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ASPECTS OF SEED QUALITY

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Abstract. Seed quality refers to a number of seed properties which may have varying degrees of practical importance for agriculture. As well as the traditional purity and germination capacity of seedlots, seed quality also includes species purity, cultivar purity, vigour, seed size, seedlot uniformity, seed health and seed moisture content.

The quality of New Zealand herbage seedlots is reviewed. Data are presented for weed seed contamination, germination, seed vigour and seed weight. The influence such factors as analytical and cultivar purity, freedom from weeds, vigour and seed health have on New Zealand's domestic and export seed trade is discussed.

Keywords: Seed quality, herbage seed, analytical purity, weed seeds, cultivar purity, germination, vigour, seed size, seedlot uniformity, seed health.

INTRODUCTION

In the early days of seed testing, purity and germination capacity tended to be the only properties of seed which were considered when assessing seed quality. Today, seed quality refers to a collection of seed components considered to be of importance for the value of seed for sowing purposes (Esbo, 1980). Thompson (1979) outlined 10 seed quality components with varying degrees of practical importance to agriculture ***viz*** analytical purity, species purity, freedom from weeds, cultivar purity, germination capacity, vigour, size, uniformity, health and-moisture content.

Internationally acceptable methods of seed quality assessment are published periodically by the International Seed Testing Association (ISTA, 1976; 1985). The principles and practices more directly applicable to the testing of New Zealand herbage seeds have been previously outlined (Scott, 1980), and summarised in AgLinks FPP 828 and NZA 28 (Young ***et al.,*** 1984; Scott ***et al.,*** 1985).

In this paper, we outline some aspects of current interest and concern regarding the quality of New Zealand herbage seeds.

ANALYTICAL PURITY

Analytical purity indicates the proportion of a seedlot which is pure seed of the species concerned. The laboratory analysis also identifies and quantifies impurities (seeds of other crops and weeds, inert matter) which may occur in the seedlot. The purity components are always expressed as a percentage by weight of the seed sample analysed (Scott, 1980).

As part of the New Zealand seed certification scheme, analytical purity standards (Anon., 1984) must be met. The proportion of seedlots downgraded or rejected from certification is generally low (Table I), but problems with seed cleaning are encountered with some species, particularly white clover, cocksfoot and lotus.

High contents of other crop and weed seed in field dressed seedlots cause serious difficulties for seed cleaning operators. For example, in white clover, contamination with suckling clover (other crop), or the weed species ***Trifolium glomeratum*** (clustered clover), ***Chenopodium album*** (fathen), ***Stellaria media*** (chickweed) and ***Plantago lanceolata*** (narrow-leaved plantain) are common reasons for downgrading or rejection of seedlots. Damage to weed seeds during threshing can also create difficulties during machine cleaning, e.g. ***Sherardia arvensis*** (field madder) in white clover. Around 50% of white clover seedlots downgraded or rejected in any one year are "seconds", which may be expected to contain higher proportions of contaminants. In lotus seedlots, contamination with -white and/or suckling clover, and less frequently weed species such as ***Amaranthus*** spp. (redroot) and ***Rumex*** spp. (docks), results in downgrading or rejection from certification.

Seeds of some grass cultivars prove more difficult to clean than others. While the weed seed ***Bromus mollis*** (soft brome) is the greatest single cause for downgrading/rejection of ryegrass seedlots (Rolston ***et al.,*** 1985), it is particularly difficult to clean out of the tetraploid cultivars Tama and Moata. Similarly, the occurrence of ***Avena fatua*** (wild

TABLE 1 Proportion of seedlots of herbage cultivars downgraded or rejected from certification through failure to meet analytical purity standards.

