size, loam soils would be preferable to sandy soils.
Nutrient Requirements:
Confirmation of fertilizer needs is required. Soil tests should be used to vary the following recommendations:

pruning is generally kept to a minimum.
Tillage:
Shallow rooting habit requires a minimum of close tillage. Weed free tree rows. May be maintained with herbicide and mulch.
Time to First Harvest:
2-4 years after planting out, 4-5 tonnes per hectare.
Time to Full Production:
10 years after planting 20 - 25 tonnes per hectare.
Method of Harvest:
Anticipate natural maturity (fruit drop) Fruit detaches easily from tree, when mature and undergoing ripening, Some skin colour change to yellow/green noticeable with flesh softening.
Storage:
Cool storage at 0°C for 4-5 weeks possible.
Main Pathogens:
Hard wax scale, greedy scale, leaf roller caterpillars.

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
		Split applications in August and Nov-Dec. Total Nutrient (element). Young tree: 25-30 kg N, 40 kg P, 20 kg K. Mature, bearing tree: 120 kg N, 80 kg P, 100 kg K.		

KIWIFRUIT

Common Name
Kiwifruit, Chinese gooseberry,
Yang-tao, Mao-erhtao

Botanical Name
Actinidia chinensis
Planch

Botanical Name of Related & useful species
Actinidia arguta
Actinidia kolomikta
Both have edible fruit and may be used as rootstocks and for ornamental purposes.

Type of Plant & Size
Trailing deciduous vine
Up to 9 m length or height with support.
Large cordate leaves up to 20 cm.

Temperature Needs
Requires 400-500 hours below 7°C during winter
Requires frost free growing period 8-10 months
Jan temperatures approx, ave max. 24°C ave min. 14°C.

Frost Tolerance
Young growth damaged at - 2°C.
Woody growth damaged at - 8°C

Water Needs
Indications are that it has a high water demand. Estimates that 1000 mm is necessary for the 8 month growing period

Propagation
Seed sown late July, bud or graft after one growing season. Cuttings may be used

Rootstocks
Seedling rootstocks of Hayward & Bruno cultivars are most used
Related species are being tested

Spacing
6-9 m in rows, 4-5 m between rows.

Training & Pruning
Training into fence, T bar or pergola trellis. Permanent fruiting arms supported at 1.8-2 m

World Production
Not known, but likely to increase.

Local Production: 1979
Total: 18650 tonnes
Processing: 2526
Fresh: 16124
Main area = Bay of Plenty
Area = 1516 hectares

Main Products and Their Uses
—

Special Marketing Requirements
—

Main Cultivars Grown in N.Z.
Hayward (pistillate) also a number of male staminate plant clones are used for pollination including Tomuri and Matua.

New or Promising Cultivars in N.Z.
None at present.

Older Cultivars Being Phased Out
Abbott
Allison
Monty (Montgomery)
Bruno
Greensill

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
Sexuality dioecious (separate male flowering & female flowering plants) **Pollination** Essential, bees required Flower is not very attractive to bees **Flower Buds** Flowers found on first 1-6 nodes of current seasons extension growth from lateral buds. Microscopic flower formation occurs in lateral buds during July-October. Previous season may influence plant ability to form flower e.g. heavy shading of leaf and axil reduces flowering. **Growth of Fruit** Reported as triple sigmoid growth curve. **Time of Bud Burst (relative to apple):** Same as apple. Bud swell begins approx. 10 days before bud burst **Time of Flowering** October-November	**Water Tolerance** Will not tolerate wet feet. Tolerates high rainfall of 2,500mm if drainage is good. **Drought Tolerance** Probably low tolerance. Reduction of yield is likely. **Humidity Tolerance** Good **Wind Tolerance** Low tolerance essential good shelter, young growths snap and bruise in wind, fruit may wind scar. **Edaphic Features** Warm slopes with good air drainage and wind shelter. **Soil Needs** Deep well drained soils. A good water holding capacity desirable for summer growth. **Nutrient Requirements:** heavy fertilization required to maintain vine vigour.	height. Temporary fruiting arms renewed every 3-4 years. Fruiting laterals on temporary arms are summer pruned to control leaf vigour and shading, winter prune to 2 buds past previous fruiting node. **Tillage** Usual to allow grass/clover and herbicide strip row. **Time to First Harvest** Year 3 or 4 after planting out and grafting. **Time to Full Production** Year 7-9 at 25 t/ha **Method of Harvest** Sample for soluble solid content of 6.25% or more. Hand pick into bulk bin. **Storage** 0°C and 90% relative humidity will keep fruit approx. 6 mths. **Main Pathogens** Leaf roller caterpillar. Greedy scale Thrips Rootknot eelworm Botrytis		**Other Important World Cultivars** None.

