PROGRAZE™

Profitable, sustainable grazing

SEGMENT 7

FODDER BUDGETING AND GRAZING FOR WORM CONTROL

In this segment you will learn:

- How to prepare a fodder budget.
- How to use a fodder budget to assist with stocking rate and grazing management decisions.
- How grazing management is used to reduce the incidence of internal parasites.

FODDER BUDGETING AND GRAZING FOR WORM CONTROL

Pasture assessment and animal assessment skills form the basis of monitoring the targets that you will set for beef or sheep enterprises. Grazing management options allow you to modify the animal impact on pasture to achieve a certain animal or pasture target, while the need for an overall plan is paramount to ensure you and your enterprises are on track.

Another tool to keep the plan on track is fodder budgeting.

FODDER BUDGETING

Fodder budgets, which usually integrate production targets via the pasture benchmarks in section 2, provide a basis for planning over 2 to 5 months during the pasture growing season. Fodder budgeting involves assessing current pasture mass (kg DM/ha), adding potential pasture growth (kg DM/ha/day) and subtracting livestock intake/ha (stocking rate* animal intake). A fodder budgeting process can be used to determine stocking rate, grazing days or to identify pasture surpluses or deficits. A template for these calculations is given in Appendix 7. Strategies can then be developed to handle unexpected situations before they occur, thus avoiding crisis management.

A fodder budget can be for a paddock or any area up to the whole farm.

The budget period is normally set by the requirements of your stock, e.g. from mid-pregnancy until birth, or ensuring adequate growth of replacement females during winter. A quick budget can be done by comparing the pasture growth rates (kg DM/ha/day) with animal intake/ha/day (stocking rate/ha* animal intake). The units are the same kg DM/ha/day so you are not dealing with big numbers. This will tell you what direction and how quickly the paddock is changing.

A fodder budget by itself does nothing to improve management. It is the action resulting from the budget that is critical. If you do a budget at the same time each year and it is always in deficit, your overall management calendar needs re-thinking.

Budgeting over the dry period needs to include pasture decay rates which are hard to obtain. Advice is need if you intend to budget during the dry period of the year. Approximately half of the dry matter at the end of spring will decay by the following autumn even in an unstocked paddock.

Bill's fodder budget	
Pasture available	
Present pasture mass	1700 kg green DM/ha
Less Bill's required minimum pasture mass	1200 kg green DM/ha
Available pasture from the existing supply	500 kg green DM/ha
Plus pasture growth – 42 days lambing × 20 kg DM/ha/day	840 kg green DM/ha
Total available pasture	1340 kg green DM/ha
Livestock requirements	
Ewes intake 2.7 kg green DM/head/day × 42 days (Intake estimate includes an additional 15% for spoilage due to grazing)	113 kg green DM/head
No. of ewes per hectare = total available pasture ÷ livestock requirements = 1340 ÷ 113 = **11.8**	
Bill's stocking rate: **11.8 ewes/ha times 40 ha equals approximately 470 ewes for the paddock.**	

An example might be that Bill wants to know how many lambing ewes he can put on a 40 ha paddock. At present the paddock contains 1700 kg green DM/ha.

Bill wants the paddock to last the 42 days of lambing and to maintain at least 1200 kg green DM/ha in the lambing paddock (pasture benchmark for lactating ewes). Average pasture growth rate is estimated to be 20 kg DM/ha/day and ewe intake of pasture is 2.3 kg green DM/head/day.

Alternatively, the question may be how long a paddock is likely to last a mob; in these circumstances the calculations are just rearranged. For example, Bill has another mob of 200 ewes in late pregnancy grazing a 14 ha paddock. Will the paddock last the 42 days of lambing?

The intended stocking rate is 200÷14 = 14.3 ewes/ha, which have an intake of 2.7 kg dm/hd/day giving an intake/ha of 39 kg dm/ha/day. Expected pasture growth for the period was 20 kg dm/ha/day. So the animal intake is twice the pasture growth and the 500 kg dm/ha of pasture surplus will be quickly consumed, 500÷19 = 26 days so the paddock will not last the lambing period.

