

Appendix 1

Problem weeds of pasture lands in northern Australia

The most significant weeds of pasture lands are:

- Prickly acacia (*Acacia nilotica*)
- Mimosa (*Mimosa pigra*)
- Mesquite (*Prosopis* spp.)
- Rubber vine (*Cryptostegia grandiflora*)
- Parthenium (*Parthenium hysterophorus*)

The following weeds occur at varying levels of nuisance value:

- Acacia*:
 - brigalow – suckering (*A. harpophylla*)
 - gidgee – regeneration (*A. cambagei*)
 - georgina gidgee – feed poisoning (*A. georginae*)
 - mulga – regeneration (*A. aneura*)
 - wattle – regeneration (*Acacia* spp.)
- African box thorn (*Lycium ferocissimum*)
- Calotropis (*Calotropis procera*)
- Chinee apple (*Ziziphus mauritiana*)
- Eucalypt regrowth (*Eucalyptus* spp.)
- Grasses
 - Blady grass (*Imperata cylindrica*)
 - Carpet grass (*Axonopus affinis*)
 - Rats-tail grasses (*Sporobolus* spp.)
 - Giant rats-tail (*Sporobolus pyramidalis*)
 - Wire grasses (*Aristida* spp.)
- Harrisia cactus (*Harrisia martinii*)
- Heart leaf (*Gastrolobium bilobum*)
- Hopbush (*Dodonaea* spp.)
- Hyptis (*Hyptis suaveolens*)
- Lantana (*Lantana camara*)
- Parkinsonia (*Parkinsonia aculeata*)
- Pimelea (*Pimelea pauciflora*)
- Sida (*Sida* spp.)
- Teatree (*Melaleuca* spp., *Leptospermum* spp.)
- Turkey bush (*Eremophila gilesii*)

Source: Tothill, J.C. and Gillies, C. (1992) *Tropical Grasslands. Soc. Aust. Occas. Publ. No. 5.* p 89.

Appendix 2

Guide to choosing pasture and forage crop species in Queensland using rainfall and soil fertility.

Soil fertility	Minimum annual rainfall requirement (mm)					Irrigated and ponded (P) pastures
	250	500	750	1000	1250	
	Legumes	Caribbean stylo	Centurion ^w Leucaena		American jointvetch ^w Calopo Creeping vigna ^w Greentleaf desmodium ^w	Balansa clover
Tolerate most soils		Shrubby stylo	Round-leaved cassia Lablab Siratro		Kenya white clover Silverleaf desmodium	
	Vetches^f					
	Grasses	Indian blue Sabi	Pangola ^w Plicatulum ^w Setaria ^w	Gamba ^w Koronivia ^w Signal		Hymenachne ^w (P) Para ^w (P) Aleman ^w (P)
		Barley				
Low to moderate fertility (sands, loams)	Legumes	Strand medic^f Lupina ^f Serradella ^f Subterranean clover^f	Common stylo Fine stem stylo ^f Bargoo jointvetch ^f Lotononis ^{f,w} Greater lotus ^w		Puero ^w	Subterranean clover^f
	Grasses	White panicum	Creeping blue	Bahia ^{f,w} Molasses		
Moderate to high fertility (sandy loams, clays)	Legumes	Barrel medic^f Gama medic ^{f,w} Snail medic ^f Lucerne	Cowpeas	Axillaris	Forage peanut	
	Grasses	Buffel	Sorghum alatum Silk sorghum Hybrid forage sorghums Sweet sorghum Sudan grass Oats Jap millet Purple pigeon Rhodes grass	Creeping blue Para ^w (wet, low lying locations)		
Require high fertility (loams, heavy clays)	Legumes		White clover ^{f,w}	Glycine	Centro ^w	Berseem clover Lablab Leucaena Lucerne White clover ^{f,w}
	Grasses	Makarikari panic ^{f,w}	Paspalum ^{f,w} Green panic Gatton panic Prairie ^f Phalaris ^{f,w}	Guinea Kikuyu ^f (elevated, cooler locations)		Forage sorghums Paspalum ^{f,w} Phalaris ^f Ryegrasses ^f

