GRAZING MANAGEMENT - SOME KEY ISSUES:

FORAGE CROPS AND FEED GAPS

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Abstract: The role and usefulness of forage crops will vary on an individual property as determined by the composition of existing pastures. In those situations where a deficit occurs in pastures to provide sufficient feed of adequate quality and quantity to satisfy animal requirements during critical periods (feed gaps) then I believe forage crops can have a vital role to play. However, where both the quality and productive capacity of existing pasture resources are high and they have been managed to ensure maximum year-round production of high quality feed then the role of forage crops must be seriously questioned. Even in these situations however forage crops may be sown for the ulterior agronomic advantages they can provide in whole farm management.

INTRODUCTION

Forage crops can play a vital and integral role in overall farm management. Their usefulness will be determined on an individual property basis in accordance with the existing pasture resources and their overall levels of production together with the specialised feed requirements of the grazing animal.

This paper attempts to present some of the advantages which both summer and winter forage crops can provide with special emphasis upon their role in overcoming feed gaps. While I am most familiar with the Monaro region of NSW I have attempted to direct the paper towards the tablelands of NSW so that it can be as meaningful and relevant as possible. In order to realistically assess the contribution which forage crops can make to overall farm management I have first provided a general outline of the status of existing pasture resources throughout the tablelands of NSW.

EXISTING PASTURE RESOURCES

Native Pastures

Animal production throughout the tablelands of NSW is based upon the grazing of native, naturalised or introduced species. While the total area of improved pastures (56% of the region) exceeds that of the native pastures, the ratio varies according to location. The central and southern tablelands account for the highest proportion of sown species with approximately two thirds (65%) being pasture improved while the northern tablelands and Monaro (52% and 54% respectively) still maintain a higher percentage of existing native vegetation.

In terms of carrying capacity unimproved native and naturalised pastures generally are far less productive than introduced pasture species. The carrying capacity of unimproved pastures on the central tablelands is about 2 DSE/ ha, (Crofts, 1982), compared to improved pastures that can carry about 10 DSE/ha. Similar estimated marked differences in carrying capacities can be expected on the northern tablelands (Lodge and Whalley, 1989), southern tablelands (Simpson, 1991) and Monaro .

The species abundance and distribution of native grasses throughout the tablelands varies according to location. The most frequent species occurring in the northern tablelands are the summer growing perennials *Bothriochloa macra* (redgrass) and *Aristida ra-*

Table 1: Area of improved and native pasture throughout the tablelands of New South Wales, 1987/88 (Source: NSW Agriculture, Agricultural Statistics Summary, 1987-88).

Region	Total area (ha)	Improved pastures (ha)	%	Native pastures (ha)	%
Southern Tablelands	856723	553579	65	303144	35
Central Tablelands	594993	382876	64	212117	36
Northern Tablelands	1409008	679603	48	729405	52
Monaro	465200	214363	46	250837	54
Total	3325924	1830421	56	1495503	44

mosa (wiregrass). Other species such as *Dichanthium sericeum* (bluegrass), *Eragrostis* spp. (lovegrasses), *Chloris truncata* (windmill grass), *Panicum effusum* (hairy panic) and *Sporobolus elongatus* (slender rats tail) are also relatively abundant warm season perennials. Of the yearlong green perennials grasses, *Microlaena stipoides* (weeping grass) is commonly found throughout the northern tablelands (M Duncan, *pers. comm.*), as are *Stipa scabra* (corkscrew grass), *Danthonia* species (wallaby grasses), and *Poa sieberana* (poa tussock).

The native grasses of the central and southern tablelands and Monaro have been the subject of a major survey effort over the past 2 years (D.Garden, P.Dowling and D.Eddy, unpublished). The findings are presented in Table 2 which summarises the percentage distribution of the major native pasture species.