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
Time of Maturity Between late April and late June. Fruit may ripen satisfactorily if soluble solids 6.25% or more at harvest.	Split applications in August/September and December Total: 180-220 kg N/ha also phosphate (P_2O_5) at 100 kg/ha potash (K_2O) 55 kg/ha			
PASSIONFRUIT **Common Name** Passionfruit Granadilla Grenadilla **Botanical Name** *Passiflora edulis* (Sims) forma *edulis* purple passionfruit forma *flavicarpa* yellow passionfruit **Botanical Name of Related and Useful Species** Edible fruits *P. quadrangularis* giant granadilla *P. ligularis* sweet granadilla *P. mollissima* banana granadilla Ornamental *P. caerulea* - passion flower.	**Temperature Needs** Cool winters, frost free, warm summers. Main N.Z. passionfruit area has summer (Jan) av max 24°C av min 14°C winter (July) ave max 14°C av min 5°C (Bay of Plenty, Tauranga). Areas with hot summers have shorter bearing life cycle. Natural environment is tropical highlands. **Frost Tolerance** Very frost sensitive Damage severe at - 2°C **Water Needs** Well distributed rainfall 7,500 mm to 12,500 mm. **Water Tolerance** Poor tolerance, increased susceptibility to disease.	**Propagation** Seedlings sown in nursery beds Oct, thin, plant out at 20 cm Jan/Feb or hold over. Cuttings -tip cuttings of virus free matured laterals after growth flush. Mist with bottom heat in well drained compost **Rootstocks** Various rootstocks used to increase tolerance to root rots & cankers. In warm/hot regions, yellow passionfruit used. In N.Z. *P. mollissima* may be used. **Spacing** 3-6 m between plants	**World Production** Figures not available Main commercial areas are Australia, South Africa, Hawaii, Kenya. Production also occurs in Fiji, and South Pacific islands, India, Ceylon, Ghana, and Malawi. **Local Production** (tonnes) 1978 Total = 96 Processing = 11 Local market = 85 Main areas: Bay of Plenty and Poverty Bay. Area = 20 ha **Main Products and Their Uses** Pulp and seeds used fresh, or canned/	**Main Cultivars Grown in N.Z.** Purple passion fruit. *(Passiflora edulis forma edulis).* **Other Important World Cultivars** Yellow passionfruit also hybrids between purple and yellow.

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
Type of Plant & Size Vigorous woody perennial climber, up to 15 m long. Stems have tendrils, leaves are ovate or 3 lobed, approx. 10 x 18 cm. Flowers showy (5 cm across), solitary. Fruit is a many seeded berry. Seed is surrounded by juicy pulpy aril. **Sexuality** Hermaphrodite **Pollination** In N.Z. fruit set is not usually a problem, but some plants, especially the yellow passionfruit, need cross pollination, often from plants of other clones. Large bees and wasps can act as pollinating agents. **Flower Buds** Flowers are produced on current season's growth. Flowers are axillary. No information is available regarding initiation factors.	**Drought Tolerance** Fair. Poor flower set and fruit retention may result, and also some defoliation. **Humidity Tolerance** Fair. Increased susceptibility to leaf and fruit diseases. **Wind Tolerance** Poor. Shelter essential to prevent vine damage through breakage, and bruising also fruit marking, and vine tangling. **Edaphic Features** Warm, sun facing aspect, sheltered from strong and cold winds, with good air drainage. **Soil Needs** Wide range suitable, except heavy clay. Good drainage essential, sandy loams very suitable. **Nutrient Requirements** According to soil fertility. Most N.Z. passionfruit areas have fair to poor fertility. Split application in	2-5 m between trellis rows, dependent on machinery, management, and soil fertility. **Training and Pruning** Trained onto T bar of 2 wire fence trellis. One or more leaders may be taken up to wires running along the row. A curtain of fruiting laterals is produced from the wire supported leaders. When the curtain becomes too long, dense and tangled, laterals are shortened to 20 cm long and new laterals encouraged. **Tillage** Plant rows are kept weed free by shallow cultivation or herbicide. Cover crops and green manures may be used between rows if rainfall sufficient. **Time to First Harvest** 15-18 months after planting out. 1½-2½ tonnes/ha	bottled. A juice may be extracted and used for drinks, confectionery, jellies, and jams.	

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
Growth of Fruit Fruit has respiration climacteric and will release ethylene. **Time of Bud Burst (relative to apple):** No bud burst as such, but growth flushes occur during the year. In N.Z. a spring growth flush can be expected and possibly one or two later flushes. **Time of Flowering** Prolonged flowering periods for most of year, but especially Nov-Feb, June-July. **Time of Maturity** Approx. 8-12 weeks from fruit set. Main season Feb-May, also Sept-Oct. May be fruit at other times. Sample for maturity.	Aug-Sept, and Nov-Dec recommended. Total NPK 68 kg N, 49 kg P, 29 kg K.	**Time to Full Production** 24 months after planting. 3-7 tonnes/ha **Method of Harvest** Common to allow fruit to fall and pick from ground every 1-3 days. Fully coloured fruit may be picked from plant. Remove perianth if present. **Storage** May be kept for 1 week with no deterioration. **Main Pathogens** Grease spot, brown spot, sclerotina, septoria blotch, bitter rot, *Cladosporuim, Fusaarium,* woodines virus, rootrots (various organisms).		

Botanical, Anatomical, Physiological Aspects

TAMARILLO

Common Name
Tamarilla
Tree Tomato

Botanical Name
Cyphomandra betacea
(Eav) Sendt

Botanical Name of Related and Useful Species
Tamarillo is in *Solanaceae* family (tomato, potato, etc.) Related plant grown in N.Z. is casana. *Cyphomandra*

Type of Plant & Size
Brittle softwood shrub or small tree, growing to 3-4m in height and 1-3 m spread. Has large leaves, brittle branches, shallow roots. Life expectancy 7-10 years.

Sexuality
Hermaphrodite

Pollination
Self pollinating but also insect assisted cross pollination.

Flower Buds
Borne on current season's growth.

Climatic, Geographic, Soil and Water Requirements

Temperature Needs
Only some localities suitable. Typical locale - Kerikeri, temps summer (Jan) av max 25°C, av min 13°C, winter (July) av max 15°C, av min 6°C i.e. frost free, cool winter, warm/hot summer.

Frost Tolerance
Damaged by frost, severe at -2°C.

Water Needs
Requires ample water.

Water Tolerance
Very intolerant of excess soil moisture.

Drought Tolerance
Shallow root system has poor ability to stand drought.

Humidity Tolerance
Fair, disease incidence increased.

Wind Tolerance
Very poor, weakly rooted and anchored, large leaves and brittle branches may break off.