Cultivar	No. seedlots tested	Number and percentage of seedlots Downgraded no.	%	Rejected no.	%
Ryegrass					
Grasslands Ariki	53	7	13.2	1	1.9
Ellett	382	0	0	4	1.0
Grasslands Manawa	271	18	6.6	8	3.0
Grasslands Moata	219	4	1.8	15	6.8
Grasslands Nui	732	35	4.8	26	3.6
Grasslands Paroa	49	1	2.0	1	2.0
Grasslands Ruanui	114	5	4.4	2	1.8
Grasslands Tama	101	1	1.0	5	5.0
Clover					
Grasslands Hamua	65	0	0	4	6.2
Grasslands Huia	1301	141	10.8	87	6.7
Grasslands Pawera	70	4	5.7	4	5.7
Grasslands Pitau	85	9	10.6	8	9.4
Grasslands Turoa	51	1	2.0	6	11.8
Cocksfoot					
Grasslands Apanui	137	21	15.3	30	21.9
Grasslands Wana	15	2	13.3	2	13.3
Crested dogstail					
Southland	11	1	9.1	0	0
Lotus					
Grasslands Maku	33	6	18.2	10	30.2
Lucerne					
Wairau	25	0	0	3	12.0
Prairie grass					
Grasslands Matua	38	2	5.3	2	5.3
Timothy					
Grasslands Kahu	22	1	4.5	4	18.2

oat) is greater in these two cultivars than the other ryegrass cultivars.

Some changes to the purity standards for herbage seeds have been recently made (Anon., 1984). The minimum percentage of pure seeds for prairie grass (***Bromus willdenowii*** Kunth.) seedlots was reduced by 1-2% depending on certification class, to allow for the difficulties encountered in removing attached sterile florets during machine cleaning. In 1981, the certification standard for minimum pure seed of cocksfoot (***Dactylis glomerata*** L.) was raised by 5%, as new international rules (ISTA, 1981) meant that the need to apportion one fifth of the weight of multiple seed units (MSU) to the inert matter component was dispensed with. The new rule requires that the MSU percentage, if 1% or greater, should be stated separately on the seed analysis certificate.

FREEDOM FROM WEEDS

Seeds of a large range of weed species occur regularly in New Zealand seedlots, although many are of little significance provided their collective rate of occurrence is kept within the standards required by the certification scheme. However, the New Zealand Agricultural Merchants Federation and the Official Seed Testing Station recognise fourteen weed species as particularly undesirable seedlot contaminants (Young, 1984). The presence of three of these species, ***Carduus nutans*** (nodding thistle), ***Avena fatua*** (wild oat) and ***Amsinckia calycina*** (yellow gromwell) in certified seedlots is cause for automatic rejection (Anon., 1984). The other eleven species include five, ***Carduus tenuiflorus*** (winged thistle), ***Cirsium arvense*** (Californian

thistle), C. *vulgare* (Scotch thistle), *Conium maculatum* (hemlock) and *Hordeum murinum* (barley grass) which occur at a low but regular level in seedlots (Table 2). The presence of any one of these fourteen undesirable weed species in a seedlot is given special prominence on a seed analysis certificate by showing its botanical and common name. Further information on the occurrence and significance of undesirable weed seed contaminants has been published elsewhere (Young, 1984; Rolston *et al.*, 1985).

TABLE 2 Occurrence of undesirable weed species in officially sampled[1] seedlots, 1983 and 1984.

Botanical name	Common name	%occurrence 1983	1984
Amsinckia calycina	yellow gromwell	0.27	0.18
Avena fatua	wild oat	2.29	1.76
Cardaria draba	hoary cress		
Carduus nutans	nodding thistle	0.25	0.50
Carduus tenuiflorus	winged thistle	0.56	0.77
Cirsium arvense	Californian thistle	0.43	0.61
Cirsium vulgare	Scotch thistle	0.60	0.70
Conium maculatum	hemlock	0.13	0.17
Convolvulus arvensis	field bindweed	.	
Cuscuta spp.	dodder		
Hordeum murinum	barley grass	0.51	1.14
Leucanthemum vulgare oxeye	daisy		0.01
Senecio jacobaea	ragwort	0.02	.
Stipa trichotoma	nassella tussock	.	

[1]original and retests of 11,933 seedlots in 1983 and 11,547 seedlots in 1984.

