DECLINE IN NUTRITIVE VALUE OF CEREAL STUBBLES IN THE VICTORIAN MALLEE

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SUMMARY
The quality and quantity of components in two ungrazed wheat stubbles were assessed at Walpeup for six months post-harvest between December 1999 and May 2000. The quantity of stem and leaf material in the stubble in paddock B and the stem material in paddock A declined by 2.6 kg DM/ha/day (P<0.01). The quantity of leaf material in paddock A did not significantly change over time (P>0.05). The ME, DMD and CP of leaf was higher (P<0.001) than that of stem, and the ME and DMD of leaf declined at a faster (P<0.001) rate. The crude protein content did not significantly change over time. Between January and May the quantity of green material was higher than 200 kg DM/ha. It was concluded that without supplementation, both leaf and stem components of cereal stubbles would be nutritionally inadequate to maintain adult sheep, and would generally contribute little to sheep production in most years compared to the large quantities of green weed material present.

Keywords: sheep, stubble, nutrition, cereal, residues

INTRODUCTION
Most sheep in the Victorian Mallee graze cereal stubbles during summer/autumn. Sheep grazing stubbles preferentially select grain and green weeds, but when only small quantities of these components are present, sheep are forced to consume dead material (Mulholland and Coombe 1979; Mulholland *et al.* 1984). The nutritional value of cereal residues *per se* declines over time (Purser 1984) primarily as a result of rainfall leaching nutrients and promoting decomposition (Pearce *et al.* 1979; Pearce 1983). Data on the rate of decline in nutritive value of stubble, and the contribution of green weed to the feed base, are required to make more informed feed budgeting decisions during summer/autumn. Neither the nutritive value nor rate of decline in value of stubbles has been examined in detail in the 350 mm rainfall Mallee environment. This study evaluated the potential contribution of cereal stubble components over time to the feed base.

MATERIALS AND METHODS
Following harvest, a 50 x 50 m section of wheat stubble (cv. Ouyen) at Walpeup was fenced in each of two paddocks (replicates A and B) to exclude sheep. At 4-5 weekly intervals from 20 December 1999 (day 0) to 29 May 2000 (days 0, 38, 71, 98, 134 and 161 of the experiment) 12 quadrats (0.5 x 0.5 m) in both paddocks were cut to ground level. All plant material was collected, sorted into leaf, stem, grain and trash, edible green (non-toxic plants which are readily consumed), and non-edible weeds. Edible green material consisted primarily of perennial skeleton weed (*Chondrilla juncea*), annual medics (*Medicago spp*.) and wheat (*Triticum aestivum*), and annual green weed included white heliotrope (*Heliotropium europaeum*) and caltrop (*Tribulis terrestris*). The samples were dried to constant weight at 60^{o}C, weighed, and data converted to kg DM/ha. Samples were combined and three samples of leaf and stem components from each paddock at each sampling time were analysed by Feedtest® for crude protein (calculated from % nitrogen) and dry matter digestibility (DMD) using wet methods. Metabolisable energy (ME) was calculated. Meteorological data was recorded. Regression techniques were used for data analysis. Statistical analyses were performed using Genstat 5 (Genstat 5 Committee 1993).

RESULTS
Walpeup received unusually high summer rainfall during the experiment (Table 1). The amount of stem material decreased by 2.6 kg/ha/day (P<0.01) in both paddocks A and B (Figure 1). Leaf material in Paddock B also declined by 2.6 kg/ha/day but leaf material in paddock A was not significantly affected by time (Figure 1). Large standard errors were associated with mean quantities, particularly of leaf in paddock A. Similar trends for decline were observed for the quantity of grain

and trash in paddock B (P=0.054), but large errors precluded any relationship in paddock A (P>0.05) (results are not presented).

Table 1. Total monthly rainfall (mm) and mean maximum monthly temperature (^oC) recorded at Walpeup between December 1999 and May 2000, and long-term median (1911-2000) rainfall

	Dec	Jan	Feb	Mar	Apr	May
Rainfall	49	1	145	7	69	21
Long term median rainfall	16	11	14	11	15	30
Temperature	28.4	31.0	33.3	28.0	23.1	17.4