Edaphic Features
Warm sun facing slopes. Aspects with good wind

Cultural Aspects

Propagation
Seedlings, start seed under glass July-August, plant out October-November. Cuttings from virus free plants 1-2 year old wood, 45 cm long, 2 cm thick, set out autumn or spring in nursery.

Rootstocks
Selected seedling and cuttings, also *Solanum aviculare* and *Solanum mauritianum* for root rot tolerance.

Spacing
1.5 m between plant
4.5 m between row

Training and Pruning
Plants need staking and a T bar trellis may be used to support the head. Plant encouraged to branch at 1.2m by heading. Bearing tree pruned to remove dead, diseased and crowded old wood. Prune to produce new growth, and flowers distributed throughout plant head.

Tillage
Usual to grow in weed free strip. Green manure or covercrops of grass and

Marketing and Statistics

World Production
Neglible

Local Production
Total = 11532(t) 1978
Processed = 150
Local Market = 1003
Export (fr) = 22
Main areas - Northland/ Bay of Plenty.
Area = 232 ha.

Main Products and Their Uses
Red tamarillo: fresh market, juice, chutney, but not canned. Yellow tamarillo: fresh market, juice, chutney, may be canned.

Cultivars

Main Cultivars Grown in N.Z.
Cultivars are designated by fruit colour.
-Red tamarillo
-Yellow tamarillo
Seed strains exist, but are not defined as cultivars. Hybrids between red and yellow are in existence. Red tamarillo has higher acid and flavour levels.

New or Promising Cultivars in N.Z.
Hybrids between red and yellow are being developed.

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
Growth of Fruit Single sigmord curve **Time of Bud Burst (relative to apple)** No bud burst as such. Phases of increased growth may be induced by pruning as well as seasonal conditions. **Time of Flowering** Flowering may be influenced by pruning and season. Main period November-April **Time of Maturity** Fruit must be fully coloured up to calyx. Commercially mature 21-24 weeks after flowering.	shelter, and cold air drainage. **Soil Needs** Light, well drained soil required. **Nutrient Requirements** The appropriate soils tend to have poor fertility and therefore fertilizer application needs close attention. General recommendations; split applications August, November , February of total NPK annum N 110-170 kg/ha P 35- 55 kg/ha K 50-100 kg/ha	clover can be grown between rows. **Time to First Harvest** 18 months after setting out 6.5 tonnes/ha. **Time to Full Production** 3-4 years after setting out. 15-17 t/ha. **Method of Harvest** Pick by colour assessment, fruit must be uniformly at correct colour. **Storage** At 3.5-4.5°C after hot water dip and waxing. Fruit will keep 12-14 weeks with 7 day shelf life afterwards. **Main Pathogens** Aphid, looper caterpillar, white fly, nematode, green vegetable bug, bacterial blast, powdery mildew, leaf spot. *Colletotrichum acutatum,* Root rot, various viruses including cucumber mosaic, tamarillo mosaic, arabis mosaic		

14.3 NUT PRODUCTION

Botanical, Anatomical, Physiological Aspects.

ALMOND

Common Name:
Almond

Botanical Name:
Prunus amygdalus

Type of Plant and Size:
Tree 4-6m high, 3-4m at base. Round and bushy.

Sexuality:
Hermaphrodite

Pollination:
Flowers are self-incompatible. Careful selection of pollinators essential. Insect pollinated.

Flower Buds:
Fruiting habit is similar to peaches, (flower buds surround a vegetative bud) on last year's shoots: Also form flowers on spurs produced on old wood. Flowers have 5 sepals, 5 petals, a single carpel and numerous stamens.

Growth and Type of Fruit:
Unlike other stone fruit, the flesh does not grow in stage III.

Climatic, Geographic, Soil and Water Requirements

Temperature Needs:
Mostly grows in areas with dry, warm-hot climates.

Frost Tolerance:
A serious problem due to very early blossom. Buds showing pink can tolerate -4°C to -6°C.

Water Needs:
Although often grown in dry areas they crop better with supplementary irrigation, especially in areas below 500 mm rain pa. More tolerant of drought than other stone fruit.

Water Tolerance:
Dislike wet climates especially at blossoming and close to harvest.

Drought Tolerance:
Moderate to good.

Humidity Tolerance:
Poor.

Wind Tolerance:
Moderate.

Edaphic Features:
In cold districts slopes can be beneficial.

Cultural Aspects

Propagation:
Budded.

Rootstocks:
Peach and almond seedling rootstocks used. Peach is more disease resistant but somewhat more susceptible to drought.

Spacing:
Normally planted on square at 6 - 7.5m. Closer spacing in the row is possible since, like peaches, almonds have a limited life span.

Training and Pruning:
Grown as vase-shaped trees. After establishment of framewood, detailed pruning is not used.

Tillage:
Grass between rows, sprayed under trees and along rows with simazine/paraquat.

Time to First Harvest:
3 - 4 years

Time to Full Production:
7 - 9 years

Marketing and Statistics

World Production:
(1000t) 1978
Total: 830511
Spain: 298500
Hungary: 163000
USA: 154221

Local Production:
Negligible.

Main Products and Their Uses:
The kernels are used chiefly in confectionery, most are of the sweet type; bitter almonds are used for the manufacture of flavouring extracts and prussic acid.

Special Marketing Requirements:
Local producers will need to compete with well established overseas producers and be able to guarantee continuity of supply.

