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## ERRORS ASSOCIATED WITH HERBAGE DISSECTION ANALYSES :

### 2. Problems of Species Identification

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#### INTRODUCTION

HERBAGE DISSECTION is the process in which samples of herbage cut from trials are separated by hand into component species. Heavy reliance is placed on herbage dissection as an analytical tool in New Zealand, and in the four botanical analysis laboratories in the Research Division of the Ministry of Agriculture and Fisheries about 20 000 samples are analysed each year. In the laboratory a representative subsample is taken by a rigorous quartering procedure until approximately 400 pieces of herbage remain. Each leaf fragment is then identified to species level or groups of these as appropriate. The fractions are then dried and the composition calculated on a percentage dry weight basis. The accuracy of the analyses of these laboratories has been monitored by a system of interchanging herbage dissection samples between them. From this, the need to separate subsampling errors from problems of plant identification was appreciated and some of this work is described here.

It is relatively simple to distinguish monocotyledon herbage from dicotyledon herbage. However, material available for identification purposes is often limited to leaf blades and parts of these: thus many of the textbook characteristics used to separate different species are of little value, and a limited range of genotypic and phenotypic characteristics must be relied upon. Under these conditions there is considerable scope for mis-identification.

A related problem associated with botanical servicing is the seasonal pattern of the workload. This follows the pattern of pasture growth. Peak workloads occur in the late spring and autumn and errors in herbage dissection analyses are likely to increase owing to pressure of work. Fresh samples do not last

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much longer than 3 weeks without marked deterioration even under cool (0 to 5° C) storage. Freeze drying of samples may be one method of increasing the storage period. For this reason a limited experimental programme compared herbage dissection of fresh and freeze-dried herbage.

### METHODS

#### SUBSAMPLING EXERCISE

In 1973 and 1974 the standard of identification and subsampling by individual technicians was assessed within individual laboratories. Three subsamples were taken from at least two samples of herbage and each subsample was dissected by each technician; the dissected fractions were weighed green and the percentage composition calculated from these weights. The fractions from each subsample were then mixed and re-dissected by the next technician.

#### PLANT IDENTIFICATION EXERCISES

In 1975 and 1976 identification experiments were instigated. A total of 26 experiments were conducted throughout the 2-year period. These covered a range of species and morphological differences within species related to stage of growth and growing conditions. The numbers of experiments conducted at five participating laboratories and the number of staff involved at each are shown in Table 1.

TABLE 1: NUMBER OF IDENTIFICATION EXERCISES CARRIED OUT BY LABORATORIES AND STAFF INVOLVED, 1975-1976

| <i>Laboratory</i>              | <i>No. of Technicians Involved</i> | <i>No. of Exercises</i> |
|--------------------------------|------------------------------------|-------------------------|
| <b>Rukuhia</b>                 | <b>4-6</b>                         | <b>17</b>               |
| <b>Palmerston North</b>        | <b>3-8</b>                         | <b>23</b>               |
| <b>DSIR (Palmerston North)</b> | <b>3-4</b>                         | <b>4</b>                |
| <b>Winchmore</b>               | <b>2-3</b>                         | <b>20</b>               |
| <b>Invermay</b>                | <b>2-5</b>                         | <b>17</b>               |

Weighed quantities of pure material of 4 or 5 individual species were mixed to make a 400-piece dissection sample for each technician involved. Duplicate quantities of the unmixed components were dried and weighed. These figures were used to calculate the standard composition for each experiment. Technicians were required to dissect the samples according to species,

without subsampling. The percentage composition of components was based on the dry weight. Errors in identification and confusion between species were checked after each experiment.

**FREEZE DRYING OF HERBAGE SAMPLES**

Experiments involving freeze-dried samples were conducted by two laboratories. In each experiment two subsamples of approximately 400 pieces per technician were obtained from one sample of herbage. Each technician was required to dissect both subsamples — one fresh, the other freeze-dried.

**RESULTS**

The results of a combined subsampling and identification experiment are shown in Table 2. There was generally good 'agreement between technicians on the identification of species, but different subsamples often produced different results.

Table 3 shows the results of an identification experiment in which misidentification was obvious. A majority of technicians confused barley grass (*Hordeum murinum*) with either prairie grass (*Bromus catharticus*), goose grass (*Bromus mollis*), couch (*Agropyron repens*) or meadow foxtail (*Alopecurus pratensis*). Some technicians also confused lucerne (*Medicago sativa*) with lotus (*Lotus pedunculatus*).