The presence of weed seed contaminants in seedlots can create problems for New Zealand seed exporters. Many countries have restrictions or prohibitions on the importation of seedlots contaminated with specified weed seeds. For example, *Amsinckia calycina* (yellow gromwell), *Carduus nutans* (nodding thistle), *Cirsium arvense* (Californian thistle), *Conium maculatum* (hemlock) and *Orobanche minor* (broom rape) regularly occur as contaminants in New Zealand herbage seedlots, and all are prohibited entry into Australia. Many other weed seeds are prohibited, restricted or required to be declared in one or more individual Australian States. Those regularly occurring in ryegrass seed are *Carduus tenuiflorus* (winged thistle), *Cirsium vulgare* (Scotch thistle), *Echium vulgare* (viper's bugloss), *Marrubium vulgare* (horehound), *Polygonum aviculare* (wire weed), *Polygonum convolvulus* (cornbind) and *Rumex* spp. (docks).

The occurrence of any of these impurities in seedlots creates difficulties in meeting export requirements. A greater awareness of the identity of these weed seeds and more active efforts to reduce their occurrence in seed crops is required of New Zealand seed producers.

CULTIVAR PURITY

Maintenance of cultivar purity is the major reason for the existence of the seed certification scheme (Anon., 1984), and the smooth operation of the scheme relies on seed producers and seed merchants adhering strictly to the correct procedures. Methods of testing for cultivar purity have been recently reviewed (Anderson, 1984). In New Zealand, MAF undertakes laboratory and field plot testing to verify cultivar purity.

(i) Ultra-violet light testing for perenniality

This laboratory test has been used for many years at the Official Seed Testing Station, to test for perennality in ryegrass seedlots (Scott, 1980). All certified perennial ryegrass (*Lolium perenne* L.) seedlots are examined under ultra-violet (UV) light. Roots of annual types produce a substance which fluoresces under UV light, while true perennial types do not. Of 1,228 samples of certified perennial ryegrass cultivars tested for UV light fluorescence in 1984, two were downgraded and five were rejected on account of failure to meet the required standards.

(ii) Field plot tests

With the establishment of OECD schemes for varietal certification of seed moving in international trade, guides and rules were produced for testing cultivar purity in field plots and at field inspection (Thomson, 1971). In New Zealand, field plot testing is carried out as a requirement of New Zealand's membership of OECD seed certification schemes. The purpose of plot testing is to ascertain that the schemes are operating satisfactorily (OECD, 1982). For each cultivar entered into OECD certification, samples of basic seedlots and certified first and second generation seedlots are sown in field plots. Plants are then examined at various stages of growth to determine conformity with standard cultivar characteristics.

In New Zealand, field plot testing has shown that the cultivar purity of certified

herbage seedlots is high. For example, in 1984, 466 seedlots of herbage grasses and 424 seedlots of white clover were plot tested and no cultivar contamination or substitutions were detected. Out of 52 red clover seedlots tested, one cultivar substitution was found.

Although field plot testing is now well etablished for cultivar identification and purity, the process is costly and time consuming. As a rule, the results are not available until the actual seedlot has been put on the market and sown by the consumer. Consequently, other methods of establishing seedlot cultivar purity have been investigated (Andersson, 1984), and much attention is being focused on the laboratory technique of electrophoresis.

(iii) Electrophoresis

Apart from morphological tests of growing plants, electrophoresis seems to be the most promising method of identifying cultivars and detecting off-types (Andersson, 1984). The technique is a physico-chemical one (Gilliland et *al.*, 1982), by which plant or seed storage proteins separate out at different rates in a gel support medium when an electrical potential is applied across that medium.

Electrophoresis has been used for identification of grass cultivars (Payne *et al.*, 1980; Gilliland *et al.*, 1982), particularly *Lolium* spp. The latter authors concluded that the technique was valuable for varietal control in seed certification schemes. Recent research in New Zealand (S. Gardiner, pers. comm.) has shown that annual and perennial ryegrass cultivars can be distinguished using gel electrophoresis. The Official Seed Testing Station is currently examining the possibility of introducing such a test as part of the seed certification requirements.

GERMINATION

Historically, seed quality has been synonymous with germination; the basic aim of germination testing being to provide information about the planting value of the seedlot.