F = Frost tolerant W = Waterlogging tolerant

* Indicated adaptation to rainfall and soils is approximate. Legumes grown on soils of low to moderate fertility may require fertiliser particularly phosphorus and sometimes trace elements. Grasses respond well to nitrogen fertiliser under favourable moisture conditions, but the use of nitrogen is only justified in high return grazing enterprises. Medics and lucerne require neutral to alkaline soils. Species in bold print are winter growing and sown mostly in autumn/winter, the balansa are summer growing and sown mostly in spring/summer.

Appendix 3

Breed rankings in a temperate climate (unless otherwise indicated)

Birthweight and likely calving difficulty (A)	Dam calving difficulty	Milk production (B)	Growth Rate (A)	
			Tropical (*)	Temperate
Maine Anjou Chianina Charolais Brahman(*)	Simmental Charolais Blond D'Aquitaine South Devon Limousin Red Poll Hereford	Friesian Jersey Brown Swiss Simmental Sahiwal Gelbvieh Red Poll	Brahman Sahiwal Africander Droughtmaster Santa Gertrudis Belmont Red	Maine Anjou Blond D'Aquitaine Charolais Gelbvieh Simmental Chianina
Gelbvieh Brown Swiss Blonde D'Aquitaine Simmental South Devon	Maine Anjou Gelbvieh Devon Brown Swiss Friesian Murray Grey Beef Shorthorn	Brahman Santa Gertrudis Droughtmaster South Devon Maine Anjou Blond D'Aquitaine Charolais Chianina Angus Beef Shorthorn Murray Grey Limousin Galloway Devon	Angus Beef Shorthorn Galloway Jersey South Devon Brown Swiss Friesian American Angus Limousin Hereford Belmont Red Santa Gertrudis Droughtmaster Murray Grey Red Poll Devon Gelbvieh Maine Anjou Charolais Blond D'Aquitaine Simmental Chianina	South Devon Brown Swiss Friesian
Friesian Limousin Sahiwal(*)	Murray Grey Beef Shorthorn Galloway Angus Chianina Jersey	Charolais Chianina Angus Beef Shorthorn Murray Grey Limousin Galloway Devon	Limousin American Angus Limousin Hereford Belmont Red Santa Gertrudis Droughtmaster Murray Grey Red Poll Devon Gelbvieh Maine Anjou Charolais Blond D'Aquitaine Simmental Chianina	American Angus Limousin Hereford Belmont Red Santa Gertrudis Droughtmaster Murray Grey Red Poll Brahman Africander Sahiwal Devon
Red Poll Hereford Devon Santa Gertrudis(*) Droughtmaster(*) Africander(*)	Belmont Red Santa Gertrudis Droughtmaster Brahman Africander Sahiwal	Murray Grey Limousin Galloway Devon	Red Poll Devon Gelbvieh Maine Anjou Charolais Blond D'Aquitaine Simmental Chianina	Red Poll Brahman Africander Sahiwal Devon
Murray Grey Beef Shorthorn Angus Galloway Belmont Red Africander(#) Brahman(#) Sahiwal(#)		Belmont Red Africander Hereford	Belmont Red Africander Chianina	Angus Beef Shorthorn Galloway Jersey

Carcase Fat (C)	Lean/Bone Ratio (D)	Earliness of puberty
Beef Shorthorn Jersey	Blond D'Aquitaine Limousin Charolais Chianina	Jersey
Angus Galloway Red Poll Hereford Devon Brahman Sahiwal Murray Grey	Maine Anjou Gelbvieh Simmental South Devon Murray Gray Angus Galloway Brown Swiss	Friesian Angus Galloway Murray Grey Beef Shorthorn Red Poll Brown Swiss Gelbvieh South Devon Simmental Maine Anjou Belmont Red
Belmont Red Santa Gertrudis Africander Droughtmaster Friesian South Devon Brown Swiss Gelbvieh	Red Poll Hereford Devon Sahiwal Belmont Red Santa Gertrudis Africander Droughtmaster	Hereford Devon Santa Gertrudis Droughtmaster Africander Sahiwal Blond D'Aquitaine Charolais Limousin Chianina
Limousin Maine Anjou Simmental	Brahman Beef Shorthorn	Belmont Red
Charolais Blond D'Aquitaine Chianina	Friesian Jersey	Brahman