It should be noted that percentage distribution does not necessarily relate to the abundance of the species within the pasture nor to the contribution which these species make to the total level of production. For example, while *Stipa scabra* was located at only 13% of sites on the Monaro, at most of these sites it is a dominant component of the pasture. Conversely in another survey on the northern tablelands and slopes *Stipa scabra* was found at 73% of sites but its frequency of occurrence (*ie.* abundance) was only 6% (Lodge and Whalley, 1989).

The quality and usefulness of our native pastures and the contribution which they make to overall levels of animal production can be directly related to species composition and fertility (Robinson and Archer, 1988). The warm season frost tender species such as *Bothriochloa*, *Aristida* and *Themeda* (kangaroo grass)produce most of their feed during the summer and early autumn period and have the major limitation of a low availability of green forage in late autumn, winter and spring. Consequently, very low stocking rates reflect the lack of both quantity and quality of available feed from such pastures during winter.

Table 2: Percentage distribution of native perennial grass species throughout the Central and Southern tablelands and Monaro, 1992 (Source: D.Garden, unpublished data).

Species	Location:		
	Central Tablelands	Southern Tablelands	Monaro
Microlaena	31	41	16
Danthonia	31	37	19
Bothriochloa	25	2	6
Themeda australis	3	8	16
Poa labillardieri	6	5	16
Stipa	0	0	13
Aristida	0	3	0
Other species[1]	0	3	3

Notes: [1]Other species includes *Panicum* spp., *Eragrostis* spp. *etc.*

The year-long green perennial species such as *Microlaena* and *Danthonia*, are recorded as being much more useful species providing feed of high quality throughout the year. Indeed with introduction of appropriate legumes (such as white clover and/or subterranean clover) and with the maintenance of a regular fertiliser application, high levels of production can be achieved from these species (Robinson and Dowling, 1985). Again, however, winter production from these grasses is limited by low temperatures on the tablelands.

Poa labillardieri (another poa tussock) and *Stipa scabra* are also year-long green perennials which provide reasonable production in winter and spring especially during droughts. However, their overall usefulness is limited by low digestibility and low protein content. These species can also become quite invasive and dominant which together with the troublesome awned seed head of *Stipa scabra* they often assume weed status.

Therefore it is evident that with regard to our native pasture lands:

(1) Approximately 1/3 of the central and southern tablelands and over 1/2 of the northern tablelands and Monaro remain under native or naturalised pasture with the remainder having been sown to introduced pasture species.

(2) Native pastures have as a major limitation for animal production a low availability of green forage during autumn, winter and spring and this is reflected in much lower stocking rates when compared with introduced improved pasture species. It is also apparent that for many species feed quality deteriorates markedly as native pastures turn reproductive in summer and run to seed.

(3) The usefulness or otherwise of native pastures is really related to species composition and overall management practices. While summer-green, frost

sensitive species are of limited value some of the yearlong green species such as *Microlaena* and *Danthonia* can be extremely productive especially in association with legumes and with appropriate fertiliser inputs.

(4) Many of the native grass species possess inherent characteristics which render them undesirable in an animal grazing system, such as a high proportion of highly fibrous and senescent leaves of low palatability and digestibility, and seed heads (awns) which can cause animal health problems and contribute markedly to vegetable fault.

(5) Finally one of the most significant advantages of our native grasses is their excellent persistence especially during dry or drought periods and in low fertility environments, and hence they contribute markedly to the stability of our grasslands.

Introduced Improved Pastures

Introduced improved pastures have been sown on about 56% of the total area of grazing lands of the tablelands of NSW. On average, these pastures have carrying capacities 4 times higher than unimproved native pastures. Accordingly, introduced pasture species are the major source of forage for livestock in these areas where they impart both greater levels of pasture production and generally feed of higher quality and nutritive value.

