
THE OCCURRENCE OF BROWNTOP, IN THE MANAWATU

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Abstract

Results are presented from a survey of the frequency of occurrence of pasture species in the different topographical and soil type areas of the Manawatu. It was carried out in the early spring of 1967 and again in the summer of 1968. The survey indicated a high frequency of occurrence of browntop on hill country (81 and 87% in early spring and summer, respectively) and terrace country (46 and 40%, respectively) and moderate amounts on flat land and sand country. Lowest occurrence was recorded on flat country dairy farms (15 and 17%, respectively). Marked differences in species frequency of occurrence were recorded between farms on hill country. These ranged from farms in which pastures were dominantly browntop, sweet vernal, and moss, to farms where relatively high amounts of white clover, ryegrass, and dogstail occurred in association with other less productive species. These differences have been related to productivity levels possible from such extremes in species composition. Results are discussed in relation to current hill country farming practices. Factors considered to be significant in altering hill country botanical composition and hence levels of productivity are also discussed.

INTRODUCTION

SINCE the earliest days of pastoral farming in New Zealand, varieties of *Agrostis* have contributed significantly to livestock feeding. How much and in what proportions relative to that contributed by other pasture species are unknown. Considered over the 13 million hectares of land currently being used for pastoral endeavours, the percentage contribution is likely to halve been high. For some regions such as the wetter hill country, estimates of well over 30% may not be unrealistic.

Madden's pasture survey of the North Island published in 1940 showed that at that time most North Island hill country was in fact dominated by browntop or associations of browntop and *Danthonia* land that *Agrostis* varieties were also significant components in most other North Island regions. From observations and various published reports, a similar situation applied over considerable areas of the South Island.

Reasons for the very high proportions of browntop in New Zealand pastures have been well documented by some of the earlier pasture ecologists and agronomists. Levy, for instance, in 1924 described browntop as a species with wide moisture limits, tolerant of low to moderate fertility levels, and having a densely tillered and stoloniferous or rhizomatous habit. These characteristics made the species ideally suited to the low input, close, and continuous grazing systems which were and still are normal farm practice on much hill country.

In spite of the contribution that browntop has made to livestock feeding over the years, there is ample evidence to support Levy's observations that productivity levels from browntop-dominant pastures are usually much lower than those from comparable areas or farms where species such as the ryegrasses, white clover, dogstail, and cocksfoot are the main pasture components. Suckling (1960), for example, in a comparison at Te Awa recorded 8500 kg/ha from pure browntop plots under high fertilizer input, a level of production about one half to one third that of ryegrass and cocksfoot. He also showed marked differences in seasonal spread of production. This and similar early work have highlighted the desirability of changing the composition of pastures especially on hill country to higher yielding species that are of higher nutritive value and produce feed more evenly throughout the year.

Based on these types of results, there has been a continuing farming and research effort to devise ways and means of altering species composition on hill country. These efforts gained considerable impetus with the advent of aerial topdressing and clover oversowing and for the past 20 to 25 years there has been a continuing effort in these terms. How effective have these efforts been? Unfortunately, there is no way in which this can be assessed. However, indications can be obtained through pasture surveys. The material presented in this paper is one such effort and gives some of the results of an intensive pasture survey carried out during early spring of 1967 and summer (February-March) of 1968 in the Manawatu.

EXPERIMENTAL AND RESULTS

A frequency of occurrence technique was used. Random samples of farms were taken in four distinct (topographical and soil type) areas of the region. These were:

- (1) Hill country (land 120 to 600 m above sea-level and dominantly yellow-brown earths) .
- (2) Terrace country (land between 30 and 120 m and dominantly yellow-grey earths) .
- (3) Flat land (land generally below 35 m from sea-level and dominantly recent alluviums) .
- (4) Sand country.

On each farm 2 transects along the longest dimension of the farm were sampled. One hundred plugs 20.3 cm² in area (Matchell and Glenday, 1958) were taken equidistant along each transect and species presence recorded. No account was taken of tiller unit or plant size of the species present in the plug and no estimates were made of productivity. Species were recorded as present as long as they showed a rooted node, tiller or plant. Sampling details are shown in Table 1.

TABLE 1: SAMPLING DETAILS

	No. of Transects	Area ('000 ha)	
		Sampled	Typical of*
Hill	42	8	400
Terrace	61	13	140
Flat land	134	22	440
Sand	46	32	88

*North Island on the basis of major soil types.

As an example, 42 transects were sampled in early spring on the hill country and again the following mid-summer. Each transect averaged about 2500 m. Along each transect a plug was taken at random on average each 25 m. The 42 transects were randomly sited over a farming area of about 8000 ha (20 000 acres) ; the 8000 ha are considered typical of at least 400 000 ha (1 million acres) .