Cultivars

Main Cultivars:
Few are grown commercially. The following may have promise:
Mona Vale - local selection (hard).
C.P.S. - Californian Paper Shell.
Texas - hard.
Ne Plus Ultra - paper
I.X.L. - paper
Davey - soft
Kapareil - paper

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
but dries and splits on ripening to expose the endocarp. The endocarp, or shell may be a crumbling, soft 'paper shell', moderately soft 'soft shell' or 'hard shelled'. The latter cannot be broken by hand. **Time of Bud Burst (relative to apple):** Normally 2 months before apple, but ranging from late July to early September. **Time of Flowering:** Flower buds open before leaf buds. **Time of Maturity:** Nuts mature from March to April.	**Soil Needs:** Tolerant but do better in lighter deep fertile soils. **Nutrient Requirements:** Like most stone fruits they respond to nitrogen.	**Expected Yields:** 3yrs - 1 kg/tree. 5yrs - 2 kg/tree. 8yrs - 9 kg/tree. This is yield of unshelled nuts at 7 x 7m; this is 1.8 t/ha at 8 yrs. **Normal Productive Life:** Probably 20-25 years in N.Z **Method of Harvest:** Hand or by machine. **Storage:** Remove nuts from pericarp as soon as possible and store in a cool, dry place. **Main Pathogens:** Silver Leaf not quite as serious as in peaches since less detailed pruning is used. Nevertheless it can be serious. Blast and brown rot can cause problems and crown gall may occur in trees budded on almond.		

Botanical, Anatomical, Physiological Aspects

CHESTNUT

Common Name:
Chestnut
Sweet Chestnut

Botanical Name:
Castanea sativa - European, Spanish or Italian chestnut.

Botanical Name of Related and Useful Species:
C. dentata - American sweet chestnut
C. crenata - Japanese chestnut
C. mollissima - Chinese chestnut

Type of Plant and Size:
Tall, spreading deciduous tree, 20-30m tall, 20-25m diameter.

Sexuality:
Plant has two types of catkins, those at base of flowering shoot are male and are produced first. Mixed catkins are formed a little later above these.

Pollination:
Most seem to be self-sterile, although some self-compatibility

Climatic Geographic, Soil and Water Requirements

Temperature Needs:
Will grow in a wide range of temperate climates.

Frost Tolerance:
Can be damaged by frosts of -4°C to -6°C in October

Water Needs:
Need good annual rainfall to produce good crops.

Water Tolerance:
Moderate:

Drought Tolerance:
Poor as young tree, improves at maturity.

Humidity Tolerance:
Fair to good.

Wind Tolerance:
Moderate.

Edaphic Features:
Use flat land but not frost pockets.

Soil Needs:
Because it is a deep-rooted tree, it grows best in deep well-drained soils. Tolerant of poor soils but crops poorly on heavy clays or with impermeable subsoils; life of tree is short.

Nutrient Requirements:
Crops better in soils which

Cultural Aspects

Propagation:
Use bark grafting, inverted T budding or nurse seed grafting. Long tap root causes problems in transplanting.

Rootstocks:
Use seedlings of species to be propagated.

Spacing:
Normally planted at 12 x 12m. Planting much closer - down to 3m - followed by later thinning will increase early yields.

Training and Pruning:
Establish a centre-leader shape in early years otherwise little pruning required.

Tillage:
Probably would do better in clean, cultivated, weed-sprayed or close-cut grass sward.

Time to First Harvest:
Probably 3-5 yrs with improved cultivars.

Time to Full Production:
Probably 10-20 yrs.-

Expected Yields:
Details not available 1-2 tonnes per hectare would seem likely.

Marketing and Statistics

World Production: (1000t) 1978
Total: 501380
Japan: 70000
Italy: 55000
Turkey: 49000

Local Production
Negligible.

Main Products and their Uses:
May be roasted, used in cooking, also for flour, biscuits and confectionery. Also used in peanut butter manufacture.

Special Marketing: Requirements:
Because of the devastation of overseas trees by chestnut blight, there is a large potential market. Japan uses large amounts of chestnuts. N.Z. must not allow blight to be imported.

Cultivars

Main Cultivars Grown in N.Z.:
Most are seedlings. Many good trees exist, especially in the Waikato. Selection of these will be more sensible than importing overseas cultivars with a danger of blight introduction.

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
appears to exist. Probably both wind and insect pollinated. **Flower Buds:** Buds are mixed and produced laterally on last season's growth. These open to form shoots with male catkins, opening first, at the base and mixed male and female catkins, produced slightly later, further up the shoot. **Growth of Fruit:** *C. sativa* has two forms: 'Marrons' normally have single chestnut in spiky husk which is large, more aromatic and sweeter than 'Chataignes', which are the more common among seedlings. These have 2-3 smaller nuts in the husk. Relative size of other species: *C. crenata,* large with poor flower; *C. molissima,* moderate and sweet; *C. dentata,* small, sweetest of the species. **Time of Bud Burst** (relative to apple) Same - early to mid October **Time of Flowering:** November.	are fertile. Does not like calcerous soils. **Time of Maturity:** March - May.	**Normal Productive Life:** Probably 100 years or more, if not diseased. **Method of Harvest:** Hand picked from the ground after falling naturally or shaking. Can be swept up by machine. **Storage:** Fresh chestnuts can be stored for about 8 weeks at 4-5°C. One hour in water bath at 68°C will suppress mould and not injure nuts. Can be stored for 12 months at 4-5°C if dried to 10% moisture. **Main Pathogens:** Main disease is Chestnut Blight which has destroyed most of the *C. dentata* and *C. sativa,* trees in America and many in Europe. *C. crenata* is moderately susceptible, and *C. molissima* resistant. Not yet found in N.Z.		

Botanical, Anatomical, Physiological Aspects.

HAZELNUT

Common Name:
Hazelnuts,
Cobnuts,
Filberts,
Barcelona nuts.