However, in recent years there has been concern that production from introduced species is declining throughout the central tablelands and slopes (Kemp and Dowling, 1991), and possibly a similar situation is occurring throughout the remainder of the tablelands. On the Monaro, a succession of extreme drought years from 1979 to 1983 (47 consecutive months), together with the use of unsuitable species, heavy continuous grazing, and irregular fertiliser application have caused a noticeable reduction in the proportion of sown species (perennial grasses and legumes) and a corresponding increase in the weed component of the pastures.

During October and November 1988, Kemp and Dowling surveyed improved pastures on the central tablelands and slopes to determine the composition of pastures and distribution of pasture species. A significant finding of this survey was the low proportion of sown perennial grasses and legumes in the majority of pastures surveyed, and that these had been replaced by annual grasses including vulpia, brome, barley grass and annual ryegrass. Indeed, annual grasses exceeded 40% of the pasture at 60% of survey sites.

The importance of maintaining a high proportion of legume in the pasture (30-50%) in order to maximise annual production is well documented (Dove, 1988) as is the importance of perennial grasses for providing year round green feed, drought tolerance and alleviating soil acidity.

However, a disturbing and disappointing finding was that "overall, recommended legume species comprised less than 40% of the pasture at 60% of sites", and that "only 9% of pastures had more than 60% legume, a minimum level generally considered to be required for high animal production". Similarly, the low level of perennial grasses relative to annual species is reflected in the fact that "grasses exceeded 60% of the pastures at 34% of sites", but that "perennial grasses were less than 10% of the pasture at 54% of sites and only exceeded 25% of the pasture at 23% of sites" (Kemp and Dowling, 1991).

Discussions with colleagues throughout the tablelands indicate a similar trend in most districts, *ie.* declining stocking rate levels of introduced improved pastures, and a proliferation of annual broadleaf weeds and annual grasses in run-down improved pastures. With the current decline in wool prices it is anticipated that there will be a further reduction in carrying capacities of improved pastures as farmers continue to ignore fertiliser topdressing programs.

It is apparent that our native pastures are characterised by their inherently low carrying capacities especially during the winter period (with the possible exception of well managed *Danthonia* and *Microlaena*) and generally low nutritive value and digestibility. Similarly, improved pastures have declined in both the quantity and quality of the feed on offer and hence an overall reduction in carrying capacity in recent years. Furthermore, many introduced cultivars have growth characteristics which render them unsuitable for inclusion in our current pasture management systems or until present grazing management practices are altered (Kemp, 1987).

ROLE OF FODDER CROPS

What then is the role of forage crops in our tablelands grazing system?

Forage crops should be regarded as a means to an end, that end being the establishment of a highly productive improved perennial pasture. As such they occupy an intermediary role in terms of:

- replacement of a less productive or less desirable native pasture species, *ie. Aristida, Poa, Stipa, Themeda, Bothriochloa* with a more productive improved pasture.
- replacement of a run down or degraded improved pasture with a more productive one.

In doing so forage crops contribute a number of advantages - in terms of both animal production benefits and in terms of agronomic advantages - which justify their inclusion in whole farm management.

Agronomic Advantages

Forage crops are regarded as crops sown annually to provide feed for animals at specific times of the year. They can broadly be divided into 2 groups - those sown in spring to provide summer/autumn feed *ie.* Brassicas, Millets, Sorghums, and those sown to provide late autumn/winter and early spring feed, *ie.* oats.

The contribution which forage crops make in terms of overcoming feed gaps and to animal production will be discussed later in this paper. However, forage crops are also sown for a number of indirect agronomic advantages which they provide and which may justify their inclusion in a farm development program.

Firstly, in terms of weed control, forage crops can play a vital role. One of the major causes of establishment failure of autumn sown pastures is the excessive competition provided by autumn/winter germinating grass weeds, notably vulpia, barley grass, Brome grass and annual ryegrass. While the importance of prevention of seed set of most of these annual weeds in the preceding spring(s) is now commonly acknowledged (and which has led to the widespread adoption of "spray-topping"), the success rate of this technique in a tablelands environment is not satisfactory. This is obvious where there is a mixed composition of species, each having different flowering times, and in large paddocks of uneven slope and aspect where the physiological growth rate tends to vary considerably throughout the paddock. This fact, together with the absolute requirement for correct timing makes one sceptical of this approach.