Table 2 shows the frequency of occurrence of browntop in the four major areas at both sampling times. For the terrace country, the alluvial flats and the sand country, occurrence is shown separately for sheep and dairy farms.

Significant features of these results are:

- (1) The very high frequency of occurrence of browntop in hill country farmlands in both spring and summer.

TABLE 2: FREQUENCY OF BROWNTOP IN MANAWATU PASTURES (Mean frequency of occurrence as a %; individual SEM in parentheses)

	<i>Season</i>	
	<i>Spring</i>	<i>Summer</i>
Hill	81 (1.6)	87 (1.8)
Terrace sheep	51 (3.1)	46 (4.0)
Terrace dairy	42 (3.2)	34 (3.2)
Flat sheep	21 (2.0)	19 (2.3)
Flat dairy	15 (1.7)	17 (1.6)
Sand sheep	26 (4.1)	19 (1.9)
Sand dairy	23 (3.4)	23 (3.0)

- (2) The high frequency of occurrence of browntop in pastures on sheep and dairy farms on the terrace country in spite of average to good dairy production levels on the dairy farms sampled. This 'area of country is winter wet and generally poorly drained.
- (3) The significant occurrence of browntop on flat land in spite of high natural fertility and reasonable levels of productivity on both sheep and dairy farms.
- (4) The general tendency for a higher occurrence of browntop on sheep farms relative to dairy farms, a probable consequence of differences in farm management practices and grazing behaviour of the two types of animals.
- (5) With the exception of the hill country, a general tendency for a slight decline in occurrence over the summer months.

Results presented in Table 2 are the mean occurrences for a relatively large number of transects in each of the four 'areas. While carrying out the survey and again when assessing the data obtained, one of the significant features to emerge was the marked variations that occurred between farms within a topographical area. An indication of these extremes in pasture composition is shown in Table 3 for hill country and sheep farms on the terrace country and alluvial flats for the early spring sampling.

Significant features of these data are:

- (1) A very similar pattern of species occurrence on the best hill country farm and the average for terrace country farms (not shown) although the hill country farm had slightly more browntop present.

TABLE 3: EXTREMES IN PASTURE COMPOSITION
(% frequency in spring for individual transects)

	<i>Hill</i>		<i>Terrace</i>	<i>Sheep</i>	<i>Flat</i>	<i>Sheep</i>
Browntop	61	97	6	80	3	58
White clover	51	29	83	81	90	95
Ryegrass	43	2	82	61	97	59
<i>Poa trivialis</i>	11	—	80	54	73	70
Fog	26	22	1	8	—	27
Dogstail	33	20	5	4	1	11
<i>Danthonia</i>	12	33	—	—	—	—
Chewings fescue	17	17	—	—	—	—
Sweet vernal'	16	66	17	31	4	3
Moss	38	62	—	—	—	—
Total species	26	24	21	15	12	14

- (2) The similarities in frequency of occurrence of browntop, ryegrass, and Yorkshire fog between the best hill country farm and the moist botanically diverse flatland sheep farm. The flatland sheep farm had a much higher occurrence of white clover and *Poa trivialis*.
- (3) The appreciably higher browntop occurrence of one of the terrace country farms relative to the best 'hill country farm.
- (4) The very high occurrence of browntop in one of the hill country farms. This farm also had a high occurrence of sweet vernal and moss.
- (5) The very low occurrence of browntop on one of the terrace country farms and one of the flatland farms. The latter was botanically very simple and pastures were dominantly white clover, ryegrass, and *Poa trivialis*.

It is of interest to record that the best hill country farm had a carrying capacity of about 17.5 ewe equivalents/ha and systems of pasture management and fertilizer inputs were well planned and organized.

The results presented in Table 3 illustrate the extremes in pasture composition and hence productivity levels that occur between farms in different areas of the Manawatu.

These differences are further highlighted in Table 4. They are unpublished data of D. A. Grant obtained at Ballantrae in the lower Ruahine Ranges.

Shown are productivity levels obtained from pastures on two different aspects at Ballantrae in relation to pasture composition. The composition data are percentage species yields and show

TABLE 4: COMPOSITION AT DIFFERENT PRODUCTIVITY LEVELS UNIMPROVED BALLANTRAE SWARD

						<i>Production</i>	<i>(kg/ha)</i>
						<i>2 140</i>	<i>10 800</i>
White clover	.	...	....	....	.	2.0	1.0
Ryegrass	...	....			....	trace	14.3
High fertility responsive grass species						3.5	15.2
Low fertility responsive grass species						58.3	51.1
Flatweeds	....		....		....	20.4	6.4
Other clover?		....	....		....	3.4	0.4
Dead matter						12.5	11.6

that, at the low productivity level, approximately 80% of the annual yield was obtained from species such as browntop, *Danthonia*, Chewings fescue, sweet vernal, and flatweeds — pastures somewhat similar in composition to the average hill country pastures assessed in the survey. At the higher productivity level, pasture composition was very similar to that of pastures of the best hill country farm shown in Table 3.