Botanical Name:
Corylus avellana -
European cobnut
Corylus maxima
European filbert

Botanical Name of Related and Useful Species:
Corylus americana -
American filbert
Corylus colurna
Turkish filbert

Type of Plant: and Size:
Deciduous tree 4-6 m tall, 4-5 m diameter; all except *C. colurna,* which is much taller, have a tendency to sucker.

Sexuality:
Monoecious and dichogamous; usually the female flowers open first.

Pollination:
Wind pollinated. Female

Climatic, Geographic, Soil and Water Requirements

Temperature Needs:
Grows in wide range of temperate climtes.

Frost Tolerance:
Good. Flowers will tolerate - 8°C.

Water Tolerance:
Moderate to good.

Water Needs:
Requires plentiful water supply.

Drought Tolerance:
Poor.

Humidity Tolerance:
Good.

Wind Tolerance:
Sometimes reported to be good but will definitely crop better under shelter.

Edaphic Features:
Use flat land.

Soil Needs:
The shallow rooting habit means it will grow satisfactorally in shallow soils. Also tolerant of clay which it prefers to sandy soils.

Nutrient Requirements:
Needs fertile soils with pH approximately 6. Often fertilized to similar

Cultural Aspects

Propagation:
Can be grown in stool beds or layered. Cuttings are not always easy but better if taken from suckers For rapid propagation grafting on to seedling stock is used. Better results are obtained if grafted in warm position or in glasshouse.

Rootstocks:
Seedlings of either species.

Spacing:
Traditionally grown at 4.5 x 4.5 m. Close planting (3.6 x 2.4 m) has been recommended and will give earlier returns.

Training and Pruning:
Can be allowed to sucker and grow as a large bush but it is better to restrict suckering and grow as an open-centre tree and adopt only moderate pruning. This prevents it from becoming too dense.

Tillage:
Spray under tree and use grass sward between rows. Total weed suppression with herbicides can also be considered

Marketing and Statistics

World Production: (1000 t) 1978
Total: 504045
Turkey: 320000
Portugal: 120700
Iran: 15000
U.S.A.: 11249

Local Production:
Negligible.

Main Products and their Uses:
Sold as fresh nuts or used in confectionery.

Special Marketing Requirements:
Most nuts used in N.Z. are imported. Exported nuts from N.Z. will need to be of good quality and relatively cheap to compete with Turkish or American nuts.

Cultivars

Main Cultivars Grown in N.Z.:
Currently most are seedlings. Local improved selections are being made. Of the imported cultivars Barcelona and improved strains originating in Oregon are likely to hold most promise.

Botanical, Anatomical, Physiological Aspects.	Climatic, Geographic, Soil and Water Requirements.	Cultural Aspects	Marketing and Statistics	Cultivars
flowers may open in May and June, while male catkins open from June to September. Females remain receptive for several weeks but male pollen has a short life. Pollinator cultivars must be selected to overlap with female flowers of desired cultivar. **Flower Buds:** Buds with male and female flowers are separate, simple and borne laterally on last season's growth. **Growth and Type of Fruit:** After pollination, fruit development over winter is very slow. Main development is over October and November. *C. avellana* has roundish nuts not completely enveloped by husk. Nut may drop free at maturity. *C. maxima* has long nuts enveloped by the husk which adheres to the nut.	extent as peach. Emphasis on nitrogen and potassium.	especially where mechanical sweeping is contemplated. **Time to First Harvest:** 4 - 6 yrs. **Time to Full Production:** 10 - 12 yrs. **Expected Yields:** 5yrs : 2kg/tree 8 yrs : 4kg/tree 12 yrs : 12kg/tree At 4.5 x 4.5, 12kg/tree = 59t/ha. **Expected Productive life:** 40 or more years. **Method of Harvest:** Pick by hand from the ground or shake mechanically.		

Botanical, Anatomical, Physiological Aspects.

Many cultivars are hybrids between these and other species.

Time of Bud Burst
(relative to apple)
Male and female flower buds open early - see above. Leafing occurs in early October.

Climatic, Geographic, Soil and Water Requirements

Cultural Aspects

Marketing and Statistics

Cultivars

MACADAMIA

Common Name:
Macadamia.
Queensland nut

Botanical Name:
Macadamia integrifolia
Macadamia tetraphylla
L. Johnson

Botanical Name of Related and Useful Species:
Macadamia is from the *Proteaceae* family which includes the flowering Proteas, Banksia and Grevillea.

Type of Plant and Size:
Tree of 10-15m height, tending to thick, upright growth. Leaves in whorls 3 or 4, leathery, dark green

Temperature Needs:
M. tetraphylla originates in northern NSW (Australia) and is more cold tolerant than *M. integrifolia*
Depending on tissue condition (dormant, hardened, and mature tissue) some low temperatures may be tolerated. For growth to occur 12.8°C or more is required. Calculations of NSW climate, suggests 2,500 heat units p.a. are required, but San Diego, USA experiences 1151.

Frost Tolerance:
Depends on tissue condition and plant species. Older trees will tolerate light frosts but

Propagation:
Seedling trees for grafting may be produced from selected nuts. Nuts need stratification. Reports of marcottage and leafy cut tings being used may be found. Grafting and budding seems particularly difficult. Approach grafts are dependable but time consuming.

Rootstocks:
M. tetraphylla seedling rootstocks used for cold tolerance.

Spacing:
Double planting and thinning out 10-15 yrs after establishment. Slow growth in N.Z. allows close initial spacing:

World Production:
Not available.

Local Production:
Negligible.

Main Products and their Uses:
Used raw or roasted, confectionery, paste and oil.