Due to the unreliability of this technique there may be a large carry over of seed which competes with sown species during establishment in the following autumn. A spring sown summer forage crop using either a herbicide or plough for initial weed control is a much more successful means of overcoming or circumventing this problem. Frost tolerant species such as rape or turnips can provide feed for up to 12 months, and at the conclusion of their growth period in the following spring, spraying or ploughing will further reduce the weed problem to a minimal level. A similar result can be achieved with winter forage crops where the paddock is fallowed (by whatever means) in the preceding spring.

Secondly, in terms of livestock performance, the importance of maintaining "clean" paddocks on which to wean Merino lambs or to finish cross-bred lambs should not be underestimated. Pasture weed species such as vulpia, barley grass and brome grass, as well as some native grasses such as *Stipa* (cork-screw or spear grass), *Aristida* (wire grass) and (occasionally) *Microlaena* and naturalised legumes can be major wool contaminants and also provide serious problems associated with stock health.

Finally, forage crops can be used as a means of ground preparation prior to the sowing of permanent pasture. Cultivation and soil disturbance not only provides good weed control but also allows for the mechanical or physical breakdown of vegetation and contributes to soil aeration and nutrient release.

Feed Gaps

Generally fodder crops are sown to provide feed at times of the year when it is considered that the sown crops will provide more and/or better quality herbage than existing pasture. As a result of the preceding discussion, it is evident that there are two critical periods of feed availability on the tablelands:

(1) The winter/spring period when low temperatures restrict plant growth not only of native pasture species but also of improved or introduced pasture

species. The role of forage crops - and especially winter cereals - in overcoming the so-called winter feed trough when the quantity (as well as quality) of available feed limits animal production, has been extensively researched and is well documented.

(2) The summer/autumn period which corresponds to a period of declining pasture feed quantity and deterioration in pasture feed quality. This period of pasture maturity and reduced feed quality coincides with weaning of spring lambs and therefore can have serious implications for flock management.

WINTER FORAGE CROPS

Winter forage crops have traditionally been sown on the tablelands and slopes of NSW to provide feed when low temperatures restrict pasture growth especially of native pastures. It is generally acknowledged that the quantity of feed available during winter is the ultimate determinant of overall farm carrying capacity. As mentioned previously, other than the effect of stocking rates, the provision of adequate high quality feed during winter is also essential to ensure maximum reproductive performance of the breeding animal.

While the sowing of winter forage crops has become a common practice on many properties, there exists some controversy over the value of forage crops, in terms of their ability to produce more winter feed than improved pastures treated similarly.

Early experiments in 1958 and 1959 by Wheeler (1963) found that annual winter fodder crops at Armidale NSW yielded up to 800% more dry matter during the March-August period than nearby pasture ungrazed for a similar period. Similarly, Crofts (1966) indicated that at "Coolamatong", Orange, NSW, oats sown in April produced over 500% more herbage than saved pasture.

More recent investigations by Kemp (1988) and Davidson (1990) suggest that there may be very little difference in overall dry matter production during the winter period between crops and pastures, and that differences may be due to a number of variable factors which may "determine the outcome". These include:-

(1) *Composition of the pasture/pasture species.* Variations occur in the growth rate between pasture grass species and cultivars during winter and this is largely due to the timing of reproductive development (Kemp, 1988). In an experiment at Orange, NSW, it was found that greater forage yield was obtained from grasses that switched into reproductive development early in winter. In other words the earlier a plant initiates flowering, the greater its growth rate over winter. In this particular study growth rates of Kangaroo Valley perennial ryegrass (the earliest flowering cultivar) and Wimmera annual ryegrass were significantly higher than from oats and prairie grass which in turn were greater than mountain rye and Sirosa phalaris and thence Currie cocksfoot and Australian phalaris.