TABLE 2: DIFFERENCES IN COMPOSITION DUE TO SUBSAMPLING  
(Percentages — green weight basis)

| Sub-sample | Technician | LOpe | DAgl | PLpr | ASte | BRmo | POA | TRre | DM | W  |
|------------|------------|------|------|------|------|------|-----|------|----|----|
| A          | 1          | 15   | 1    |      | 1    | 1    |     | 40   | 1  | 41 |
|            | 2          | 14   | 1    |      | 1    | 1    | 1   | 41   | 1  | 40 |
|            | 3          | 14   | 1    |      | 1    |      | 1   | 40   | 1  | 42 |
|            |            | 15   |      |      |      |      |     |      |    |    |
| B          | 1          | 15   | 2    |      | 1    | 1    |     | 35   | 1  | 45 |
|            | 2          | 15   | 11   |      | 1    | 1    |     | 33   | 1  | 45 |
|            | 3          |      |      |      |      |      |     |      | 1  | 45 |
| C          | 1          | 11   | 1    | 1    | 1    |      |     | 35   | 1  | 53 |
|            | 2          | 11   | 1    |      | 1    |      |     | 33   | 1  | 53 |
|            | 3          | 10   | 1    |      | 1    |      |     | 34   | 1  | 52 |

**Notes:** Abbreviations used are given in Appendix 1.  
DM = Dead plant material.  
W = Weeds.

TABLE 3: HERBAGE DISSSECTION IDENTIFICATION EXERCISE USING "MADE UP" SAMPLES  
(Percentages — dry weight basis)

|              | HRmu | FEar | BRca | BRmo | AGre | ALpr | LOpe | Dagl | ASte | Side | MEsa | L  | T  | ACHmi | TRre | D | M  |
|--------------|------|------|------|------|------|------|------|------|------|------|------|----|----|-------|------|---|----|
| Standards:   |      |      |      |      |      |      |      |      |      |      |      |    |    |       |      |   |    |
| 1            | 14   | 33   |      |      |      |      |      |      |      |      |      | 25 | 18 | 10    |      |   |    |
| 2            | 14   | 33   |      |      |      |      |      |      |      |      |      | 25 | 18 | 10    |      |   |    |
| Technicians: |      |      |      |      |      |      |      |      |      |      |      |    |    |       |      |   |    |
| 1            |      | 39   |      |      | 12   |      | Tr   |      | Tr   | Tr   |      | 25 | 14 | 9     | Tr   | 1 |    |
| 2            |      | 40   |      |      | 11   |      | Tr   |      |      |      |      | 25 | 14 | 9     | Tr   | 1 |    |
| 3            |      | 37   |      |      | 11   |      | Tr   |      | Tr   |      |      | 27 | 14 | 10    | Tr   | 1 |    |
| 4            |      | 36   |      |      | 12   |      | Tr   |      |      |      |      | 25 | 13 |       | Tr   | 1 |    |
| 5            |      | 41   |      |      | 11   |      | Tr   |      |      |      |      | 24 | 14 | 10    | Tr   | 1 |    |
| 6            | 12   | 37   |      |      |      |      |      |      |      |      |      | 27 | 14 | 10    | Tr   |   |    |
| 7            | 13   | 33   |      |      |      |      |      |      |      |      |      | 27 | 16 |       |      |   |    |
| 8            | 13   | 33   |      |      |      |      |      | 1    |      |      |      | 26 | 18 | 8     | 1    |   | Tr |
| 9            | 12   | 36   |      |      |      |      |      | 1    |      |      |      | 28 | 14 |       |      |   |    |
| 10           | 13   | 36   |      |      |      |      |      | Tr   |      |      |      | 28 | 14 | 9     | Tr   |   | Tr |
| 11           |      |      |      | 12   |      | 40   |      |      |      | Tr   |      | 26 | 14 | 8     | Tr   |   |    |
| 1 2          |      |      |      | 12   |      | 39   |      |      |      | Tr   |      | 25 | 15 | 9     | Tr   |   |    |
| 13           |      | 38   | 12   |      |      |      |      | 1    | Tr   |      |      | 25 | 14 | 9     | Tr   |   |    |
| 14           |      | 37   | 12?  |      |      |      |      | Tr   | r    |      |      | 25 | 15 | 10    | Tr   |   | 1  |
| 1            | 5    | 12   | 35   |      |      |      |      | Tr   |      |      |      | 28 | 14 |       |      |   |    |
| 16           | 5    | 36   | 7    |      |      |      |      |      |      |      |      | 26 | 16 | 10    | Tr   |   |    |

Notes: Abbreviations used are given in Appendix 1.