As there is a shortfall Bill is presented with four possible options: he can either reduce stock numbers in the paddock, find an alternative paddock for the mob, supplementary feed the mob in the existing paddock or accept a lower level of production from the ewes.

Another example might be that Bill wants to know how long a 12 ha paddock of oats is going to last his 55 steers.

Bill has assessed the crop and predicts the herbage mass to be 1900 kg green DM/ha and he will remove the steers once the herbage mass reaches 1500 kg green DM/ha. The growth rate of the oats is predicted over the next 2 months to be 27 kg DM/day.

Bill's other fodder budget	
Pasture available	
Present herbage mass	1900 kg green DM/ha
Less Bill's required minimum herbage mass	1500 kg green DM/ha
Available herbage from the existing supply	400 kg green DM/ha
Daily growth rate of the oats	27 kg DM/ha/day
Livestock requirements	
Stocking density (55 steers ÷ 12 hectares)	4.6 steers/ha
Livestock intake (9.1 kg DM/head/day × 4.6 steers/ha) (The requirement of 9.1 kg DM/hd/d is derived from an intake of 7 kg DM/d plus another 30% of this figure to allow for spoilage)	42 kg DM/ha/day
Results	
These calculations indicate a net herbage loss of 15 kg DM/ha/day (The livestock requirements of 42 kg DM/ha/day minus the growth rate of 27 kg DM/ha/day) Therefore, available herbage from the existing supply (400 kg DM/ha) is declining at the rate of 15 kg DM/ha/day.	
To Bill's question, how long will the paddock last? (400 kg DM/ha ÷ 15 kg DM/ha/day)	**About 27 days**

Intake by the steers is predicted to be 7 kg DM/day. Due to the relatively wet soil conditions usually experienced during these winter months, spoilage of the crop caused by grazing is expected to add 30% to the intake prediction. Adjust the spoilage figure to reflect the conditions.

Over the whole farm if there is a feed:

- **Surplus**. Options may be to make silage or hay, buy trading stock, take on agistment, increase target marketing weights of existing stock, or leave in the paddock for future use when feed is short.
- **Deficit**. Options may be to feed supplements, ration feed via high density rotation, seek agistment, sell stock, or accept lower levels of production.

Pasture growth

Pasture growth estimates are required for fodder budgeting. General examples for NSW can be found in Appendix 4. Remember these are generalised estimates and may require adjustment due to location, soils, fertility and/or season. Take account of existing soil moisture and paddock aspect when selecting growth rates in late spring.

Estimates of pasture growth rate, in conjunction with pasture assessment and individual animal requirements (see Individual animal allowances below), will allow fodder budgets to be calculated. If you are able to obtain relevant pasture growth figures from any source for your local area, the precision of the fodder budget will be increased.

Livestock intakes

As part of feed budgeting, a prediction of pasture intake by livestock is required. GrazFeed® was used to produce Tables 7.1 to 7.4 providing intakes over a range of herbage masses and digestibilities based on **temperature pastures**. The numbers are rounded to one decimal place which explains why the same numbers appear in different herbage masses.

These tables are a guide to the daily pasture intake of sheep and cattle. The tables are **NOT meant to indicate livestock requirements** but rather how much stock are likely to consume each day from the pastures described. In fact, at the lower herbage masses and/or digestibilities stock will have significant weight loss. In the sheep table the intakes figures in **bold** indicate that the ewes are gaining weight. These tables were developed using predictions from GrazFeed®. On most properties you will only be using one of the weight ranges for your sheep or cattle so most of the table does not apply to you. The weights are the mature weight of females at fat score 3, for sheep the 40 kg are traditional super fine ewes, the 50 kg and 60 kg cover the merinos and the 70 kg represents the xbred ewe. The same logical applies to the cattle weights.

These tables should be used in conjunction with the pasture benchmarks (see Segment 2). Remember, avoid grazing below the benchmark otherwise pasture intake would be insufficient for desired production levels.

Pasture spoilage

In addition to the pasture or fodder crop consumed by grazing livestock, there is an added loss of plant material which should be included in the fodder budget. This loss or spoilage is caused by stock treading on plants or as a result of their excretions.