It should be considered also that in terms of pasture composition, legume growth in winter is less than that from grasses when temperatures are less than 10 degrees celsius (Kemp *et al.*, 1989).

(2) *Timing of the autumn break.* It would appear that the productive advantage of a winter forage cereal over a permanent pasture in terms of total winter production, occurs when the cereal is able to be sown during its optimum period of February-March. Sown at this early time, the crop is able to express far higher growth rates than the pasture. Late sowing for whatever reason means that the crop loses its early competitive and comparative advantage.

This may also be due to the fact that the higher growth rates of some perennial grasses during winter - associated with the timing of reproductive development has its major effect from mid-winter on and that there may still be a gap in the forage supply from mid-autumn to mid-winter. It is during this period that the early sown forage crop comes into its own.

(3) *Management.* Growth rates of pasture swards are dependent upon sward leaf area which is influenced by grazing and species. Swards with larger leaf area at the start of winter may sustain higher growth rates and provide a greater quantity of forage during winter. Furthermore, a greater sward biomass in winter may also help to protect plants from frost damage (Kemp, 1988).

Autumn sown forage crops are obviously starting from a point of zero ground cover and their growth rates during winter will also be affected by the available leaf area at the commencement of winter. Any factor which contributes to reduced autumn growth rates (*eg.* moisture stress, weed competition, inadequate fertility) of the crop will impact upon overall winter production by causing reduction in leaf area at the onset of winter. Davidson (1990) expressed the view that standard drill row spacings are a major handicap for crops in the early stages of growth or regrowth because of the high proportion of ground that is bare. Conversely established pastures generally have higher percentage ground cover and better spatial distribution.

An interesting treatise on the comparative performance of winter forage cereals and pasture is the recent work undertaken by Jim Davidson *et al.* at Ginninderra Research Station, Canberra in which he assessed the role of mixtures of cereals as a means of providing greater forage supply during winter. This investigation compared the production between mixes or combinations of long-season wheats (*ie.* Isis) and extreme spring (so-called "express") wheats, with a range of cereal varieties (including oats) when sown alone. These were then evaluated in comparison to the production of perennial pastures treated similarly. While the experiment "cannot provide an unequivocal answer to the question of whether cereals produce more winter feed than pastures" - due to variability in pastures - it nevertheless makes a more than useful contribution to this debate.

Amongst other findings it was concluded that grazing of crops sown for winter feed in cool (*ie.* tablelands) environments should be delayed as long as possible into winter (without endangering ears), in order to provide maximum amounts of fodder. This confirms the findings of Dann *et al.* (1983) who found that withholding grazing of oats until August gave more grazing days per hectare than any of the other grazing options tried.

Under this delayed grazing regime, mixtures of "express" and winter wheats provide at least as much feed as a pasture treated similarly but that both will produce substantially more dry matter than the traditional practice of sowing oats or winter wheats alone.

It is noteworthy, however, that while total annual production is maximised by delaying grazing as long as possible into winter, pasture production during the critical winter period of lowest pasture feed availability (26 June to 21 August) was increased by early defoliation (*ie.* grazing) and to a greater extent by N application. Of further interest was the fact that in the early defoliation treatment, which entailed harvesting at 4 weekly intervals until mid-winter (24 July) and which most closely resembles farmer practice, pastures produced 2 t/ha more growth than crops, "presumably because of their much greater plant density and ground cover". This supports the opinion of Dann (1972) who suggested that although regrowth is greater from grazing or cutting early in the life of the crop (or pasture), total yields (initial yield plus regrowth) are greater when defoliation occurs late in the life of the crop (or pasture). However, to meet animal requirements it is usually necessary to graze a fodder crop at fairly early stages of growth and under these circumstances a pasture can exhibit marked productive advantages over a winter forage crop.