DM = Dead plant material.

Tr = Trace.

Technician 14 questioned the identification of BRca because auricles were present in the sample but felt that BRca was the species "best fitted" to the dissected component.

The results of the 26 identification experiments have been summarized in Tables 4 and 5 for legumes and grasses, respectively. These show the number of times confusion occurred between two species as a percentage of the number of times this could have occurred over all experiments. Technicians were classified as experienced or inexperienced if they had more or less than six months' dissection experience, respectively.. The extent of confusion between pairs of species for experienced technicians only and for all technicians is also shown in Tables 4 and 5.

The ratings are a combination of misidentification and confusion. Thus, although crested dogstail (CYcr) is frequently misidentified and confused with the ryegrasses (LOmu and- LOpe), the reverse is seldom the case. As ryegrass was present in more samples than crested dogstail, the overall rating for the combination is lower than might be expected. Each rating is largely independent of all others, but a comparison of ratings within species will generally give realistic differences. However, comparisons between species are likely to be less reliable as the number of times the different species and combinations occurred was not constant.

The effect of freeze drying herbage for dissection analysis is shown in Table 6. After freeze drying, *Poa annua*, prairie grass and cocksfoot (*Dactylis glomerata*) caused some problems of identification.

Results from two identification experiments carried out, one before (a) and the other soon after (b) a staff training course, are shown in Table 7. Although the species composition of the

TABLE 4: PERCENTAGE OF STAFF MISIDENTIFYING OR CONFUSING PAIRS OF LEGUMES

| <i>Species</i> | <i>Extent of Confusion</i> |                  |
|----------------|----------------------------|------------------|
|                | <i>Experienced Staff</i>   | <i>All Staff</i> |
| LT with MEsa   | 26                         | 26               |
| TRdu           | —                          | 1                |
| TRre           | —                          | 3                |
| TRam — TRfr    | 17                         | 20               |
| TRhy           | 67                         | 60               |
| TRme           | 8                          | 7                |
| TRre           | 7                          | 80               |
| TRfr — TRhy    | 8                          | 7                |
| TRpr           | 28                         | 32               |
| TRre           | 32                         | 34               |
| TRhy — TRre    | 59                         | 54               |
| TRpr — TRsu    | 26                         | 48               |

TABLE 5: PERCENTAGE OF STAFF MISIDENTIFYING

|      | AGre | ASte | ALpr | AREl | AVsa | BRca | BRmo | Cygr | DAGl | FEar | FEpr | FERu |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| AGre |      | F    |      |      |      |      |      |      |      |      |      |      |
| ASte | F    |      |      |      |      |      |      | D    |      | F    |      | F    |
| ALpr |      |      |      |      |      |      |      |      |      | F    | F    |      |
| AREl |      |      |      |      |      | F    |      |      |      |      |      |      |
| AVsa |      |      |      |      |      | F    |      |      |      |      |      |      |
| BRca |      |      |      | F    | F    |      | F    |      | F    | F    |      |      |
| BRmo |      |      |      |      |      | F    |      |      | F    |      |      |      |
| CYor |      | D    |      |      |      |      |      |      |      | F    |      |      |
| DAGl |      |      |      |      |      | F    | F    |      |      |      |      |      |
| FEar |      | F    | F    |      |      | F    |      |      |      |      | F    | F    |
| FEpr |      |      |      |      |      |      |      |      |      | F    |      |      |
| FERu |      |      |      |      |      |      |      |      |      | F    |      |      |
| GLfl |      |      |      |      |      |      |      |      |      |      |      |      |
| HOLA | E    | F    |      |      |      | E    |      |      |      |      |      |      |
| HRmu | D    |      |      | F    |      | C    | F    |      |      | F    |      |      |
| HRvu |      |      |      | E    |      | F    |      |      |      |      |      |      |
| LOmu |      |      |      | E    |      |      |      | F    |      |      | D    |      |
| LOpe |      | F    |      |      |      | F    |      | E    | E    | E    |      |      |
| PADI |      | F    |      | F    |      | F    |      |      |      | F    |      |      |
| PLpr | A    | E    | F    |      |      |      |      |      | D    |      |      | F    |
| POan |      |      |      |      |      |      |      |      |      |      |      |      |
| POpr |      |      |      |      |      |      |      |      |      |      |      |      |
| POTr |      |      |      |      |      |      |      |      |      |      |      |      |
| SEce |      | F    |      |      | C    | C    | F    |      | F    |      |      |      |
| TRae |      |      |      |      | E    |      |      |      |      |      |      |      |