Due to the interaction of a number of factors, it is difficult to be precise as to the extent of the spoilage. These factors include herbage mass, stocking rate, whether they be sheep or cattle, pasture and soil type and in particular, the moisture content of the surface soil. Below 1000 kg DM/ha spoilage is very low and can be ignored. By adding the spoilage to the animal intake figure (often rounding intake up to a whole number) variation in stocking rates are accounted for.

An appropriate percentage increase in per head intake is probably in the range of 5 to 30%, being at the upper end when soils are wet and herbage mass is greater than 2000 kg DM/ha.However, it is important to recognise spoilage can be considerably higher than indicated by this range. For example, total yield losses in the order of 50% have been estimated for cattle on grazing cereal crops under very wet conditions.

While spoilage results in potential loss of feed for livestock, it is not wasted to the system. This material is likely to become part of the litter layer, protecting the soil surface from rain and surface run-off and eventually incorporated as organic matter within the soil.

Table 7.1. Predicted daily intake of pasture by ewes.

Livestock Category	Herbage Mass (kg DM/ha)														
	500					1000					1500				
	Pasture Digestibility (%)					Pasture Digestibility (%)					Pasture Digestibility (%)				
	40	50	60	70	80	40	50	60	70	80	40	50	60	70	80
	kg/h/d					kg/h/d					kg/h/d				
40 kg Ewe when FS 3															
Dry or pregnant	0.2	0.4	0.6	**0.7**	**0.9**	0.3	0.5	0.8	**1.0**	**1.1**	0.4	0.5	**0.8**	**1.1**	**1.2**
Lactating – singles*	0.4	0.7	0.9	1.2	**1.4**	0.6	0.8	1.3	**1.6**	**1.8**	0.7	0.9	1.4	**1.7**	**1.9**
Lactating – twins*	0.5	0.8	1.0	1.3	1.5	0.7	0.9	1.5	1.8	**1.9**	0.8	1.0	1.7	**2.0**	**2.1**
50 kg Ewe when FS 3															
Dry or pregnant	0.3	0.5	0.7	**0.9**	**1.2**	0.4	0.6	1.0	**1.2**	**1.3**	0.6	0.7	**1.1**	**1.3**	**1.4**
Lactating – singles*	0.5	0.9	1.1	1.4	**1.9**	0.8	1.0	1.6	**1.9**	**2.1**	0.9	1.0	1.7	**2.0**	**2.2**
Lactating – twins*	0.6	1.0	1.3	1.6	2.0	0.9	1.1	1.9	2.2	**2.3**	1.0	1.1	2.1	**2.4**	**2.5**
60 kg Ewe when FS 3															
Dry or pregnant	0.4	0.7	0.8	**1.0**	**1.5**	0.5	0.7	1.2	**1.4**	**1.6**	0.7	0.8	**1.3**	**1.6**	**1.7**
Lactating – singles*	0.6	1.1	1.4	1.7	**2.2**	0.9	1.2	1.9	**2.2**	**2.5**	1.2	1.4	2.1	**2.4**	**2.6**
Lactating – twins*	0.7	1.2	1.6	1.9	2.4	1.0	1.3	2.2	2.7	**2.9**	1.3	1.5	2.5	**2.9**	**3.1**
70 kg Ewe when FS 3															
Dry or pregnant	0.4	0.8	1.0	**1.2**	**1.7**	0.6	0.8	1.4	**1.7**	**1.9**	0.8	0.9	**1.5**	**1.8**	**1.9**
Lactating – singles*	0.7	1.3	1.6	1.9	**2.6**	1.0	1.3	2.2	**2.6**	**2.9**	1.3	1.4	2.4	**2.8**	**2.9**
Lactating – twins*	0.8	1.4	1.8	2.1	2.8	1.1	1.4	2.6	3.1	**3.4**	1.4	1.5	2.9	**3.4**	**3.6**

* For lactating ewes, an allowance has been made for the pasture intake of their lambs.

Table 7.2. Predicted daily intake of pasture by cows.