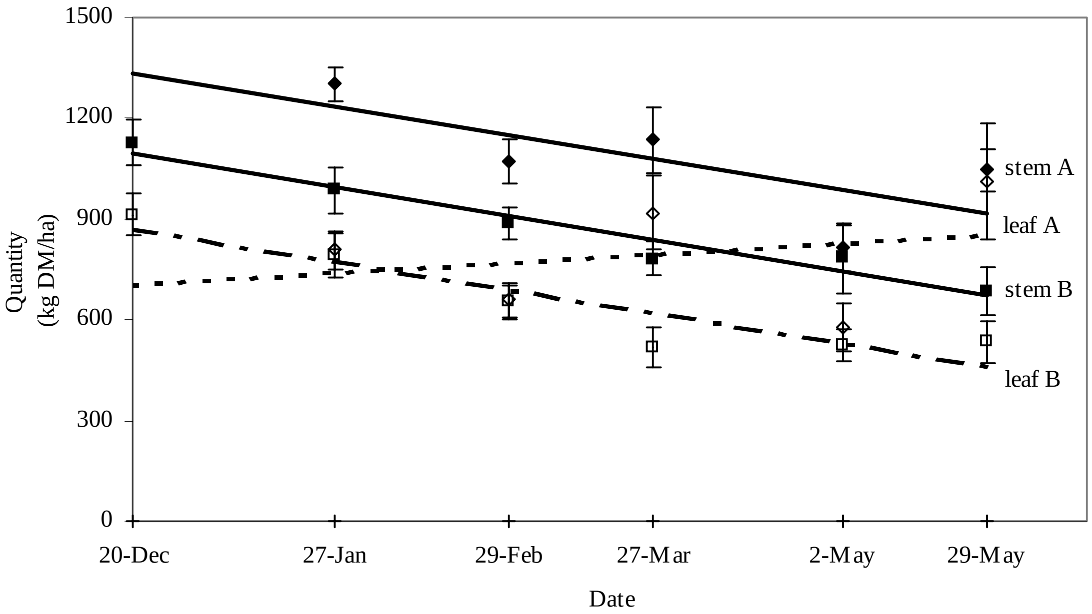

Figure 1. Mean quantity (kg DM/ha ± s.e.) of leaf and stem material in paddocks A and B over time

Regression equations, where y is the quantity of leaf or stem (kg DM/ha), x is number of days since 20 December and r^2 is the coefficient of determination were:

Stem paddock A: $y = 1331 - 2.6x$, $r^2 = 0.16$, P<0.01
Stem paddock B: $y = 1094 - 2.6x$, $r^2 = 0.27$, P<0.001
Leaf paddock A: $y = 702 + 0.9x$, $r^2 = 0.10$, P>0.05
Leaf paddock B: $y = 869 - 2.5x$, $r^2 = 0.32$, P<0.001

The interaction between date and the total quantity of green material in each paddock was significant (Table 2; P<0.001) with more green material in paddock B in comparison with paddock A in January/February, but less thereafter. The interaction can be attributed to the death of the heliotrope fraction during April. Heliotrope was a minor component of the green material in paddock A but a major component in paddock B. Heavy rains during February promoted total and edible green matter growth (Table 1).

Table 2. The mean quantity (kg DM/ha) of total green (edible green in brackets) in paddocks A and B over time

Day of sampling	Total green in paddock A	B
20 December	-	0 (0)
27 January	219 (207)	307 (11)
29 February	448 (218)	456 (0)
27 March	1654 (1348)	1177 (15)
2 May	1498 (1498)	390 (143)
29 May	2725 (1721)	683 (514)
cv (%) of individual means	99 (97)	45 (124)

Leaf contained higher (P<0.001) levels of ME (5.8 vs 4.9 MJ ME/kg DM) and DMD (42.8 vs 37.1%) than stem. The ME and DMD of both leaf and stem components of stubbles were similar (P>0.05) in paddocks A and B, and declined over time (P<0.001) (Table 3). Leaf material declined at a faster rate than stem (P<0.001). The following equations were used to explain the variation in the DMD of material (y) over time:

DMD% of leaf $y = 51 - 0.1x$ ($r^2 = 0.79$, P<0.001)

DMD% of stem $y = 43 - 0.1x$ ($r^2 = 0.86$, P<0.001)

where x is the number of days since 20 December and r^2 is the coefficient of determination.

Table 3. Mean digestibility of the dry matter (DMD %) of leaf and stem components over time

Day of sampling	DMD%	
	Leaf	Stem
20 December	49.7	41.8
27 January	50.5	41.4
29 February	43.7	38.0
27 March	41.1	36.0
2 May	37.6	34.3
29 May	37.7	33.6
Mean	42.8	37.1
l.s.d. (P=0.05) leaf vs stem	0.83	

The crude protein (Table 4) content of the leaf and stem components increased slightly, but not significantly (P>0.05), over time. Paddock B had a higher (P<0.001) protein content than paddock A for both leaf and stem components, and overall leaf had a higher (P<0.001) protein content (5.48%) than stem (2.61%).