(i) Grasses

The germination of New Zealand ryegrass cultivars is usually 85% or greater (Hampton and Scott, 1980), although season and region of production can both strongly influence germination results (Hampton and Young, 1985). Marked differences can also occur between ryegrass types, and between certified and non-certified seedlots (Table 3).

TABLE 3 Percentage of herbage seedlots with a germination of 90% or greater, 1984.

1. GRASSES	No. seedlots tested'	%seedlots with germination ≥90%
Ryegrass		
certified oerennial	1175	76.0
italian	200	61.9
hybrid	295	46.0
Westerwolds	78	66.7
uncertified	462	53.0
Browntop		
certified	23	89.7
uncertified	17	34.6
Cocksfoot		
certified	116	38.2
uncertified	34	27.4
Dogstail		
certified	11	72.7
uncertified	30	31.7
Prairie grass		
certified	36	88.9
uncertified	16	87.8
Timothy		
certified	20	40.0
uncertified	13	34.3
Yorkshire fog		
certified	1	100.0
uncertified	3	33.3
2. LEGUMES		
White clover		
certified	1319	71.0
uncertified	467	51.0
Red clover		
certified	174	16.8
uncertified	112	8.9
Lotus		
certified	23	30.4
uncertified	17	11.8
Lucerne		
certified	54	0.0
uncertified	98	1.0

'data are for official tests only and do not include retests.

Low germination in New Zealand ryegrass seedlots is commonly associated with dead seeds which result from one of three factors – blind seed disease, heating damage or immature

seed (Hampton and Young, 1985). Seasonal, region of production and cultivar germination differences are often explained by the incidence of blind seed disease, caused by the fungus *Gloeotinia temulenta* (Prill. and Del.) Wilson, Noble and Gray (Hampton and Scott, 1980). For example, the germination differences reported between cultivars Nui and Ellett (Hampton and Young, 1985) are not cultivar related, but do reflect the occurrence of blind seed disease as influenced by the major regions of production (Canterbury for Nui and Hawkes Bay for Ellett). Seedlots of Nui grown in Hawkes Bay in 1983 and 1984 also had germination results greater than those of Nui grown in Canterbury (Hampton and Young, 1985).

The germination of other herbage grass seed species is often poorer than that of ryegrass, with between 1520% of seedlots in some species having a germination of less than 80%. Little published information exists as to reasons for low germination in these species, but observations at the Official Seed Testing Station suggest that seedlots of dogstail, cocksfoot and prairie grass often contain immature seed, and seedlots of timothy and Yorkshire fog contain hulled seed, the embryo having been damaged during harvesting. It is also possible that blind seed disease may be affecting germination in some species; the pathogen has been detected in *Festuca arundinacea* Schreb (Neil1 and Hyde, 1942; Hampton, unpub. data) and reported overseas from seedlots of *Bromus, Cynosurus, Dactylis, Holcus* and *Phleum* (Richardson, 1979). The germination differences between certified and uncertified seedlots of browntop and dogstail (Table 3) can be partly explained by seed age; uncertified seedlots submitted for testing having often been in storage for over a year after harvest.

(ii) Legumes

The germination of herbage legumes is complicated by the presence of hard seeds; that is, seeds which fail to imbibe water within the prescribed test period. Such seeds are still viable, but if sown, may only germinate over a long period of time as the impermeable seedcoat is gradually broken down. The water impermeability of the seedcoat of hard seed is a type of dormancy (Rolston, 1978) which has ecological advantages for some species, e.g. subterranean clover, but is agronomically undesirable in others (Hyde, 1954).

In hand harvested legumes, seed is often more than 90% hard (Gunn, 1972). Mechanical harvesting and cleaning (including scarification), usually result in sufficient physical stress on the seed to reduce the hard seed content to acceptable levels. New Zealand white clover seedlots rarely have a hard seed content of greater than 10% (Table 4). However, hard seed can be a problem in red clover, lotus and lucerne seedlots (Table 4). The percentage of hard seeds in a seedlot is always reported as a separate category on a seed analysis certificate.