	Herbage Mass (kg DM/ha)																			
	500					1000					1800					2600				
	Pasture Digestibility (%)					Pasture Digestibility (%)					Pasture Digestibility (%)					Pasture Digestibility (%)				
	40	50	60	70	80	40	50	60	70	80	40	50	60	70	80	40	50	60	70	80
Livestock Category	kg/h/d					kg/h/d					kg/h/d					kg/h/d				
400 kg Cow when FS 3																				
Dry/late pregnancy (8 mths)	1.1	2.3	2.7	3.4	4.2	1.9	3.0	4.1	5.2	6.3	2.5	3.7	5.2	6.3	6.8	3.2	4.9	6.6	6.8	7.0
Early lactating (2 mths)*	1.8	4.0	4.7	5.5	6.4	3.1	4.8	6.6	8.0	9.3	4.4	5.2	7.1	9.5	10.1	5.2	6.9	8.6	10.0	10.4
Late lactation (5 mths)*	2.5	4.9	6.2	7.4	8.5	4.7	6.8	8.9	10.6	12.2	6.3	8.8	10.7	12.7	13.5	6.8	9.3	11.3	13.4	13.9
500 kg Cow when FS 3																				
Dry/late pregnancy (8 mths)	1.4	3.1	3.5	4.2	5.0	2.3	3.8	5.2	6.5	7.8	3.4	4.9	6.5	7.9	8.5	4.0	5.4	6.9	8.4	8.8
Early lactating (2 mths)*	2.2	4.8	5.5	6.8	8.2	3.8	6.0	8.2	9.9	11.6	5.5	7.7	10.0	11.8	12.5	6.4	8.6	10.7	12.4	12.9
Late lactation (5 mths)*	2.9	5.7	7.1	8.9	10.7	5.1	7.8	10.8	12.8	14.0	7.0	10.0	13.0	15.4	16.4	8.3	11.0	13.7	16.3	17.0
600 kg Cow when FS 3																				
Dry/late pregnancy (8 mths)	1.6	3.2	4.1	5.1	6.2	2.8	4.8	6.2	7.8	9.4	4.1	6.5	7.8	9.5	10.2	4.9	7.3	8.4	10.1	10.6
Early lactating (2 mths)*	2.7	5.2	6.6	8.1	9.7	4.5	7.7	9.9	11.8	13.5	6.6	10.2	12.0	14.2	15.0	7.7	11.4	12.8	14.9	15.5
Late lactation (5 mths)*	3.4	6.3	8.6	10.7	12.9	5.8	10.1	12.9	15.3	17.5	8.5	13.4	15.7	18.6	19.7	9.9	14.9	16.4	19.5	20.3
700 kg Cow when FS 3																				
Dry/late pregnancy (8 mths)	1.9	3.6	4.7	6.0	7.4	3.3	5.6	7.1	9.1	10.7	4.8	7.5	9.1	11.1	11.9	5.7	8.6	9.8	11.8	12.4
Early lactating (2 mths)*	3.1	5.9	7.7	9.4	11.1	5.3	9.0	11.5	13.7	15.9	7.7	11.9	14.0	16.5	17.5	9.0	13.3	14.9	17.4	18.0
Late lactation (5 mths)*	4.0	7.2	9.9	12.3	14.7	6.7	11.6	14.9	16.6	18.3	9.7	15.4	17.9	21.1	22.6	11.4	17.2	18.9	22.4	23.4

* For lactating cows, an allowance has been made for the pasture intake of their calves.

Table 7.3. Predicted daily intake of pasture by weaner sheep.

	Herbage Mass (kg DM/ha)														
	500					1000					1500				
	Pasture Digestibility (%)					Pasture Digestibility (%)					Pasture Digestibility (%)				
	40	50	60	70	80	40	50	60	70	80	40	50	60	70	80
Lamb weight (kg)	kg/h/d					kg/h/d					kg/h/d				
15	0.2	0.3	0.4	0.5	0.6	0.3	0.5	0.6	0.7	0.8	0.4	0.6	0.7	0.8	0.9
25	0.3	0.5	0.6	0.8	1.0	0.4	0.7	0.9	1.1	1.2	0.5	0.8	1.0	1.2	1.3
35	0.3	0.6	0.8	1.0	1.2	0.5	0.9	1.1	1.3	1.5	0.6	0.9	1.2	1.4	1.5
45	0.3	0.7	0.9	1.1	1.3	0.6	1.0	1.2	1.5	1.6	0.7	1.1	1.3	1.6	1.7

1. The weaners described in this table are assumed to be the progeny from ewes with a standard reference weight of 50 kg.
2. The table is based on wethers. Intakes of ewe weaners would be approximately 10% below those indicated.