Main Cultivars Grown in N.Z.
A range of cultivars imported into N.Z. is still being evaluated by growers and the MAF.
M. intergrifolia cultivars
from Hawaii:
Keahou
Keaau
from Australia:
Hind
Own Choice
M. tetraphylla
from Australia:
Elimbah
Sewell
Hybrids from Australia:
Beaumont
Hybrids from South Africa:

Botanical, Anatomical, Physiological Aspects

in *M. tetraphylla*. Branching with narrow angles and consequent splitting common.
Long flower spike 10-20 cm long; 75-400 flowers/spike. Fruit has fleshy husk, very hard brown shell. Seed 1.5 - 2.5cm diameter with high oil content required for processing (better than 72%).

Sexuality:
Flowers hermaphrodite.

Pollination:
Allow for cross pollination. Self pollination occurs but evidence of some partial self incompatibility. Bees may be introduced into orchards.

Flower Buds:
No information available regarding flower initiation and development.

Growth of Fruit:
Initially the endosperm is absorbed by the embryo and cotyledons and shell hardening begins. Thereafter (3 months) oil content starts

Climatic Geographic, Soil and Water Requirements

best to consider all trees very frost sensitive.

Water Tolerance:
Providing good drainage indications that tolerates high rainfall.

Water Needs:
Well distributed rainfall 1000mm, native habitat receives 1,5000-2, 250mm mostly in summer.

Drought Tolerance:
Drought will cause small nuts, poor kernel development and reduced yield. However tree survival may be fair to good.

Humidity Tolerance:
Providing good drainage for high humidity and rainfall conditions, indications are that it tolerates a wide range of humidity.

Wind Tolerance:
Weak anchorage and poor branch angles makes *Macadamia* very susceptible to damage and breaking with wind. Shelter is essential.

Edaphic Featues:
Warm, sheltered condi-

Cultural Aspects

4.5m between rows and 2.25m between trees.

Training and Pruning:
Evergreen trees are not normally pruned. However it is desirable to produce a single leader tree with wide angled side branches in the early stages of the orchard. To do this it is usual to head back into the main stem and allow growth from both primary and secondary buds. When growth has hardened reduce primary growths to one.

Tillage:
As nuts are often harvested after falling, complete fallow may be practised. However mulching or herbicide clean tree rows are feasible.

Time to First Harvest:
4-7 years.

Time to Full Production:
Uncertain as not enough experience with older trees. Perhaps 15 yrs.

Marketing and Statistics

Cultivars

Nelmark 1
Nelmark 2

Other Important World Cultivars:
The Hawaii range of cultivars is wider than quoted above. Additions are still being made.

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
to rise until maturity 4 months later. **Time of Bud Burst (relative to apple):** Not applicable; a number of growth flushes may be expected particularly a spring flush.	tions, sun-facing slopes with good air drainage. **Soil Needs:** Macadamia grows on a wide range of soils but a well drained soil of a pH 6-7 of 1 m depth is ideal. **Nutrient Requirements:** Several applications are made in a season e.g. 3 or 4 dressings amounting to 5kgs p.a. for a 10yr old tree. Macadamia appear to be sensitive to a number of trace element deficiencies.	**Method of Harvest:** Usual to pick nuts regularly from the ground. Nuts must be dehusked and moisture level allowed to fall to 1-4% with drying for 3-4 weeks. Nuts may then be processed. **Storage:** Air dried nuts, in the shell may be stored for several months in a dry, ventilated place. **Main Pathogens:** Leaf roller caterpillar, mealy bug, and thrips. Rots may damage fallen nuts. Outside N.Z. *Phytophora, Anthracnose,* and *Botrytis* are problems. **Bearing/Yields:** 5-14kgs/tree 8-10 yrs 15-27kgs/tree 12-14 yrs Up to 113 kgs/tree in good season from older trees.		

Botanical, Anatomical, Physiological Aspects

PECAN

Common Name:
Pecan

Botanical Name:
Carya illinoensis

Botanical Name of Related and Useful Species:
C. ovata - shagbark hickory
C. laciniosa - shellbark hickory.
C. tomentosa - mockernut hickory.

Type of Plant and Size:
Large deciduous tree up to 50m in height, 35m in diameter. Long tap root makes transplanting difficult.

Sexuality:
Monoecious, dichogamous. Use several cultivators in small plantations to ensure overlapping of pollen shed and pistil receptivity. Probably enough overlap in large plantations of one cultivar.

Pollination:
Wind pollinated

Climatic, Geographic, Soil and Water Requirements

Temperature Needs:
Reported to need between 1200 and 1700 degree (C) days to mature, which would suggest the North Island or warmer areas of the South Island would be most appropriate.

Frost tolerance:
Similar to walnut. Unlikely to be a problem in the warmer areas where pecans will be grown.

Water Needs:
Although growing naturally in both arid and humid areas their water requirements in the summer are reported to be quite high.

Water Tolerance:
Moderate.

Drought Tolerance:
Moderate.

Humidity Tolerance:
Moisture and blossoming restricts pollination.

Wind Tolerance:
Moderate.

Edaphic Features:
Flat land preferred.

Cultural Aspects

Propagation:
Grafted or budded using the whip and tongue graft, or skin or patch budding. Long tap root of seedling causes problems in transplanting.

Rootstocks:
Seedling pecans

Spacing:
Have been planted on the square at 10-21m depending on fertility and climate. More recent planting has been established at 4.5 x 9.0 or 7.5 x 7.5 or 4.5 x 4.5 but trees may need thinning later.

Tillage:
Usually grown under clean cultivation or closely cut sword.

Time to First Harvest:
4-5 years.

Time to Full Production:
15-20 yrs.

Expected Yields:
These are for good cultivars on good soils,

Marketing and Statistics

World production:
Not known.

Local Production:
Negligible

Main Products: and their Uses:
Used fresh or for culinary purposes.