TABLE 4 Hard seed content of legume seedlots, 1984'.

Species	No. seedlots tested	Percentage of seedlots with hard seed <10%	10-19%	>20%
White clover				
certified	1319	95.2	3.9	**0.9**
uncertified	**467**	90.8	5.5	3.7
Red clover				
certified	174	84.7	14.7	0.6
uncertified	112	65.1	29.5	5.4
Lotus				
certified	23	65.2	21.7	13.1
uncertified	17	88.2	11.7	0.1
Lucerne				
certified	54	4.9	24.6	70.5
uncertified	98	13.2	26.5	60.3

'data are for official tests only and do not include retests.

Hard seed in leguminous plants is genetically controlled, but its expression can be strongly influenced by environmental factors (Rolston, 1978). Relative humidity and temperature affect the degree of hardseededness retained in seed crops prior to harvest. Crops grown at sites with low relative humidity and high temperatures during seed development and maturation tend to have high levels of hard seed (Rolston, 1978). Factors affecting hard seed retention in New Zealand herbage legumes require further investigation.

VIGOUR

Seed vigour refers to those properties of seed which influence the speed and uniformity of germination, and the ability to germinate and emerge under a wide range of field conditions (Scott, 1980). Lack of seed vigour may be seen as slow or uneven field emergence, or failure to establish as well as laboratory germination tests otherwise indicate. With herbage seeds, differences in emergence between seedlots of similar germination capacities have usually been attributed to seed size (Naylor, 1980); the effects of seed size on subsequent production are discussed elsewhere in this paper. However, Naylor (1981) investigated the use of indices derived from germination and emergence tests for seedlots of *L. multiflorum* Lam., and showed that indices which estimated mean germination time (or its inverse, rate of germination), were good predictors of final field emergence, whereas measurements of seed weight were not well correlated with final field emergence. He demonstrated that vigour differences existed in Italian ryegrass seedlots, both between cultivars and between different seedlots of the same cultivar. The effects of seed vigour on the field emergence of some New Zealand herbage seed cultivars requires investigation.

Differences in the ability to retain germination during storage may also be attributed to differences in seed vigour (Delouche and Baskin, 1973). The germination of any seedlot begins to decline following harvest. Initially, there is only a slow decline in the percentage germination, when a few seeds die early on in their storage life. There is then a relatively rapid decline as most seeds die in the middle storage period, following by a slow final decline. The total time taken for this process depends on the species, seed vigour status and storage conditions.

Low vigour seeds are physiologically older, consequently nearer to the point where they are vulnerable to a rapid decline in germination. The underlying reasons for low vigour are still being determined but are likely to be associated with problems during physiological development, mechanical damage and exposure to unfavourable environmental conditions.

Tests are being developed to distinguish between seedlots of differing vigour levels. Clark (1982) showed that an accelerated ageing vigour test (germination after 4 days at 100% RH at 42°C) could be used to determine the vigour status of New Zealand crested dogstail (*Cynosurus cristatus* L.) seedlots. Since 1980 the Official Seed Testing Station has used this test to indicate the suitability of crested dogstail seedlots for export. Seed of 'high vigour' is expected to retain its initial germination even when briefly exposed to adverse storage conditions such as those which occur during shipping overseas; seed of 'low vigour' is expected to suffer a more rapid decline in germination during shipping, particularly if under unfavourable conditions.

A similar type of vigour test (germination after 4 days at 100% RH at 45 °C) has also been used to determine the vigour status of Matua prairie grass (*Bromus willdenowii* Kunth) seedlots (Table 5).

TABLE 5 Germination after accelerated aging for seedlots[1] of Grasslands Matua prairie grass, 1984. (Hampton, unpub. data)

Germination result	Days in accelerated ageing chamber 3		Days in accelerated ageing chamber 4	
	No. of seedlots	%	No. of seedlots	%
90% or greater	33	67	23	47
75-89%	11	22	18	37
50-74%	4	8	5	10
50%	1	3	3	6

'all seedlots had a laboratory germination of 90% or greater prior to accelerated ageing.