Table 7.4. Predicted daily intake of pasture by weaner/younger cattle.

	Herbage Mass (kg DM/ha)																			
	500					1000					1800					2600				
	Pasture Digestibility (%)					Pasture Digestibility (%)					Pasture Digestibility (%)					Pasture Digestibility (%)				
	40	50	60	70	80	40	50	60	70	80	40	50	60	70	80	40	50	60	70	80
Cattle weight (kg)	kg/h/d					kg/h/d					kg/h/d					kg/h/d				
150	1.0	1.8	2.4	3.1	3.8	1.6	2.8	3.5	4.4	5.2	2.3	3.6	4.2	5.1	5.4	2.7	4.0	4.5	5.3	5.5
200	1.3	2.3	3.1	3.9	4.7	2.1	3.6	4.6	5.7	6.8	3.0	4.6	5.5	6.6	7.0	3.4	5.1	5.8	6.9	7.2
250	1.4	2.4	3.3	4.1	4.9	2.2	3.8	4.9	6.1	7.4	3.2	5.1	6.0	7.4	7.8	3.7	5.7	6.5	7.8	8.1
300	1.4	2.5	3.5	4.3	5.1	2.4	4.1	5.3	6.6	8.0	3.4	5.5	6.6	8.1	8.6	4.0	6.2	7.2	8.6	9.0
350	1.5	2.7	3.8	4.7	5.6	2.6	4.4	5.8	7.2	8.6	3.7	6.0	7.2	8.8	9.5	4.4	6.8	7.8	9.4	9.8
400	1.6	2.9	4.0	5.0	6.1	2.7	4.7	6.1	7.6	9.0	4.0	6.3	7.6	9.3	10.0	4.7	7.2	8.2	9.9	10.3
450	1.7	3.0	4.1	5.2	6.3	2.9	4.9	6.2	7.8	9.4	4.1	6.5	7.9	9.6	10.3	4.9	7.4	8.5	10.2	10.7

1. The cattle described in this table are assumed to be the progeny from cows with a standard reference weight of 500 kg.
2. The table is based on steers. Intakes of females would be approximately 10% below those indicated.
3. For live weights greater than 450 kg, use pasture intake predictions indicated for 450 kg.

GRAZING MANAGEMENT FOR CONTROLLING WORMS IN SHEEP AND CATTLE

Increased animal production can be achieved by a well-defined strategy, matching livestock requirements with pasture production, Good parasite control is critical to such an outcome. This section outlines how grazing practices can optimise productivity and worm control.

Survival of worms on pasture

Parasite burdens occur in animals because they graze pasture containing infective worm larvae. The worm larvae migrate onto the herbage after hatching from eggs passed in animal dung.

Worm larvae can last for long periods on pasture provided the weather is not too hot or too dry. Paddocks grazed by livestock are rarely 'worm free' but graziers can create 'safer' pastures with low worm numbers by:

Resting paddocks or controlling contamination so that high levels of worm larvae are avoided.

Resting paddocks in summer is effective for worm control when it is hot for at least 6–8 weeks. Unless it is very hot, rapid rotation of stock around paddocks does not control worm problems because the resting phase is usually too short to be effective. However, adequate resting may be impractical on properties with limited feed. The lower the herbage mass the quicker that hot weather will kill the larvae as they are exposed.