ROT9: Abbreviations used are given in Appendix I.

KEY

OR CONFUSING PAIRS OF GRASSES

| Lfl | HOLA | HRmu | HRvu | LOmu | LOpe | PAdi | PHaq | PLpr | POan | POpr | POtr | SEce | TRa |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|-----|
| F   | D    |      |      |      | F    | F    | F    | B    |      |      |      | F    |     |
| F   |      |      |      |      | F    |      | F    | E    |      | F    |      | F    |     |
|     |      |      |      |      |      |      |      | F    |      |      |      |      |     |
|     | F    | F    | E    |      |      |      | C    |      |      |      |      | E    | F   |
| D   | B    | F    |      | F    |      |      | F    |      |      |      |      | C    |     |
|     | F    |      |      |      |      |      |      |      |      |      |      | F    |     |
|     |      |      | F    | F    |      |      |      |      |      |      |      |      |     |
| F   |      |      |      | F    | F    |      | F    | D    | F    |      |      | F    |     |
|     | E    |      | D    | E    |      |      | E    | F    |      |      |      |      |     |
|     |      |      |      |      |      |      |      | F    |      |      |      |      |     |
|     |      |      |      |      |      |      | F    | F    |      |      |      |      |     |
|     | E    |      |      | F    |      |      | F    | F    |      |      |      | C    |     |
| E   |      |      |      | F    |      |      | D    | F    |      |      |      | A    |     |
|     |      |      |      |      |      |      | F    |      |      |      |      | C    |     |
|     |      |      |      |      |      |      | E    |      |      |      |      |      |     |
|     |      |      |      |      |      |      | D    | D    | F    | D    | D    |      |     |
|     |      |      |      |      |      |      |      |      |      |      |      |      |     |
| F   | D    | F    |      |      |      |      |      | F    |      |      |      | B    | F   |
| F   |      |      |      | C    |      |      |      |      |      |      |      | F    |     |
|     |      |      |      | F    |      |      |      |      |      | F    |      | E    |     |
|     |      |      |      | E    |      |      |      |      | F    |      |      | E    |     |
|     |      |      |      | C    |      |      |      |      |      | E    |      |      |     |
| C   | A    | C    |      |      |      |      | A    | E    |      |      |      |      | F   |
|     |      |      |      |      |      |      |      |      |      |      |      |      |     |
|     |      |      |      |      |      |      |      |      |      |      |      |      | F   |

All staff

| Rating | Extent of Confusion |
|--------|---------------------|
| A      | > 51%               |
| B      | 41-50%              |
| C      | 31-40%              |
| D      | 21-30%              |
| E      | 11-20%              |
| F      | 1-10%               |

) Frequently confused  
 ) Occasionally confused  
 ) Rarely confused

TABLE 6: THE EFFECT OF FREEZE DRYING ON HERBAGE  
DISSECTION ANALYSES  
(Percentages -- dry weight basis)

| FRESH        |      |      |      |       |      |      |      |      |      |   |
|--------------|------|------|------|-------|------|------|------|------|------|---|
| Technician   | LOpe | BRca | DAgl | POan  | POtr | CYcr | ASte | PHaq | TRre | W |
| 1            | 35   | 22   | 16   | 15    | tr   |      | 1    | 3    | 7    | 1 |
| 2            | 36   | 21   | 16   | 12    |      | 1    | 1    | 4    | 9    |   |
| FREEZE DRIED |      |      |      |       |      |      |      |      |      |   |
| Technician   | LOpe | BRca | DAgl | POspp | CYcr | ASte | PHaq | TRre | W    |   |
| 1.           | 57   | 15   | 11   | 6     |      | 1    | 4    | 6    |      |   |
| 2            | 47   | 15   | 26   | 2     | 1    | 3    | 1    | 5    |      |   |

Notes: Abbreviations used are given in Appendix 1.  
W = Weeds.