SUMMER FORAGE CROPS

In many areas of southern Australia, higher flock productivity is likely if lambing is in spring rather than autumn. Weaning therefore usually occurs during summer at a time when both the quantity of available feed may be limited by inadequate summer rainfall and most especially when the quality of feed on offer is deteriorating.

This is a consequence of the decline in nutritive value and digestibility associated with maturity of perennial grasses and senescence of annual grasses and legumes. The nutrition of the Merino weaner is an integral component of a successful Merino breeding enterprise and it is apparent that an imbalance occurs whereby a critical period of high nutritive demand coincides with low nutrient availability in many typical grazing situations on the tablelands and slopes. A similar problem confronts the specialist cross-bred lamb producer as he attempts to finish lambs for market in the face of poor quality feed.

The imbalance and relatively poor growth rates of Merino weaners during the summer/autumn period (and before the autumn break) is often and commonly referred to as "weaner ill-thrift". However, this phenomenon may be associated with many other factors contributing to reduced growth rates and leads to the oft-quoted expression: "Merino weaners have one mission in life - to be as miserable as possible and to die within 12 months of age!"

During the early 1960's a survey of Monaro graziers was conducted to ascertain the reason why "Monaro graziers complain that Merino weaners do not thrive". Further definition of the nature of the problem indicated that this so-called ill-thrift commenced in January, with recovery "after autumn feed comes away". The survey identified pasture feed quality (*ie.* nutrition), disease and worm control as being the principal causative factors. While considerable advances have been achieved in the areas of animal health, it is still apparent that the problem of weaner ill-thrift (associated with reduced availability of high quality forage over summer and early autumn) is still commonplace on many properties.

The options available to overcome this "summer feed gap" and to provide a diet containing more digestible energy and protein than in dry mature pasture have been the subject of considerable agronomic investigation and farmer experimentation. One option is to use species in permanent pastures that can be more productive at this time of the year (Kemp, 1987), *ie.* summer legumes such as lucerne, red clover or caucasian clover. Such pastures could be maintained as special purpose pastures and sowed for feeding in summer an autumn. Another strategy is to sow summer fodder crops; these crops could also take the pressure off existing pastures which could improve the survival of desirable species in those swards. Sowing summer fodder crops in spring (for use in summer/autumn) when the quantity of available forage is rapidly increasing would better fit farm management.

In 1981/82, David Kemp commenced an experiment at Orange, New South Wales, over 4 years to determine the most productive and hence most useful summer forages for the purpose of improving the quantity and quality of feed over this critical summer/autumn period. A comparison was made between an extensive range of legumes, grasses, cereals and Brassicas which were assessed for their seasonal and annual forage yields. The results of this research were that it is possible to improve both the quantity and quality of forage for livestock during summer and autumn but that only a few species are capable of providing sufficient forage to justify the expenditure. It was stressed that the need for summer forage crops - like forage crops in general - depends upon the productivity and growth characteristics of existing pastures on a property. Nevertheless, the findings of this experiment and a similar such study of pasture productivity showed that the quantities of standing forage, together with total summer and autumn yields from a permanent pasture were not as large as the levels of production achieved from some of the better performed summer forage crops (Kemp, 1987).

The superior performance of lucerne in all years, and white clover when summer rainfall was reasonable, is worthy of comment and certainly should be highlighted. This reinforces the absolute importance of establishing perennial summer legumes for their ability to reliably increase the quantity and quality of available feed during summer/autumn throughout the tablelands. This reinforces the common view that short-term summer forage crops are a 'means to an end' - that end being the establishment of a persistent and productive perennial summer legume based pasture.