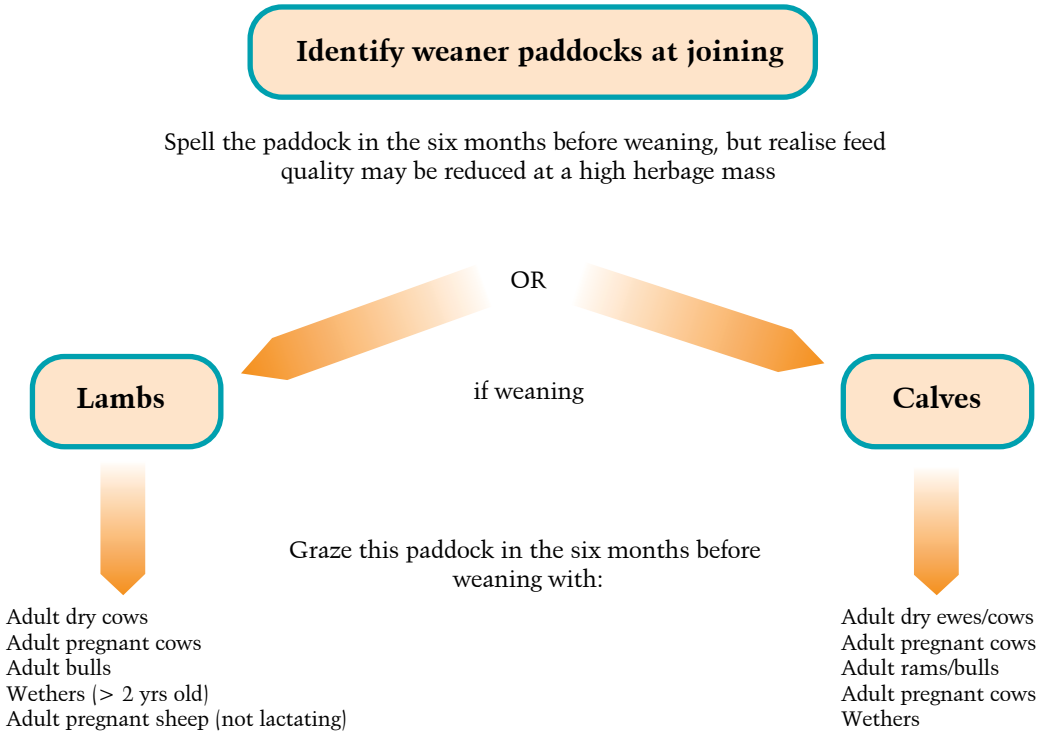
Alternate grazing of sheep and cattle

Alternate cattle/sheep grazing exploits the fact that major cattle worms do not affect sheep and vice versa (one exception is liver fluke). For example, in periods of peak pasture production cattle can usually be grazed on sheep paddocks; weaner cattle are drenched onto sheep-grazed pastures and young sheep drenched onto cattle-grazed pastures. (WormTest first to see if drenching is required.)

Avoid contaminating pastures where susceptible stock will graze.

Certain classes of livestock are easily infected by worms because they have not developed resistance or immunity (young animals) or have temporarily lost their resistance (lactating ewes). Similarly, well-nourished adult dry animals develop resistance to worms.

Figure 7.1. Specific stock classes to graze calf or lamb weaning paddocks.



Resistant stock can graze pastures that will be used later by susceptible stock. Also, resistant animals can safely graze paddocks that have been grazed previously by susceptible stock although, occasionally, barber's pole can infect resistant stock.

Livestock can be ranked for priority treatment of access to clean paddocks and to identify which class has the capacity to prepare clean paddocks:

Highest priority for clean pastures

Least resistant:

- Weaned lambs (less than 1 year old).
- Late pregnant and lactating ewes.
- Weaned calves (less than 18 months old).
- Hogget sheep.
- Cow with calf (combined with nutritional stress).

Most resistant:

- Dry (adult) ewes (more than 2 years old).
- Adult wethers (more than 2 years old).
- All adult dry cattle (more than 2 years old)

Strategies for worm control

Paddocks being made 'low worm' should only be grazed by the alternate species; or secondly, by resistant stock of the same species. Pregnant cattle can prepare pasture for both sheep and cattle weaners but heavily pregnant sheep (more than 4 months) should not be used to prepare paddocks for weaner sheep.