Special Marketing Requirements:
It will take some time before the local market is fully exploited. Export potential needs to be explored.

Cultivars

Main Cultivars Grown in N.Z.
Mostly seedlings. Some cultivars have been imported.

Important World Cultivars:
Established in USA
Colby
Desirable
Giles
Major
Peruque
Wittle

New releases USDA
Barton
Caddo
Cherokee
Chickasaw
Choctaw
Mohawk
Shawree
Shoshoni

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
Flower Buds: Male catkins develop laterally in simple buds on previous season's. growth. Female flower buds are mixed and produced terminally on previous season's growth. Female flowers are formed terminally on the spring shoot that originates from the terminal bud. **Growth of Fruit:** Hull and nut grow with double sigmoid growth curve. Tendency to biennial bearing. **Time of Bud Burst (relative to apple):** October, about the same time as apple. **Time of Flowering:** 2-3 weeks after bud burst. **Time of Maturity:** 180-220 days after anthesis; probably April or May in most N.Z. areas.	**Soil Needs:** Deep alluvial soils considered to be the best. **Nutrient Requirements:** ph 6-6.5 optimum. Do not respond to large amounts of fertilizer and maintenance dressings are sufficient.	planted at relatively high density. 5yr : 1t/ha 10 yrs : 3.5t/ha 15yrs : 4.0t/ha 20yrs : 6.0t/ha **Normal Productive Life:** 50-100 yrs or longer **Method of Harvest:** Hand harvest as nuts fall, remove hull and dry. Normally nuts are shaken off the tree and picked off the ground by mechanical sweepers. Ethephon may be used to assist hull dehiscence. **Storage:** Store the dry nuts in cool, dry vermin-proof conditions. **Main Pathogens:** Few pests and diseases recorded in N.Z.		

Botanical, Anatomical, Physiological Aspects

WALNUT

Common Name:
English or Persian Walnut

Botanical Name:
Juglans regia

Botanical name of Related and Useful Species:
J. nigra: Eastern black walnut.
J. hindsii; black walnut
J. sieboldiana var *cordiformis:* heart nut
J. cinerea: butter nut

Type of Plant
Large, deciduous tree 20 - 30m tall spreading, not especially dense.

Sexuality:
Monoecious and displaying dichogamy. Mostly the pollen of catkins is shed before the female flowers open. To ensure good pollination best to select trees where males and females overlap.

Pollination:
Wind Pollinated.

Flower Buds:
Male catkins develope in

Climatic Geographic, Soil and Water Requirements

Temperature Needs;
Will grow in cool to warm temperate climates. Cooler climates need early maturing cultivars. Very high temperatures (38°C) can damage bark and hulls, and lead to poor quality kernels.

Frost Tolerance:
Late spring frosts, below -1°C, can damage flowers. Damage not common except in early-flowering strains in cold districts.

Water Needs:
At least 760mm of rain required and irrigation will benefit trees in the drier areas.

Water Tolerance;
Wet weather at harvest causes shell and kernel stain. Can be damaged by a high water table and needs drainage to at least 3m.

Drought Tolerance;
Moderate.

Humidity Tolerance:
Dislikes cool wet weather in spring which predisposes the trees to

Cultural Aspects

Propagation:
Normally grafted, occasionally patch budded. May be done outdoors in spring using dormant scion wood. With a poorer scion and rootstock material bench grafting followed by temperatures of 25-30°C for 2-3 weeks may be used.

Rootstocks:
Seedlings of *J. nigra* or *J. hindsii* or *J. regia* may be used. Blackline disease may be a problem with black walnut. Cross between *J. regia* and *J. hindsii* is called Paradox and is considered to be superior.

Spacing:
Used to be widely spaced on the square at 12-18 m. Newer Californian cultivars are more compact and 9m square is recommended. New plantations may be double planted and subsequently thinned.

Training and Pruning:
Initially pruned and trained to a centreleader

Marketing and Statistics

World Production: 1978 (1000 t)
Total: 785082
USA: 145149
Turkey: 150000
China: 115000

Local Production:
Negligible.

Main Products and Their Uses:
Main use is culinary.

Special Marketing Requirements:
Local market is not saturated; any move to widespread production, however, must require export and this will need to be carefully investigated.

Cultivars

Main Cultivars Grown in N.Z.
Most are seedlings. Selection of good trees within N.Z. will eventually produce local varieties. Importations from California and Germany have been planted but will take time to become generally available.

Other Important Cultivars:
German selections in N.Z.:
Geisenheim 26
Geisenheim 137
USA cultivars:
Ashley
Eureka
Franquette
Hartley
Payne
Serr
Tehana
Vina

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
simple buds laterally on the previous season's growth. Female flower buds are mixed and produced terminally on the previous year's growth. The flowers are formed terminally (and in some new cultivars laterally) on the spring shoot that originates from the terminal bud. **Growth of Fruit:** The fruit is a true nut with a divided stigma. Both the outer husk or hull and nut grow with a sigmoid growth curve.- **Time of Bud Burst (relative to apple):** Slightly after the apple in mid October. **Time of Flowering:** Pollen is normally released 10-12 days after bud burst; full bloom of female flowers is normally 25-30 days after bud burst. **Time of Maturity:** Late summer.	bacterial blight which can be a serious disadvantage in the wetter parts of N.Z. **Wind Tolerance:** Will grow a crop much more slowly if exposed to persistent winds. **Edaphic Features:** Use flat land in preference. **Soil Needs:-** Deep fertile soils are best, and it is often considered that walnuts will be economic only in the most fertile soils. **Nutrient Requirements:** Considered to need moderate amounts of nitrogen and potassium and small amounts of phosphorous.	but subsequently little pruning required. **Tillage:** In California most are grown under weed free conditions where mechanical harvesting is used. The ground must be level and either free of weeds or cut very closely. **Time to First Harvest:** 4-5 yrs with good trees, 8-10 with poor cultivars or seedling. **Time to Full Production:** 10-20 yrs depending on cultivars and density of planting. **Expected Yields:** Using good cultivars and good soils, initially planted at double spacing: 4 yrs - 1 t/ha 8 yrs - 4 t/ha 12 yrs - 9 t/ha **Normal Productive Life:** 50-100 yrs or more.		