ABBREVIATIONS

- A Sire Breed Effect
- B Dam Breed Effect
- C When slaughtered at the same weight
- D The higher the lean/bone ratio, the more valuable the carcass
- * Sires mated to *Bos taurus* (non-zebu cows)
- # Sires and Dams mated to the same breed
- Extremely stressful environments e.g. far north Australia

The rankings on this page are based on United States Department of Agriculture research results with some modifications on the basis on New Zealand and Australian experiments (which were reported in the Victorian Department of Agriculture's Hamilton Pastoral Research Institute Research Review for 1987-88). The highest value is at the top of the columns. Breeds within sections are relatively similar and within breed variation would be as important as variation between breeds. *Bos indicus* and *Bos indicus* crosses estimates are from QDPI and CSIRO research.

Appendix 4

Heritability estimates for some characters in beef cattle

Character	Heritability Range	Heritability (%)	
		Temperate	Tropical
Reproduction			
Conception	low	0 - 5	5 - 20
Calving interval	low	0 - 10	na
Calving ease(heifers)	medium - high	15 - 50	na
Semen quality	medium	25 - 40	6 - 44
Scrotal circumference (18 mth)	medium - high	20 - 50	28 - 36
Serving capacity (18 months)	low - high	15 - 60	na
Maternal ability	medium	20 - 40	na
Gestation length	medium	15 - 25	na
Conformation and Growth			
Weaning score	medium	25 - 35	na
Body length	medium	25 - 45	na
Chest girth	medium - high	25 - 55	na
Wither height	medium - high	30 - 50	na
Birth weight	medium	35 - 45	35 - 45
Milk yield	medium	20 - 25	na
Weaning weight	medium	20 - 30	3 - 50
Gain - birth to weaning	medium	25 - 30	30 - 40
Yearling gain (pasture)	medium	30 - 45	20
18 month weight (pasture)	medium - high	40 - 50	30
Mature cow weight	high	50 - 70	25 - 40
Dry season gain	medium	na	30
Wet season gain	low	na	18
Carcase (US)			
Dressing percent	medium - high	30 - 50	na
Carcass weight/day of age	medium	25 - 45	na
Tenderness	high	50 - 70	na
Rump fat P8 site	medium - high	30 - 40	na
Eye Muscle Area	medium	20 - 25	na
Other traits			
Cancer eye susceptibility	medium	20 - 40	na
Eyelid pigmentation	high	45 - 60	na
Temperament	medium - high	25 - 50	25 - 50
Tick resistance	medium	na	20 - 3
Worm resistance	medium	na	25 - 30
Buffalo fly resistance	medium	na	20 - 30

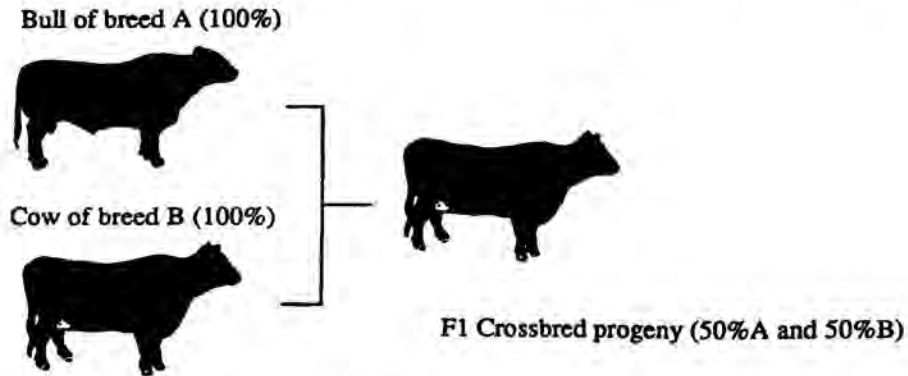
na: not available

Source: Bertram *et al.* (1995). *Breeding for Profit*, Training Series QE 93015, DPI, Brisbane.