Two forage plant groups were prominent in these trials. The cruciferous crops, forage rape, Kale and to a lesser extent turnips, were consistently productive species over the 4 years; they retained a reasonable level of green leaf, were able to regrow after cutting and will continue to grow into the winter. Forage rape was the more consistent species and although not always achieving the same yields as the tropical (*ie.* Japanese Millet) and temperate (*ie.* oats and winter wheats) grasses, it did have greater green leaf yields than the grasses through summer and autumn. This study confirms local observations and experiences on the Monaro in which forage rape has developed a reputation for its adaptability, productivity and ability to provide green feed through even the driest of summers. This fact, together with the animal production gains to be mentioned and its further ability to grow through into the winter, have contributed to the ten-fold increase in the area sown to fodder rape over the past 10 years.

The other forage type shown to be a viable option was the use of spring sown temperate grasses (*ie.* oats and winter wheat). While not as high yielding as lucerne in dry years, their overall high level of production (and especially the longer season 'winter' types sown in early spring) indicates there is a role for spring sowing of traditional winter cereals in order to fill a feed gap quickly during summer in poor seasons. The economics of doing so would obviously need to be addressed.

It was noteworthy that while the tropical grasses such as Japanese Millet were the most productive species from late a spring sowing, their yields in dry seasons were inadequate and certainly less than a good lucerne sward. Furthermore, the fact that these grasses cannot be sown until soil temperatures have increased to about 18 degrees celsius and their extreme frost susceptibility means that their place is limited in most tablelands environments.

Despite its importance there have been few detailed reports of summer forage assessment in terms of animal productivity. During the period 1967-70 Peter Simpson et al compared the performance of crossbred lambs grazing a range of pasture and crop types at Oberon in NSW. The results are presented in Table 3.

An experiment conducted at Hamilton, Victoria in 1984 by Kenny and Reed to determine the "effects of pasture type on the growth and wool production of weaner sheep during summer and autumn" provides the first really detailed assessment of annual production from summer forages. While summer forage crops as such were not included, it is noteworthy that in a Mediterranean climate during summer and autumn the mean growth of weaner Merino sheep grazing lucerne, white clover or Persian clover pastures was 50g/day, red clover 45g/day compared with 1g/day for sheep grazing perennial grass/subterranean clover pastures.

In the same environment and locality Chris and Dunstan (1989) carried out a similarly interesting experiment in which Merino weaners were grazed on various fodder crops and pastures during summer. Comparative performance in terms of stocking rate and liveweight gainis shown in Table 4. It can be seen that Merino weaners grazing either Brassicas or lucerne can gain in the order of 70-100g/head/day (500-700g/week) - more than double that from the pasture (regarded as being above average quality for that district). What is particularly noteworthy is the vastly superior overall production of the Brassica crops compared to lucerne and pasture once stocking rate was considered in which the stocking rates were 2.5 times higher than that for the lucerne. In comparison of these results with those mentioned previously for crossbreds it should be mentioned that dorset sired prime lambs can achieve almost double the growth rates of Merinos, and therefore the results achieved from this experiment compare favourably with those previously quoted.

As part of a major program on weaner nutrition, a series of similar on-farm investigations were initiatedthroughout the Monaro during 1988 and 1989 to provide more localised information about the role of summer forage crops and summer legumes on weaner performance. This work commenced in the summer of 1987/88 near Cooma. Merino weaners were compared for bodyweight gain and wool production when grazing different paddocks comprising lucerne, forage rape and native pasture (consisting of Poa tussock, corkscrew-*Stipa*, naturalised clovers and medics). The sheep were weaned on 4/1/88 and assessment occurred on 11/5/88, 18 weeks later. Drought conditions characterised the duration of the investigation. The results are expressed in Table 5.

It can be seen that the bodyweight gain was slightly higher on the rape than the lucerne (and almost twice that on the native pasture). However, for wool production weaners grazing lucerne cut 300 g/head more wool (18 week period) than those on the rape which in turn cut 300 g more than those on native pasture. It is suggested that the greater wool cut from

Table 3: Liveweight gain of cross-bred lambs grazing a range of forage types at Oberon, New South Wales during 1967-70.