Botanical, Anatomical, Physiological Aspects	Climatic Geographic, Soil and Water Requirements	Cultural Aspects	Marketing and Statistics	Cultivars
		Method of harvest: May be collected off ground as they fall, hulls fall away or are removed and nuts dried. Trees are often shaken mechanically and swept up off the ground. Ethephon can be used to assist dropping and hull dehiscence. **Storage:** Store the dried nuts in a cool, dry, vermin-proof situation.		

SECTION 15

GRAPES AND OTHER HORTICULTURAL CROPS

15 GRAPES AND OTHER HORTICULTURAL CROPS

15.1 GRAPE PRODUCTION

At December 1978 the estimated net area of the vineyards throughout New Zealand was 3715 hectares. The main areas are Auckland, Waikato, Poverty Bay, Hawkes Bay and Marlborough.

Grape-wine production in 1978 amounted to 40.5 million litres of which 310 000 litres was exported.

The area of table grapes under glass was in excess of 50,000 square metres with an estimated production of 200 tonnes. Exports of table grapes, mainly to Japan, amounted to about 9 tonnes.

New Zealand Official Yearbook 1979

15.1.1 Grape Husbandry

BOTANICAL, ANATOMICAL, PHYSIOLOGICAL ASPECTS

Common Name: Grape
Botanical Name: *Vitis vinifera* - Re European grape.
Botanical Name of related, useful spp:
Vitis labrusca.
Vitis aestivalis
Vitis rulpina
Vitis rupestris
Muscadinia rotundifolia
American species which are sometimes hybridised with *Vitis vinifera.*
Type of plant and size: Vine up to 20 metres in length or height, if supported.
Sexuality: Mainly hermaphrodite
Pollination: Insects not needed warm dry conditions preferred.
Flower buds: Mixed buds produced laterally on last summer's shoots. Buds opening to produce one or two shoots each with one or two bunches.
Growth of Fruit: Double sigmoid growth curve. Veraison (colour change) occurs at beginning of stage III.
Time of Bud Burst: Same as apple. Late September in north. Early-mid October in south.
Time of Flowering: 7-9 weeks later.
Time of Maturity: 5-7 months after bud burst.
Often late in season.

CLIMATIC, GEOGRAPHIC, SOILS AND WATER REQUIREMENTS

Temperature Needs: Warm temperature, 900 or more heat units (base 10°C).
Frost Tolerance: 20°C dormant
- 1°C early bud burst
- 0.5 bloom and fruit

Drought Tolerance: Good, especially if deep soils available.
Water tolerance: low in summer, moderate in winter.
Humidity Tolerance: low-heavy spraying needed in wet climates.
Wind Tolerance: moderae if on trellis.
Edaphic Features: slopes facing equator often used in cooler districts to promote heat accumulation and reduce frosts. Otherwise flats preferred.
Soil Needs: Tolerant of many soil types provided deep and well drained.
Nutrients: Heavy manuring, especially with nitrogen, causes problems especially in humid districts. Can tolerate low fertility but yields are then low.

CULTURAL ASPECTS

Types of Propagation: Where Phylloxera or nematodes are not a problem use cuttings - normally hardwood or softwood for rapid propagation. Otherwise bench or field graft onto resistant rootstocks.
Rootstocks: 5BB and SO4, now are preferred, 1202 can still be valuable on heavy wall soils.
Training and Pruning: Normally grown on vertical trellis. Use cane pruning for most wine cultivars. Spur pruning used in glasshouses and home gardens. Many variations on these main systems are used.
Tillage: Normally clean cultivated. Chemicals sometimes used between plants in rows.
Time to 1st harvest: 2nd or 3rd season after planting.
Time to full production: 3-4 seasons after planting.
Expected Yields: Very dependent on cultivar and district. Averages 2 year - 2 t/ha. 3-4 years - 4-8 t/ha.
Normal Production Life: 40-60 years.
Method of Harvest: Hand picking, mechanical harvest common for wine and juice.
Pathogens: Pest problems serious if nematodes or phylloxera present, otherwise minor. Disease serious in humid climates - main ones: powdery mildew (dry climate) downy mildew (wet climate) botrytis and rots (wet climate)

Virus
Birds serious in small plantation.
Storage: Bundes can be cool stored . . . at - 1 to 0°C. Fumigation with sulphur dioxide sometimes used.

15.2 HOPS

All New Zealands requirements are produced in the Waimea County. Production per hectare usually ranges from 1400 to 1800 kg. The total crop in the 1978 season was 210 462 kg. About 98 percent of the crop is picked by machine. Hop gardens covered 199.6 hectares in 1978 compared with 183 hectares the previous season. The average yield in 1978 was 1054 kg per hectare.

15.3 TOBACCO

Grown mainly in Motueka. The following particulars relate to total commercial tobacco production.

Season	Number of growers	Area planted hectares	Production kg (000)	Estimated Value $(000)
1973/74	340	1751	3238	7200
1974/75	306	1764	3007	7485
1975/76	308	1775	3349	9372
1976/77	315	1847	2719	9044
1977/78	309	1895	3559	12314

Purchase orders to: Accounts Office,
Lincoln College,
Canterbury,
New Zealand.