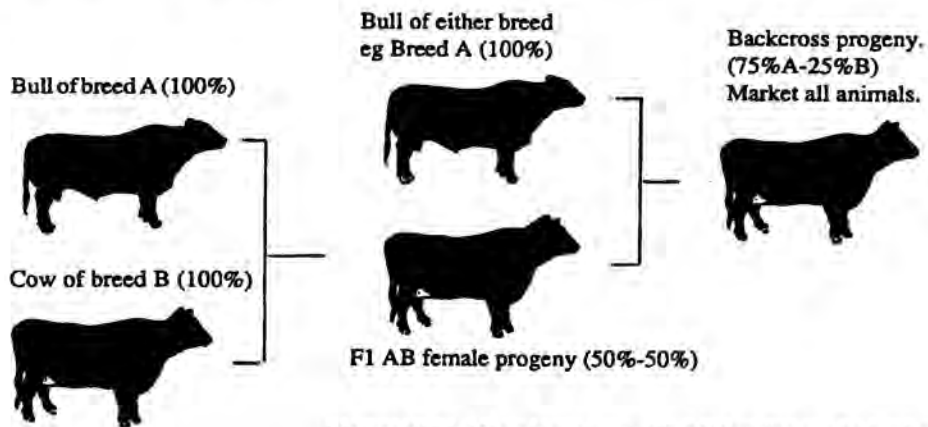
Appendix 5

Crossbreeding systems

A. Two breed cross occurs when breed A and breed B are two purebreeds and the F1 progeny (AB) contains equal parts of the two breeds.

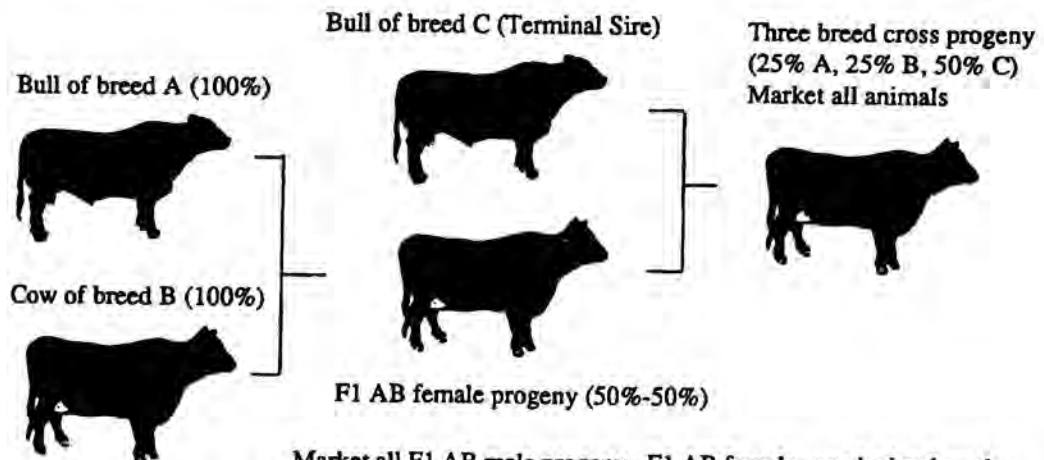


B. The backcross is obtained where all the females from a two breed cross are mated to a purebred bull of either of the original breeds. All the backcross progeny are marketed.