TABLE 7: HERBAGE DISSECTION IDENTIFICATION EXERCISE  
(Percentages -- dry weight basis)

| (a) CARRIED OUT PRIOR TO REFRESHER COURSE |                         |                           |       |      |      |      |      |       |   |       |
|---|-------------------------|---------------------------|-------|------|------|------|------|-------|---|-------|
| Instances of Misidentification            |                         |                           |       |      |      |      |      |       |   |       |
|   | LOpe                    | BRca                      | DAgl  | RHmu | AGre | AREl | DM   | T     | o | t a l |
| Experienced (12)                          | 2                       | 8                         | 1     | 7    | 1    | 2    | 0    | 20    |   |       |
| Inexperienced (6)                         | 1                       | 5                         | 1     | 5    | 1    | 0    | 1    | 14    |   |       |
| Summary of Misidentifications             |                         |                           |       |      |      |      |      |       |   |       |
|   | Experienced Technicians | Inexperienced Technicians | Total |      |      |      |      |       |   |       |
| BRca with HRmu                            | 6                       | 5                         | 11    |      |      |      |      |       |   |       |
| BRca with AREl                            | 2                       | 0                         | 2     |      |      |      |      |       |   |       |
| BRca with LOpe                            | 1                       | 0                         | 1     |      |      |      |      |       |   |       |
| LOpe with DAgl                            | 1                       | 1                         | 2     |      |      |      |      |       |   |       |
| AGre with HRmu                            | 0                       | 1                         | 1     |      |      |      |      |       |   |       |
| (b) CARRIED OUT AFTER REFRESHER COURSE    |                         |                           |       |      |      |      |      |       |   |       |
| Instances of Misidentification            |                         |                           |       |      |      |      |      |       |   |       |
|   | LOpe                    | FEea                      | BRca  | HRmu | AVsa | TRpr | TRsu | Total |   |       |
| Experienced (12)                          | 0                       | 0                         | 1     | 0    | 1    | 1    | 1    | 4     |   |       |
| Inexperienced (6)                         | 1                       | 1                         | 3     | 2    | 1    | 0    | 0    | 7     |   |       |
| Summary of Misidentifications             |                         |                           |       |      |      |      |      |       |   |       |
|   | Experienced Technicians | Inexperienced Technicians | Total |      |      |      |      |       |   |       |
| BRca with HRmu                            | 0                       | 1                         | 2     |      |      |      |      |       |   |       |
| BRca with AVsa                            | 1                       | 1                         | 2     |      |      |      |      |       |   |       |
| FEea with HRmu                            | 0                       | 0                         | 0     |      |      |      |      |       |   |       |
| LOpe with HRmu                            | 0                       | 1                         | 1     |      |      |      |      |       |   |       |
| TRpr with TRsu                            | 1                       | 0                         | 1     |      |      |      |      |       |   |       |

two groups of samples is not the same, the main problem species are common to both groups. Both experienced and inexperienced technicians showed increased awareness of ranges of characteristics of a pair of problem species, barley grass (HRmu) and prairie grass (BRca), after the course. Before the course, 61% of the technicians (11 out of 18) confused barley grass and prairie grass and a further two technicians misidentified prairie grass as tall oat grass (ARel). After the course only 11% confused barley grass and prairie grass, while two technicians misidentified prairie grass as oats (*Avena sativa*, AVsa).

#### DISCUSSION

The number of pairs of species which are listed as being confused is surprisingly large. Eighty-five pairs of grass species and 12 pairs of legumes were confused to some degree in the exercises. Many of the confused pairs of legumes and grass species are artifacts of the experiments conducted. Some species are seldom encountered in certain laboratories and the pairs involving such species may never occur together in normal dissection samples (e.g., Caucasian and Alsike clovers). However, all species used in the artificial herbage samples analysed in the experiments are encountered in normal practice in the MAF botanical services laboratories.

The records of instances of misidentification overemphasize the errors likely to occur in laboratory dissections since they are records of where confusion occurred and do not take account of the extent of misidentification. Thus, in Table 7a, two technicians misidentified a small amount of barley grass as prairie grass, two other technicians misidentified considerably more, and a further technician misidentified all of the barley grass as prairie grass. In most cases a relatively small amount of herbage was misidentified. Many of the pairs of species likely to be confused are frequently minor components in pasture samples — i.e., they are a small proportion by weight of the total sample. Errors of identification in these circumstances are of limited importance unless interest is specifically centred on the affected species.