The possibilities for export sales of Matua have suffered a severe check over the last two years because of the failure of some seedlots to maintain their germination during shipping. From February 1985, seed merchants have been able to request an accelerated ageing vigour test for Matua seedlots which will indicate the suitability of seedlots for export.

SEED WEIGHT

Brown (1977) demonstrated that increasing the weight of individual seeds of Tama ryegrass *(L. multiflorum* Lam.) sown increased seedling growth and subsequent pasture production. Similarly, Veronesi *et al.* (1983) found that with perennial ryegrass *(L. perenne* L.) a positive correlation existed between seed weight and herbage yield per plant in the year of establishment, and the presence of a positive correlation between seed weight and germination influenced establishment. Evans (1973) showed that in perennial ryegrass, cocksfoot *(Dactylis glomerata* L.), timothy *(Phleum pratense* L.), browntop (*Agrostis tenuis* Sibth.), white clover *(Trifolium repens* L.) and red clover *(T. pratense* L.), plant size and root length were related to seed size, and similar results have also been reported for tall fescue *(Festuca arundinacea* Schreb.) and Yorkshire fog (*Holcus lanatus* L.) (Hayes, 1975).

Scott (1980), commenting on the work of Brown (1977), suggested that some account should be taken of seed weight in seed certification standards, but also noted that if a thousand seed weight (TSW) standard of 4.0 g was introduced for Tama, approximately 25% of seedlots otherwise eligible for certification would be rejected. In the 1982/83 season, a 4.0 g TSW standard was introduced for Moata tetraploid Italian ryegrass (Anon., 1982). In 1982, 1983 and 1984, 19% 42% and 9% of crops respectively were rejected' from certification through failure to meet the TSW standard.

Seed weight effects on subsequent plant performance of Moata have yet to be published. However, glasshouse work has demonstrated that per plant production increased with increasing TSW of seedlots (Table 6), and also with increasing weight of individual seeds within a seedlot (Table 7). Hampton (unpub. data) also found that when equal numbers of seeds per unit area were sown in the field, dry matter production from a seedlot with a TSW of 5.0 g was between 30-50% greater during autumn and winter than that from a seedlot with a TSW of 3.0 g.

TABLE 6 The effect of seedlot thousand seed weight on seedling growth, Grasslands Moata tetraploid ryegrass.

Seedlot thousand seed weight	No. of seedlots	Dry weight, mg per plant 14 days' shoot'	14 days' root	28 days' shoot'	28 days' root
<3.0 g	3	6.4 ± 0.6[3]	0.8 ± 0.2	64.5 ± 10.1	10.5 ± 0.6
3.0-4.0 g	4	6.81t0.4	1.1 ± 0.5	88.8rt23.1	14.9 ± 4.1
>4.0 g	6	8.4 ± 1.0	1.2 ± 0.3	97.1 ± 11.8	16.7 ± 3.2

'days after sowing, glasshouse (20 ± 1 "C)
'leaf plus stem to soil level
'standard error

TABLE 7 Effect of individual seed weight on seedling performance, Grasslands Moata tetraploid ryegrass

Individual seed weight range mg	seeds sown	number of seedlings emerged	mean coleoptile length[1] cm	mean seedling dry weight[2] mg
1.1-1.9	12	8	3.30 ± 0.92[3]	6.21 ± 2.12
2.0-2.5	19	15	4.02 ± 1.87	7.49 ± 1.53
2.6-3.0	35	33	4.87 ± 2.11	9.67rt2.91
3.1-3.5	47	43	5.63 ± 2.00	11.32 ± 3.60
3.6-4.0	43	34	6.13 ± 2.48	15.04 ± 3.82
4.1-5.0	41	39	6.14 ± 2.06	14.15 ± 3.26
4.6-5.0	30	28	7.48 ± 2.00	17.56f2.99
5.1-5.5	16	15	9.39 ± 1.93	19.58k4.91
>5.5	7	7	9.70 ± 2.57	26.52 ± 2.09

'assessed 9 days after sowing in glasshouse at 20 ± 1 °C
*assessed 21 days after sowing in glasshouse at 20 ± 1 °C
[3]standard error

TABLE 8 Effect of seed weight and percentage of multiple seed units on the germination of certified cocksfoot seedlots, 1984.