The maximum benefit from grazing management comes when it is used in conjunction with a strategic worm control program:

- DrenchPlan for sheep in southern New South Wales (winter rainfall).
- WormKill for sheep in northern New South Wales (summer rainfall).
- WestWorm and Far-West Worm for sheep in western New South Wales.
- Cattle strategic drenching programs recommended by your adviser.

Supplementary feeding and drenching are available to increase the flexibility of grazing options for worm control but they can be costly and not always necessary.

As part of the grazing plan which was discussed earlier, include strategies for 'low worm' paddocks for susceptible stock. Susceptible stock usually have high nutritional needs, so plan to create low worm, high nutrition paddocks.

Graze weaning paddocks with stock that will assist in making it worm-free (see Figure 7.1). For 'clean' weaning paddocks, avoid grazing with susceptible stock in the previous 6 months. Sometimes 2–3 year old wethers have considerably higher worm counts than mature wethers. Should it be the intention to use such wethers to prepare paddocks for weaners, especially if the intention is to graze the paddock at a reasonably high stocking density, it is advisable to conduct a Wormtest to determine the wether's worm status prior to grazing.

In northern New South Wales good control of barber's pole in sheep can be achieved by grazing cattle from October into summer. When barber's pole burdens increase in young sheep towards late summer they can be drenched (WormTest first) onto the paddocks previously grazed by cattle.

Good lambing paddock preparation improves productivity and worm control in ewes, lambs and weaners. The aim is for ewes to lamb on paddocks with 900 to 1500 kg DM/ha and few worms. To achieve the aim any grazing within 6 month of lambing must be done with sheep either WormTest and low or drenched with any effective product within the last 3 weeks. Lambing paddocks can also be grazed by sheep in the June to August period in the colder parts of the Northern Tablelands.

Poor nutrition combined with parasitism can have serious consequences. An early warning system is therefore required.

Monitoring progress

Monitoring parasite burdens is done by counting parasite eggs in dung (faecal worm egg counts) and is especially useful in young sheep.

Samples of faeces are collected from representative animals in mobs. These samples are then sent for analysis. Worm eggs are counted (and worm typed if required) and, in consultation with your veterinary adviser, a decision made about the need for drenching.

WormTest enables better use of drenches. Sheep that are not wormy are not drenched; sheep that are very wormy are drenched before deaths occur. On most occasions, ewes do not need a pre-lamb drench. Don't guess Wormtest.

The Wormboss web site provides detailed information on a regional basis for all aspects of worm control in sheep.

There is an increasing problem in cattle with drench resistance so more attention needs to be paid to the control programs. The cattle parasite atlas on the MLA web site is a good resource.

More than just drenching

Worm control involves more than just drenching. Grazing management is another tool that can be used to manage worms. As worm resistance increases the role of grazing management will become more important. An 'integrated' approach to worm control is advocated, employing several interwoven methods to achieve sustainable worm control. Following is an outline of integrated worm control:

- The right drench at the right time
- Grazing management
- Flock management, including 'early weaning'
- Breeding sheep more resistant to worms
- Nutrition, and
- 'Fine-tuning' based on regular worm egg count monitoring (Wormtest) and drench efficiency testing (Drench Test – worm egg count reduction test).

SUMMARY

Fodder budgets are used:

- to assist with more pro-active decisions in respect to grazing management.
- to assist in achieving pasture and animal targets.
- to predict surpluses and deficits in pasture supply. Early recognition of a deficit allows you to access fodder at potentially lower prices because you are in the market before the majority of producers. The same logic applies to buy trading stock in a surplus situation, early entry to the market can have price advantages.

Tactical grazing of pasture with sheep and cattle can be used to provide cleaner paddocks with a low worm burden.

Further reading and information

- *A guide to feed planning for sheep farmers*. New Zealand Sheep Council.
- *DrenchPlan*. Primefact 14. www.dpi.nsw.gov.au
- *WormKill*. Primefact 1079. www.dpi.nsw.gov.au
- *West Worm and Far West Worm*. Primefact 736. www.dpi.nsw.gov.au
- Other Primefact on worm control. www.dpi.nsw.gov.au
- *Cattle worm control – the basics*. Prime fact 419. www.dpi.nsw.gov.au
- WORMBOSS. www.wormboss.com.au