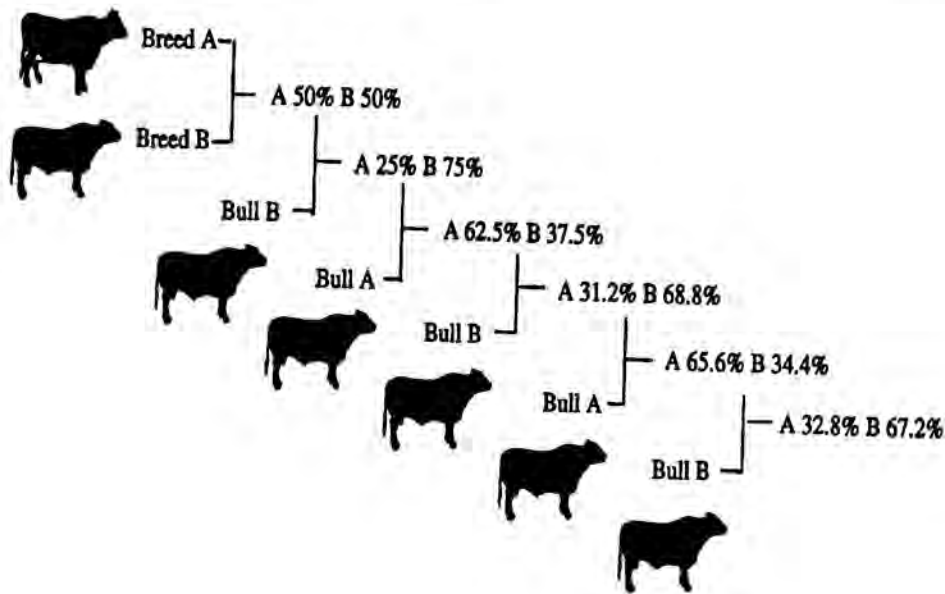
Market all F1 AB male progeny. F1 AB females can be bred on the property or brought in from properties using two breed cross.

C. The three breed cross is obtained when all the females from a two breed cross are mated to a third, unrelated breed. All the three breed cross progeny are marketed.

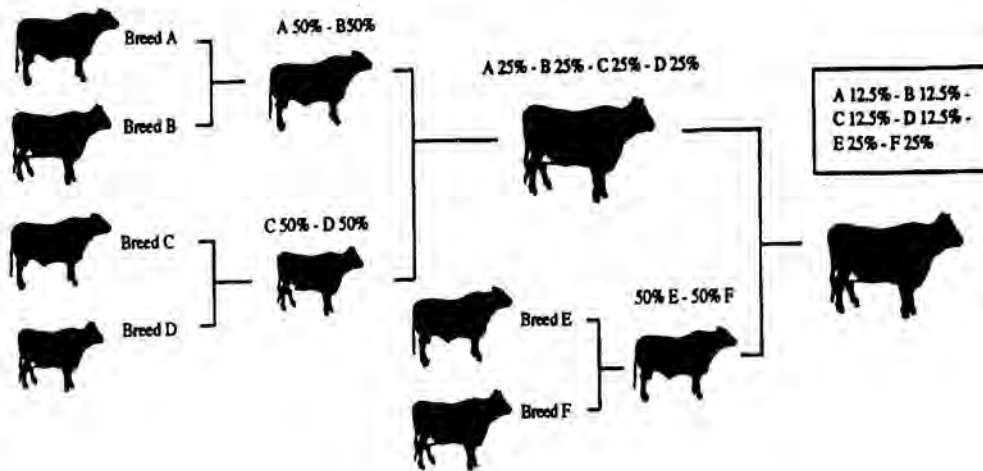


Market all F1 AB male progeny. F1 AB females can be bred on the property or brought in from properties using two breed cross.

D. Rotational crossbreeding is sometimes referred to as sequence breeding when males of two or more breeds are mated to crossbred females. Starting at 50%-50%, the rotation stabilises at 65% - 35% or 35% - 65%, giving 65% to the last used sire.



E. The development of a composite breed or synthetic breed results from the crossing of two or more existing breeds. There are many examples of this in Queensland, e.g. Santa Gertrudis, Droughtmaster, Braford, Charbray, Brangus, and Belmont Red. One simple approach to a composite breed is:



Source: Bertram *et al.* (1995). *Breeding for Profit*, Training Series QE 93015, DPI, Brisbane.