Cultivar	Seed Fraction	thousand seed weight g	%multiple seed units	%germination interim	final
G. Apanui (n = 10)	original[1]	0.821	20.86	73.5	87.8
	heavy	1.004	6.85	82.1	92.1
	medium	0.836	23.10	75.7	89.2
	light	0.680	39.15	63.4	17.5
G. Kara (n = 9)	original	0.931	38.84	61.7	91.6
	heavy	1.163	12.95	74.1	94.2
	medium	1.004	37.53	70.8	93.8
	light	0.166	57.94	61.3	87.3
G. Wana (n = 8)	original	0.712	22.60	63.1	87.3
	heavy	0.865	6.13	79.6	91.6
	medium	0.749	22.40	73.8	89.1
	light	0.586	38.48	62.1	80.3

[1]original seedlots were separated into three weight fractions by a Leggatt seed blower.

Recent data suggest that seed weight standards should also be introduced for other herbage species, particularly cocksfoot. Establishment of Wana cocksfoot in hill country is often poor e.g. 10% in Wairarapa hill country (Charlton and Thorn, 1984). Rys (pers. comm.) found that establishment of this cultivar could be improved if the number of multiple seed units in a seedlot was reduced. A recent investigation of cocksfoot seedlots from the 1984 harvest showed that seedlot germination could be increased by reducing the percentage of multiple seed units and increasing mean seed weight (Table 8). Further work is progressing to determine the effects of seed weight and the percentage of multiple seed units on seedling establishment and growth. It may be possible to improve the establishment potential of a cocksfoot seedlot through stricter seed dressing to reduce the number of multiple seed units.

UNIFORMITY

Every seedlot is to some extent a mixture of pure seed, inert matter, crop seeds, weed seeds, and of live and dead seeds (Thompson, 1979). It is desirable that within a lot, the contents of each sack or bin should be exactly the same, but in practice, complete uniformity is rarely achieved. Reasons for this include: differences within the crop from which the seed was harvested (e.g. maturity, lodging, diseases); duration of harvesting operations (e.g. different seed moisture content at the start and finish of harvesting); lack of uniformity in threshing and subsequent processing and storage of seed from the same crop; poor blending of different seedlots; segregation of light and heavy seed fractions within the bulk or within a bag.

The amount of variation within a seedlot can be measured by testing a seedlot attribute (e.g. number of weed seeds) for uniformity or heterogeneity (ISTA, 1976). However, determination of heterogeneity requires the testing of a large number of samples per lot, and this makes it unacceptable as a routine procedure in most countries (Tattersfield, 1977).

In a survey of New Zealand seedlots, Tattersfield and Johnson (1970) showed that herbage seed species differed in their degree of uniformity. Clover seedlots were generally uniform for purity and germination testing i.e. the variation found did not differ significantly from that expected from random variation. Ryegrass and cocksfoot seedlots, however, produced a wide range of purity values, the variation being accounted for by the distribution of weed seeds (*Vulpia* spp. and *Bromus mollis*) in ryegrass, and the percentage of multiple seed units in cocksfoot.

Seed stores must be operated in such a way as to ensure the highest possible levels of uniformity. Because seed analysis results are determined from a sample taken from a seedlot, the results can only be applied to the seedlot as a whole if the sample is truly

representative of the seedlot. AgLinks FPP 830 and FPP 831 (Scott and Hampton, 1984; Scott and Harding, 1984) outline the correct procedures for sampling seed and seed store operation.

SEED HEALTH

Latch (1980) reviewed the effects of plant diseases on herbage seed production in New Zealand and noted that it was important that only disease-free seed was produced. However, this has not been achieved, and currently two seed-borne diseases are creating problems for herbage seed production.