#### FACTORS INFLUENCING MISIDENTIFICATION

The amount of misidentification appeared to be affected by the experience of the technicians and by the variability of identifying characteristics of the plants. Inexperienced technicians con-

fused about 30% more pairs of species than did experienced technicians.

The identification experiments have shown that even experienced technicians can be confused between a familiar species and an unfamiliar species with some similar characteristics. The classification of technicians into experienced and inexperienced in the reported experiments was made on the arbitrary basis of length of service. However, 'experience' is not a simple attribute that can be satisfactorily attained after six months' employment in a botanical services laboratory. Experience and competence are affected by the botanical training a person has had, the length of time a technician has undertaken botanical dissections with cut herbage, the range of species encountered during that time, and the combinations of species in the dissection samples analysed. Some of these points were demonstrated by the results of two dissection exercises (Table 7) conducted before and after a 1-week course held in August 1976 which, brought technicians from the four MAF laboratories together for discussion of the range of characters within species.

Many of the characteristics used as the basis for identification in herbage dissection may vary with geographic location, the stage of growth of the plant, growing conditions, and time of year. Variability in the limited characteristics available on pieces of grass leaves 2 to 8 cm long can be expected to introduce some confusion with resultant errors in identification.

Also, new selections of some species may differ sufficiently in some characteristics from the forms normally encountered to make their identification difficult. For example, 'Grasslands Matua' prairie grass with its sometimes smaller tillers and variability in hairiness is an entity more difficult to identify consistently than the forms of prairie grass encountered before its release.

The identification characteristics of the plant are likely to be more variable when conditions for plant growth are changeable — e.g., in late spring-early summer. This period coincides with peak sample loads and thus greatest pressure on technicians for rapid completion of dissection analyses, and thus the chances of misidentification are increased.

#### REDUCING ERRORS OF IDENTIFICATION

Not all errors associated with herbage dissection analyses can be readily reduced. It would be impossible to remove all misidentification of perennial ryegrass and dogstail from a sample.

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Where both species are known to occur in a pasture, some additional analyses — e.g., tiller counts or point analyses — may be necessary to determine accurately the proportions of the two species.

It appears that less emphasis should be placed on the identification of minor species in herbage dissection analyses unless they are of specific interest to the research programme involved. The identification of these species requires a disproportionate amount of time and the errors associated with their identification would render the estimates of limited value only. Minor species can be readily separated from major species in partial dissection (as opposed to full dissection) analyses and bulked as “other grasses” or “other species”. Partial dissections are less time-consuming and therefore offer a method of reducing the laboratory workload.

The freeze-drying process can also be used to reduce peak workloads by storage of samples for later dissection analysis. Although frozen samples were unsatisfactory for herbage dissection, freeze-dried samples were stored satisfactorily for long periods. However, some species (e.g., *Poa annua*) were no longer identifiable after freeze drying (Table 6) and other grasses were also confused. Freeze drying cannot therefore be recommended where possible confusing species are present — but has proved valuable for trials where simple mixtures are present, e.g., where grass cultivars are sown in association with white clover.

Identification errors could be reduced by increasing the length of herbage pieces dissected. In some experiments such herbage is obtained by cutting samples to ground level by motorized or hand shears rather than using a mower. However, the field subsampling errors associated with such techniques are greater than those with mown samples (Boswell *et al.*, 1978) and the overall advantage is likely to be minimal.

The other method of reducing errors is by intensive staff training. During the training of new staff in the MAF laboratories, dissected fractions from each sample completed are checked by an experienced staff member. Although this approach is very good, it does have certain limitations. Unless experienced staff have their identifications checked at regular intervals by outside experienced observers, wrong identifications of strange material may occur and be repeated. The interchange of made-up herbage dissection identification samples provides a very good means of assessing the capabilities of individual technicians. The unmixed components of the identification samples are also sent to the laboratories so that the range of characteristics of the material

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comprising each species may be assessed, and confusion corrected, as soon as the dissections have been completed.

#### CONCLUSIONS

Problems in identification can be important in *herbage* dissection. This may be particularly so with inexperienced staff. However, it must be appreciated that some species are very difficult to identify when parts of leaf blades are the only material available on which to base identification.