Table 4. Mean crude protein (%) of leaf and stem components in paddocks A and B over time

Day of sampling	Leaf		Stem	
	A	B	A	B
20 December	-	6.0	-	3.1
27 January	4.0	6.1	2.1	3.7
29 February	3.8	5.7	1.9	3.3
27 March	5.2	5.8	2.3	3.1
2 May	4.8	6.8	2.5	3.6
29 May	5.6	6.4	2.9	3.2
Mean	4.7	6.1	2.3	3.3
s.e. (mean)	0.22	0.19	0.10	0.11

DISCUSSION

It was concluded that without supplementation, both leaf and stem components of cereal stubbles would be nutritionally inadequate to maintain adult sheep, and would generally contribute little to sheep production in most years compared to the large quantities of green weed material present.

As stubbles are the main source of feed for sheep between crop harvest and autumn germination of pastures, the quality of crop residues is of considerable importance. The decline in digestibility of 0.42 to 0.63% per week was approximately half the rate of decline reported by Purser (1984), but greater than that shown by Mulholland and Coombe (1979) and Rowe *et al.* (1989) for grazed stubbles. Differences would be associated with environmental conditions (Pearce *et al.* 1979; Purser 1984; Wales *et al.* 1990) as well as wheat varieties (Pearce 1983). The rate of decline over the period measured was probably higher than usual for this environment due to higher than normal summer/autumn rainfall.

The digestibility and crude protein of the leaf and stem components were within the range reported previously (Pearce 1983; Purser 1984; Wales *et al.* 1990). However, the stable content of protein over time, when other quality components declined, is not consistent with earlier reports (Mulholland and Coombe 1979; Rowe *et al.* 1989; Outmani *et al.* 1991). It is possible that the concentration of water soluble carbohydrates declined over time, possibly through leaching due to heavy rainfall (Barrett *et al.* 1973; Pearce *et al.* 1979; Purser 1984). The loss of water soluble carbohydrates is associated with a decline in digestibility of the dry matter (Gatford *et al.* 1999), although rainfall does not appear to consistently reduce the digestibility of cereals (Allden and Geytenbeek 1980) or grasses (Gatford *et al.* 1999). Nitrogen is more resistant to leaching than water soluble carbohydrates (Barrett *et al.* 1973), so the concentration of nitrogen in dry matter may increase or remain stable over time, as observed in our results, and as reported by Armstrong *et al.* (1992) and Gatford *et al.* (1999) for grass pastures.

The quantity of cereal leaf and stem declined more slowly than recorded for grazed stubbles after sheep intake has been accounted for (Mulholland *et al.* 1976), probably due to the absence of associated trampling. The large variability between samples suggests that inadequate samples were taken to accurately assess the quantity of stubble components present, or alternatively, that stubbles are inherently variable.

The quantity of green material present was unusually high for the Mallee environment as a result of the high summer rainfall. Between January and May green material was present in quantities sufficient that sheep would be unlikely to consume dead material (Mulholland *et al.* 1976), and was in quantities sufficient to maintain the weight of non-pregnant adult sheep. In the absence of green material, sheep would lose liveweight on the cereal residues, even if only leaf material was selected. Sheep are unable to consume sufficient material to maintain liveweight when digestibility of the diet is below about 60% (Arnold *et al.* 1964; Birrell 1981). It is significant that heliotrope was the major component of the green material in one of the paddocks. Heliotrope is widespread in the Mallee and resultant copper poisoning can be a significant cause of sheep mortality in the region (Harris and Nowarra 1995). This indicates that heliotrope is present in summer and autumn in sufficient quantities to comprise a significant portion of the diet in many years. While the presence of heliotrope may improve the short-term nutrition of sheep over summer and autumn, repeated exposure increases the risk of death (Peterson *et al.* 1992). The regional occurrence and dominance of heliotrope are of concern regarding the use of stubbles for grazing sheep.

In conclusion, this study shows the quality and rate of decline of the wheat stubbles measured at Walpeup is within the range reported for other regions. The composition and quality of summer green material has not previously been well reported for this region.

ACKNOWLEDGEMENTS
The technical staff at the Victorian Institute for Dryland Agriculture, Walpeup are gratefully acknowledged for collection and processing of samples. Vince Matassa kindly conducted the statistical analyses. Several people made helpful comments on the draft, including Dr Jenny Davis.

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