Appendix 6

Feed requirements of weaners during the dry season.

Weaner class: Weight and age	Growth objective	Pasture quality		Yard feeding
		Good grass (Maintenance)	Poor grass (Sub-maintenance)	
Normal: > 150 kg > 6 months	Up to 100 g/day	Urea blocks <i>ad lib.</i>	Urea + TP blocks <i>ad lib.</i>	Hay (1.5-2.5 kg/day)
	Survival	Dry licks 30 g urea daily	Dry licks + TP <i>ad lib.</i>	
Early: 100-150 kg 3-5 months	200 g/day	Cotton seed or Cotton seed meal (0.5 kg daily)	Cotton seed or Cotton seed meal (0.5 kg daily)	Supplement + good hay (1.5 kg daily)
		MUT <i>ad lib.</i>	MUT <i>ad lib.</i>	
Radical: < 100 kg < 3 months	300 g/day	Calf pellets 16-18 % CP (1-2 kg daily)	Calf pellets 16-18 % CP (1-2 kg daily)	Supplement + lucerne hay (1.5 kg daily)
Legend:				
Good grass	:	Feed which has good leaf and colour		
Poor grass	:	Feed which has little leaf or colour		
Urea + TP blocks	:	Blocks which contain urea and 5-10 % true protein		
Dry licks	:	Urea-based licks		
Dry licks + TP	:	Licks which also contain a protein meal, eg. cotton seed meal		
M8U	:	Molasses with 8 % urea (completely dissolved)		
MUT	:	Molasses with 5 % urea (completely dissolved) and 10 % true protein meal		

Source: Fordyce, G. (1992) Opportunities to increase productivity of north Australian breeder herds. Paper presented to North-West Pastoral Conference, Katherine, NT; October 1992.

Appendix 7

Beef market specifications

Japanese market sample specifications					
PASTURE FED	APGF50	AP1	AP2	APY	Japanese Feeder Steer
	Pasture fed grain finished for 50 days	Pasture fed 1st quality	Pasture fed 2nd quality	Pasture fed Yearling	(Shipping to Japan for feedlotting)
Carcase Weight	300-360kg	300-360kg	300-380kg	200-240kg	Liveweight 275-300kg
P8 Fat	12-22mm	12-22mm	8-16mm	6-12mm	Age of maturity Mid to late
Age	Max 4 teeth	4 teeth	Max 7 teeth	0 teeth	AUSMEAT fat score 1-2
Sex	Castrate male	Castrate male	Castrate male	Cast males/heifer	AUSMEAT muscle shape B or C
Meat Colour	1-5	1-6	1-7	1-3	Age 9-12 months
Fat Colour	4-6	4-6	6-9	4-6	Breed Angus or M/Grey
Marbling	2	2			
GRAINFED	APGF90	AGF300	AGF200	AGF150	AGY
Carcase specification after grain feeding	Pasture fed grain finished for 90 days	Grainfed 240 days of feed	Grainfed 180-200 days on feed	Grainfed 150 days on feed	Grainfed yearling 90-120 days on feed
Carcase Weight	300-360kg	360-420kg	360-420kg	320-400kg	200-260kg
P8 Fat	12-22mm	22-32mm	22-32mm	16-27mm	6-12mm
Age	Max 4 teeth	4 teeth	4 teeth	4 teeth	0 teeth
Sex	Castrate male	Steers	Steers	Steers	Steers/heifers
Meat Colour	1-5	2-4	1-4	1-5	1-3
Fat Colour	2-4	1-3	1-4	1-5	2-3
Marbling	2 and 3	5+	3-4	2	2
Liveweight specification at feedlot entry					
Liveweight	440-500kg	280-320kg	360-440kg	440-500kg	260-300kg
P8 Fat	6-10mm	4-8mm	4-10mm	6-10mm	4-8mm
Age	18-22 months	9-12 months	16-20 months	18-22 months	9-12 months
Sex	Steers	Weaned steers	Steers	Steers	Steers/heifers