Regular assessments of the ability of all staff to correctly identify species contained in samples are essential. Identification problems must be appreciated by the scientific staff being serviced by the laboratories, particularly when experiments are being planned and when results are being interpreted, with due consideration being given to the types of analyses undertaken,

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**APPENDIX 1**  
**Key to Abbreviations Used**

| <i>Abbreviation</i> | <i>Species Name</i>                                 | <i>Common Name</i>         |
|---------------------|---|----------------------------|
| <b>GRASSES:</b>     |   |                            |
| AGre                | <i>Agropyron repens</i> (L.) Beauv.                 | <i>couch</i>               |
| ASte                | <i>Agrostis tenuis</i> Sibth.                       | <i>browntop</i>            |
| ALpr                | <i>Alopecurus pratensis</i> L.                      | meadow foxtail             |
| ANod                | <i>Anthoxanthum odoratum</i> L.                     | sweet vernal               |
| ARel                | <i>Arrhenatheruni elatius</i> (L.) J. & C. Presl.   | tall oatgrass              |
| AVsa                | <i>Avena sativa</i> L.                              | oats                       |
| BRmo                | <i>Bromus mollis</i> L.                             | gdosegrass                 |
| BRca                | <i>Bromus cartharticus</i> Wahl.                    | prairie grass              |
| CYcr                | <i>Cynosurus cristatus</i> L.                       | crested 'dogstail          |
| DAGl                | <i>Dactylis glomerata</i> L.                        | cocksfoot                  |
| FEar                | <i>Festuca arundinacea</i> Schreb.                  | tall fescue                |
| FEpr                | <i>Festuca pratensis</i> Huds.                      | meadow fescue              |
| FEru                | <i>Festuca rubra</i> L. ssp. <i>commutata</i> Gaud. | Chewings fescue            |
| GLfl                | <i>Glyceria fluitans</i> (L.) R.Br.                 | floating sweet grass       |
| HOLA                | <i>Holcus lanatus</i> L.                            | Yorkshire fog              |
| HRmu                | <i>Hordeum murinum</i> L.                           | barley grass               |
| HRvu                | <i>Hordeum vulgare</i> L.                           | barley                     |
| LOmu                | <i>Lolium multiflorum</i> Lam.                      | Italian ryegrass           |
| LOpe                | <i>Lolium perenne</i> L.                            | perennial ryegrass         |
| PAdi                | <i>Paspalum dilatatum</i> Poir.                     | paspalum                   |
| PHaq                | <i>Phalaris aquatica</i> L.                         | phalaris                   |
| PLpr                | <i>Phleum pratense</i> L.                           | timothy                    |
| POan                | <i>Poa annua</i> L.                                 | annual meadow grass        |
| POpr                | <i>Poa pratensis</i> L.                             | Kentucky bluegrass         |
| POtr                | <i>Poa trivialis</i> L.                             | rough-stalked meadow grass |
| SEce                | <i>Secale cereale</i> L.                            | ryecorn                    |
| SIde                | <i>Sieglingia decumbens</i> (L.) Bernh.             | heath grass                |
| TRae                | <i>Triticum aestivum</i> (L.)                       | wheat                      |
| <b>LEGUMES:</b>     |   |                            |
| LT                  | <i>Lotus</i> spp.                                   | <i>l o t u s</i>           |
| MEsa                | <i>Medicago sativa</i> L.                           | lucerne                    |
| TRam                | <i>Trifolium ambiguum</i> M.Bieb.                   | Caucasian clover           |
| TRdu                | <i>Trifolium dubium</i> Sibth.                      | suckling clover.           |
| TRfr                | <i>Trifolium fragiferum</i> L.                      | strawberry clover          |
| TRhy                | <i>Trifolium hybridum</i> L.                        | Alsike clover              |
| TRme                | <i>Trifolium medium</i> L.                          | zigzag clover              |
| TRpr                | <i>Trifolium pratense</i> L.                        | red clover                 |
| TRre                | <i>Trifolium repens</i> L.                          | white clover               |
| TRsu                | <i>Trifolium subterraneum</i> L.                    | subterranean clover        |
| <b>WEEDS:</b>       |   |                            |
| ACHmi               | <i>Achillea millefolium</i> L.                      | yarrow                     |