The first of these is blind seed disease of ryegrass caused by the fungus *Gloeotinia temulenta.* Hampton and Scott (1980) reported that in 1978 the incidence of blind seed disease had declined to a mean infection level per seedlot of 4.0%, and linked this decline to an increase in the use of nitrogenous fertilisers. However, blind seed disease has continued to be recorded each year since 1978, and Hampton and Young (1985) found that 12/20 and 3/12 seedlots of Nui and Ellett perennial ryegrass respectively had blind seed disease, with a mean infection level of 35%. In 1984 Chile imposed import restrictions on New Zealand ryegrass seedlots, because of the presence of blind seed disease. As a result of representations by the New Zealand government, Chilean authorities undertook a blind seed survey in late 1984. The presence of the disease in Chile was confirmed and the import restrictions relating to blind seed disease of ryegrass were officially removed on February 4, 1985.

In the 1984/85 season, 9/54 seed crops of Matua prairie grass were rejected from certification because of the presence of head smut (*Ustilago bullata,* Berk.). Rejection rates for the 1977/78 and 1978/79 seasons were 2/21 and 4/21 respectively (Hampton, 1979). Head smut can be controlled through the use of seed treatment, and Hampton (1979) showed that benomyl was suitable for this purpose. Since 1978 benomyl treatment has been a certification requirement (J.D. Eaden, pers. comm.). Recent rejections on account of head smut have resulted from inadequate fungicide coverage of seed (Clark, 1985) or from outside inoculum entering second year crops (J.D. Eaden, pers. comm.). Recent work has investigated the effects of newer systemic seed treatment fungicides on head smut control (R.E. Falloon and M.P. Rolston, pers. comm.) and for the 1985/86 season, the use of triadimenol+ fuberidazole (Baytan F17) is recommended.

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DISCUSSION

Q. ***What fungicide can be used to control head smut in prairie grasss?***

A. 'Benlate' has been used in the past but the latest recommendations include using **'Baytan** F17' at 1.7 g/kg seed.

Q. ***Does all prairie grass seed need treatment or is it just needed for seed crops?***

A. All seed should be treated as this fungus disease can reduce seedling establishment **and** infected plants produce less herbage as well as lower seed yields.

Q. ***Some shipments of prairie grass to Europe have apparently suffered germination problems. Has this problem been solved?***

A. This problem relates to seed vigour and poor storage conditions. Current research is examining the matter, but we do know that prairie grass must always be stored at low moisture content (<14%).

Q. ***Why is the seed trade not using the accelerated-ageing test for Matua prairie grass seed?***

A. Owners of seedlots seem reluctant to incriminate their stocks. The enthusiasm of seed exporters was somewhat dampened when seedlots sent to the UK showed poor germination levels. This ageing test does safeguard the exporter so should be used more widely in future. The test will identify seedlots of prairie grass which will reach overseas destinations with satisfactory germination, but those which fail this test can still be used with some confidence within New Zealand.

Q. ***Are perennial ryegrass seedlots contaminated with annual ryegrass, as revealed by the UV test, during pollination?***

A. No, because flowering times usually differ. Contamination often occurs when seed machinery is not properly cleaned between different crops.

Q. ***Ergot is a problem in ryegrass in New South Wales but is it within New Zealand?***

A. Only from time to time.

Q. ***Seedlots of Maku lotus contaminated with white clover are rejected under certification yet have high value for use in lower fertility situations. Why are these rejected?***

A. Purity standards apply to all herbage species and have been devised by the seeds industry for marketing of individual species and cultivars. In practice, seed merchants do sell such mixed seedlots for **use** in lower fertility pastures, ensuring that the buyer is aware of their purity status.

Q. ***Are New Zealand researchers looking for off-types and genetic shift in herbage grasses and legumes?***

A. Plot testing in association with seed testing include screening for off-types and genetic shift, though this is not easy to detect sometimes. The certification rules do not cover the possibility of genetic shift, **but** generally this does not appear to be a problem, because of the restricted number of generations dealt with.

Q. ***Are thousand-seed weights determined for all cocksfoot seedlots and if so, could this value be given on the certificate?***

A. As this could involve much work, we would need to be certain that it was worthwhile before proceeding. We do not know this yet in the case of cocksfoot.