What is also highly significant is the very low contribution that white clover has made to the annual herbage yield even at the higher productivity level, a feature of results frequently obtained by Suckling (1964) at Te Awa.

DISCUSSION

The results presented show that the occurrence of browntop in pastures in the Manawatu is widespread. On the alluvial flats and on the sand country, frequency of occurrence of this species was round 20% with only small differences in occurrence attributable to the type of livestock enterprise. In these areas, however, there were some farms where the occurrence of browntop was negligible. In most cases these were the highest producing and the pastures were dominantly ryegrass, white clover, and *Poa trivialis*. The fact that a few farms were dominantly of this composition is significant as this result lends weight to Sears's hypothesis (1960) of fertility build-up leading to what could be termed a "climax pasture composition" from which maximum yields of livestock products are possible.

Only one farm on the terrace country had pastures containing browntop at less than a 10% frequency of occurrence, and only two others had pastures in which browntop occurred at less than a 30% frequency. This is in spite of the fact that none of

the farms in this area were above 120 m from sea-level, that all were relatively flat or gently rolling, and that no physical barriers impeded sound management practices. As stated previously, however, the country is winter wet.

As related to this Session, the most significant results obtained show that browntop is still the dominant component of hill country pastures. Whether this situation is typical of other regions is difficult to assess, although there are not many objective reasons that could be advanced that would rule out this possibility. The fact that the average carrying capacity of such hill country in New Zealand is around 1 ¼ ewe equivalents/ha (Brougham, 1973) would indicate that composition of most hill country pastures is no better than that surveyed.

What do results such as these indicate for New Zealand hill country? In spite of fairly massive inputs of fertilizer and white clover since the advent of aerial topdressing, the results show that browntop is still the dominant species, a situation not too dissimilar from that found by Madden in his much more extensive survey in the late 1930s. A number of alternative conclusions can be drawn. These 'are:

- (1) That hill country soil fertility is still basically low..
- (2) That there 'are major losses from the fertility cycle in hill country that prevent botanical change past the browntop stage.
- (3) That stock management systems on hill country may be limiting botanical change.
- (4) That other factors such as preferential grazing of more nutritious species such as white clover by livestock limit the capacity of this species to contribute significantly to fertility build-up or that pasture insects and pests such as porina, grass grub, and slugs impose the same limiting conditions over extensive areas of hill country.

It is not intended to elaborate on these factors here as most will be covered in subsequent papers in this Session. Recent publications by Grant et al. (1973) and Radcliffe (1973) have all assessed their significance. However, reference to Suckling's (1960) work at Te Awa is pertinent. He has shown quite conclusively that pastures initially browntop-dominant with little ryegrass or clover present responded to fertilizer inputs and management systems that controlled browntop, encouraged in-

gress of ryegrass and white clover, and resulted in marked botanical changes. The resulting pastures contained relatively high 'amounts of ryegrass and white clover, were high producing, and seasonal spread of production' was much more favourable in terms of livestock feed requirements. The deductions from this work were that fertilizer inputs or clover oversowing alone were not sufficient to obtain marked changes in botanical composition. Such inputs must be associated with changes in farm management practice and especially systems of grazing management.

To conclude, hill farms exist today where, through planned fertilizer practices associated with full utilization grazing techniques such as block grazing, and in extreme cases forms of rotational grazing, high production swards can be created. These systems maximize the beneficial effects of stock dung and urine return patterns as demonstrated by Levy and Sears (1951), they prevent excessive overgrazing of the more desirable pasture species in the sward such as white clover and ryegrass, and encourage their development (Harris and Brougham, 1968) and they maximize trampling effects over short periods of time, a factor shown by Edmond (1960) to have marked effects on changing botanical composition of pastures.

The results of this survey, when considered in relation to Madden's survey carried out 30 years before, indicate that browntop will continue to contribute very significantly to the diet of the country's livestock population, in some areas in fairly high proportions of the total annual diet. For this reason the species must be looked at as an important component of pastures and one that probably warrants more research effort than has been the case in the past. In these terms it is possible that, where it is preferred to farm hill country at low fertilizer inputs and lower levels of output, then some research effort could be warranted in developing varieties of browntop that are higher yielding, have a more even spread of production, and are more nutritious at certain times of the year.

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