Korean market sample specifications

PASTURE FED	APY	Korean Grassfed Type 1B	Korean Grassfed
	Pasture fed yearling	High quality pasture fed	AUSMEAT P1
Carcase Weight	200-240kg	225-340kg	180-280kg
P8 Fat	6-12mm	8-12mm	5-12mm
Age	0 teeth, <18 months	6 teeth max, <3 years	6 teeth max, <30 months
Sex	Steers/heifers	Steers, bulls and heifers	Steers, heifers and young cows
Meat Colour	1-3	2-4	Dark meat excluded
Fat Colour	4-6	<7, fair distribution	Yellow fat excluded
Eye Muscle Area		Min 58sq.cm at 12th rib	
Muscling		C or better	
GRAINFED	Boneless Type 1A	Frozen bone-in	AGY
Carcase specification after grain feeding	High quality grainfed, 150 days on feed (suggest European crosses)	AUSMEAT K1 100 days on feed	Grainfed yearling 90 days on feed
Carcase Wight	225-340kg 280-340kg preferred	225-340kg 240-280kg preferred	200-260kg
P8 Fat	10-22mm	4-12 mm	6-12mm
Age	24 months (2 teeth)	6 teeth	0 teeth, <18 months
Sex	steers/heifers	Steers/heifers	Steers/heifers
Meat Colour	<3	1-5	1-3
Fat Colour	1-3	4-6	0-2
Marbling	3	1 and 2	2
Muscling	C or better	C or better	C+
Liveweight specification at feedlot entry			
Liveweight	320-360kg	320-360 kg	260-300kg
P8 Fat	2-6mm	2-6mm	4-8mm
Age	15-16 months	15-16 months	9-12 months
Sex	Steers/heifers	Steers/heifers	Steers/heifers

Market	Store Specification	Live Specification	Carcass Specification
Butcher Shops			
Demand for stores is subdued with noticeable movements of stock from Victoria to the Central West of NSW.	Liveweight(kg): Sex: Muscling: No special requirements	Liveweight(kg): 300-400 Fat score: 2+/3- Sex: Steers/heifers Age: <16 months Muscle Score: A,B,C	HSCW (kg): 160-220 Fat depth (mm): 6-9 Dentition: 0 Butt shape: A,B,C Fat colour: Creamy white (0-3) Meat colour: No dark meat 1-6 Eye Muscle Area: >60 sq cm Marbling score: nil requirement
Hotels, Restaurants and Institutions			
<i>For grain fed HRI</i>			
Demand for stores is subdued with noticeable movements of stock from Victoria to the Central West of NSW.	Liveweight(kg): 300-340 Age: to 15 months Sex: Steers/heifers Muscling: A,B,C	Liveweight(kg): 410-570 Fat score: 2+/4+ Sex: Steers/heifers Age: <16 months Muscle Score: A,B,C	HSCW (kg): 220-300 Fat depth (mm): 6-22 Dentition: 0 Butt shape: A,B,C Fat colour: White (0-2) Meat colour: 1-4 Eye muscle area: nil requirement Marbling score: nil requirement
Supermarkets			
Mild conditions have favoured the turnoff of feedlot cattle reducing feed times from 100 to nearer 70 days. This has ensured steady supplies.	Liveweight(kg): 230-260 Sex: Steer Muscling: A,B,C Genetics:	Liveweight(kg): 340-400 Fat score: 2+/3- Sex: Steers/heifers Age: <16 months Muscle score: A,B,C	HSCW (kg): 180-220 Fat depth (mm): 6-9 Dentition: 0 Butt shape: A,B,C Fat colour: White (0-1) Meat colour: 1-4 Eye muscle Area: >60 sq cm Marbling score: nil requirement
EEC HGP - Free Beef			
Grass fed and grain fed and certified free of Hormonal Growth Promotants (HGPs).	Liveweight(kg): Sex: Muscling: Genetics: No special requirements	Liveweight(kg): <620 Fat score: 2+/4- Sex: Steers/heifers Age: <30 months Muscle score: A,B,C	HSCW (kg): <327 Fat depth (mm): 4-17 Dentition: 0-4 Butt shape: A,B,C Fat colour: White-creamy white (0-3) Meat Colour: 1-3 Eye muscle area: nil requirement Marbling score: nil requirement
Manufacturing			
Exported to many markets around the world and used domestically.	Liveweight(kg): Sex: Muscling: Genetics: No special requirements	Liveweight(kgs): >420 Fat Score: Sex: Bull, Steers, Heifers Age: Muscle Score: A-E	HSCW (kgs): >220 Fat depth (mm): Dentition: 0-8 Butt shape: A,B,C,D,E Fat colour: nil requirement Meat Colour: nil requirement Eye muscle area: nil requirement