Feed source	Average g/hd/day	Range g/hd/day
Improved pasture (ryegrass/clover)	50	0-150
Lucerne (dryland)	180	150-250
Rape	200	150-300
Chou moullier	200	150-300
Japanese millet	180	150-200

Table 4: Liveweight gain of Merino weaners on Brassica fodder crops, lucerne and pasture at PRI Hamilton, Victoria, 1989.

Feed type	Stocking rate (number/ha)	LWG[1] (g/hd/wk)	LWG 5.1.89-7.4.89 (kg/ha)
Rape cv Rangi	26	593	15.4
Rape cv Arran	26	502	13.1
Turnip rape cv Pasja	26	677	17.6
Kale cv Kestrel	26	570	14.8
Lucerne	10	540	5.4
Pasture	9	228	2.1

Notes: [1]LWG = liveweight gain.

Table 5: Liveweight Gain (LWG) and wool production of Merino weaners grazing on forage rape, lucerne and native pasture at Cooma, New South Wales, 1988.

Forage type	LW[1] 4.1.88 (kg)	LW 11.5.88 (kg)	LWG[2] (kg)	LWG[2] (g/hd/day)	Wool production (kg/hd)
Forage rape	25.6	37.7	12.1	96	3.8
Lucerene	26.3	36.7	10.4	83	4.1
Native pasture	26.9	34.0	7.1	57	3.5

Notes: [1]LW = liveweight; [2]LWG = liveweight gain

lucerne is due to its higher crude protein level then either the rape or native pasture.

Due to the importance of fibre diameter at the time, a similar trial was undertaken near Bombala during 1989/90 in which weaner performance was again compared on a range of pasture types including Redquin red clover, forage rape, improved pasture (ryegrass, white clover, sub-clover and annual grasses) and native pasture.

The trial ran for 150 days from weaning on 15/12/89 to 11/5/90 at which time sheep were assessed for bodyweight gain. The entire mob was then run together on the rape until shearing in late September when wool production was determined. The results are presented in Tables 6 and 7:

It is evident again that the rape contributed to achieving high bodyweight gains - similar to the red clover - and that these were superior to the improved pasture and markedly better (2.5 times) than the native pasture. A parallel situation is evident in wool production whereby the rape and red clover both outcut the improved pasture (300g/head) and especially native pasture (800g/head). The figures shown for both fibre diameter and yield are of interest but as they are based on only 1 year's results should be treated warily.

The most recent assessment of animal performance on summer forage crops was conducted at Carcoar near Orange on the central tablelands of NSW in 1991/92 by Bruce Clements of NSW Agriculture in conjunction with Wright-Stephenson. In this trial the superior productivity of forage rape was again expressed with crossbred lambs gaining up to 217g/head/day over the 95 day duration of the trial period. It is noteworthy that this gain is consistent with that achieved elsewhere. Across a range of environments and in differing years forage rape has consistently contributed to sheep bodyweight gains of 100g/head/day for Merino lambs or the equivalent 200g/head/day with crossbred lambs.

Table 6: Liveweight gain of Merino weaners on a range of forage types at Bombala, New South Wales, 1989/90.

Forage type	LW[1] 15.12.89	LW 11.5.90	LWG[2] (kg)	LWG[2] g/hd/gay
Forage rape	30	46	16	107
Red clover	30	45	15	100
Improved pasture	30	41	11	75
Native pasture	30	35	6	40

Notes: [1]LW = liveweight; [2]LWG = liveweight gain

Table 7: Wool production of Merino weaners on a range of forage types at Bombala, New South Wales, 1989/90.

Forage type	Wool cut (kg/hd)	Fibre diameter (microns)	Yield (%)
Forage rape	5.4	19.8	70.9
Red clover	5.3	20.2	73.9
Improved pasture	5.1	19.9	73.1
Native pasture	4.6	19.6	75.7

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