Specifications current at February 1993.

Source: Bertram *et al.* (1995). *Breeding for Profit*, Training Series QE 93015, DPI, Brisbane.

Appendix 8

Effect of grain and protein supplementation on liveweight change (kg/day) of dairy calves and heifers grazing tropical grass and legume forages.

Growth phase:	Pre-wean		Post-wean	Yearling		1-2 yrs
Age (months):	0-1	1-2	2-6	6-12	6-18	
Liveweight (kg):		60	60-150	130-280	130-350	300-500
TROPICAL GRASS + NITROGEN PASTURE						
● 4.5 kg milk + pasture or legume hay						
Nil supplement	0.33	0.57				
Ad lib. maize grain - 0.5 kg/d	0.31	0.65				
● Tropical grass (irrigated + N) (15% CP)						
Nil supplement			0.23			
Maize - 1.0 kg/d (10% CP)			0.53			
Maize - 1.5 kg/d (10% CP)			0.58			
5M:1CSM - 1.0 kg/d (15% CP)			0.55			
5M:1CSM - 1.5 kg/d (15% CP)			0.64			
● Paspalum hay (8% CP) +minerals (salt/DCP)						
Grain/CSM @ 1.5% live weight (15% CP)			0.52			
Molasses/urea/CSM @ 1.5% liveweight (15% CP)			0.50			
● Tropical grass (irrigated + N) (12/ha)						
Nil supplement				0.41		
Maize - 1.5 kg/d (10% CP)				0.60		
Molasses + Phosphorus - 1.8 kg/d (6% CP)				0.60		
● Tropical grass (irrigated + N) (7.4/ha)						
Nil supplement					0.50	
Maize - 1.4 kg/d (10% CP)					0.62	
● Tropical grass (raingrown + N) (kikuyu) (2.5-4.2/ha)						
Nil supplement					0.52	
● Tropical grass (irrigated + N) (7.4/ha)						
Nil supplement						0.70
LEGUME PASTURE OR HAY						
● Tropical grass + legume						
Maize - 0.9 kg/d (10% CP)			0.45			
Maize/blood meal - 0.9 kg/d (18% CP)			0.56			
● Lucerne hay + concentrate + minerals (salt/DCP)						
Sorghum - 1.2 kg/d (11% CP)			0.71			
Sorghum/CSM - 1.2 kg/d (15% CP)			0.73			
Molasses - 1.5 kg/d (6% CP)			0.64			
Molasses/CSM - 1.5 kg/d (11% CP)			0.69			
● Lucerne hay (2-12m)						
Maize @ 1.5% live weight (10% CP)				0.73		
● Tropical grass-legume + milk (suckled 0-10m)						
4 calves/cow				0.62		
2 calves/cow				0.70		
2 calves/cow						
Nil supplement			0.82	0.80		
Maize - 2.0 kg/d (8-10m)			-	0.88		
● Tropical grass-legume(1.3/ha)						
Nil supplement (steers: 130-500 kg)						0.65
Nil supplement (steers: 300-500 kg)						0.79

Source; Moss, R. J. (1993). Rearing heifers in the subtropics and tropics: nutrient requirements and supplementation. *Tropical Grasslands*. 27, 238-249.

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