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Weed seed contamination in white clover seedlots

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Abstract

Weed seeds are the major reason for white clover ***(Trifolium repens)*** seedlots being downgraded or rejected from certification. The occurrence of weed species in 537 white clover seedlots tested at the Official Seed Testing Station, Palmerston North, was analysed. The most commonly occurring species were field madder ***(Sherardia arvensis),*** chickweed ***(Stellaria media),*** fathen ***(Chenopodium album),*** sheep's sorrel ***(Rumex acetosella)*** and scarlet pimpernel ***(Anagallis arvensis).*** The percentage occurrence of four specified undesirable weeds including Californian thistle ***(Cirsium arvense)*** and dodder ***(Cuscuta epithymum)*** are reported, and the implications of seed contamination are discussed.

Keywords white clover, contamination, weed seeds

Introduction

New Zealand herbage seed has an annual farm gate value of over $40 million (Rolston et ***al.*** 1988) and is exported to more than 30 countries. The major markets are the European Community (EC), Australia and the US, all of which have strict quality standards which apply to seed being imported. New Zealand also has strict quality controls: the certification scheme run by the Ministry of Agriculture and Fisheries (MAF) ensures that any seed that meets certification standards is of high genetic and physical purity (Table 1).

At present New Zealand exports an average of around 3,800 tonnes of white clover seed a year; in 1988 the 4,000 tonnes exported were worth almost $11 million (Overseas Trade statistics Jan-Dee 1988).

Table 1 Purity standard for white clover (% by weight) (MAFQual 1989).

	Basic seed	First generation
Minimum pure seed	99.0	98.0
Maximum other crops	0.3	1.0
Maximum weed seeds	0.2	0.5

There are good prospects for expanding this export trade, but expansion will be possible only by maintaining high seed quality and competitive prices.

Weed ingress is one of the main problems in herbage seed production. Weed seed within a seedlot has been the major reason for ryegrass seedlines being downgraded or rejected from certification (Rolston et ***al.*** 1985; Rowarth et ***al.*** 1990), but apart from a ranking of weed seed occurrence in white clover seedlots (Dingwall 1969) no comparable data exist for white clover seedlots. This survey reports on the nature and extent of weed seed contamination in white clover seed crops submitted for certification.

Method

The frequency and type of weed seeds in white clover seedlots were analysed in 537 purity testing results issued by the Official Seed Testing Station in 1989. These results were compared with a survey done in 1968 (Dingwall 1969).

Results and discussion

Sixteen of the weed species whose seeds occur frequently in white clover seedlots are listed in Table &Although-data-taken from-isolated-years-does not necessarily reflect true trends, comparison between survey years has produced information of interest (Rowarth ***et al.*** 1990).

In the 1989 survey, field madder occurred in over 80% of all seedlots tested, while chickweed, fathen, sheep's sorrel and scarlet pimpernel occurred in over 40%. These results are in marked contrast to those of 1968 when sheep's sorrel was more common than field madder and chickweed. However, the top 4 contaminants in 1968 were stil the most common in 1989.

The frequent occurrence of seeds of these species is a result of the combination of three main factors: they are widespread in the field (Healy 1969; Webb ***et al.*** 1988); they have survived herbicide treatment; their seeds have physical characteristics similar to white clover seeds which make it very difficult to remove them from a seed line without incurring heavy losses of good seed (Hartley 1969).

Seed dressing techniques have altered little in the past 20 years (D.R. Harrison pers. comm.). The main methods of separating seeds are still cylinders

Table 2 Percentage occurrence of weed seeds in white clover seedlots submitted for purity analysis (Young *et al. 1984)* at the Official Seed Testing Station, 1989'. Data from an earlier survey (Dingwall 1968') is presented for comparison.

Common name	Botanical name	1989 occurrence (%)	1968 ranking
field madder	*Sherardia arvensis*	84.4	2 +
chickweed	*Stellaria media*	65.9	3 +
fathen	*Chenopodium album*	53.8	4
sheep's sorrel	*Rumex acetosella*	53.0	1 +
scarlet pimpernel	*Anagallis arvensis*	43.0	7
hedge mustard	*Sisymbrium officinale*	13.8	
catch fly	*Silene gallica*	11.9	
wire weed	*Polygonum aviculare*	9.7	
field pansy	*Viola* sp.	9.5	
mouse ear chickweed	*Cerastium* sp.	2.6	
sweet vernal	*Anthoxanthum odoratum*	2.6	
winter cress	*Barbarea* sp.	1.5	
shepherds purse	*Capsella bursa-pastoris*	0.6	
red root	*Amaranthus* sp.	0.2	
narrow-leaved plantain	*Plantago lanceolata*	<0.2	5
clustered clover	*Trifolium glomeratum*	<0.2	6

[1] Data from original tests in 537 officially sampled seedlots of Alice, Aran, Barbian, Donna, Grasslands Huia, Karina, Grasslands Kopu, Lirepa, Menna, Merwi, Olwen, Grasslands Pitau, Siwan, Sonja and Grasslands Tahora white clover.
[2] Data from original tests in 100 officially sampled seedlots (Dingwall 1969); 1 is most common.
\+ described as "extremely prevalent" (dingwall 1969).
▪ not mentioned in survey.

(removal by difference in length), screens (removal by difference in diameter), and aspiration (removal by difference in weight) in combination with specific gravity tables and velvet roller mills or dossers (differences in seed coat texture) (Hartley 1969, 1980). Although there have been no technical improvements in seed separation, farmers can sometimes make improvements themselves. Field madder and sheep's sorrel are particularly difficult to separate from white clover seedlots when they have been damaged. In field madder the crown of awns can be broken off, rendering the seeds the same size as white clover; in sheep's sorrel the loss of the rough outer surface of the seeds means that it cannot be separated from white clover using velvet rollers (Young & Hampton 1987). As damage to weed seeds usually occurs during harvesting farmers should be able to lower the incidence of madder and sorrel contamination by threshing less hard and checking field samples regularly to ensure that their seed is not being damaged, but that the clover seed is coming out of the floret.

Herbicides available for use on white clover seed crops have changed markedly in the last 20 years. The decrease in prevalence of both narrow-leaved plantain and clustered clover is probably a reflection of the development and subsequent farmer-use of the phenoxy-compounds, MCPB and 2,4-D Hi ester.

Field pansy, wireweed, hedge mustard and catch fly occurred in over 9% of the seedlots surveyed in 1989. Field pansy was identified in 1985 (Rolston et al.) as a potential problem for seed growers; field pansy, field madder, chickweed, fathen and sheep's sorrel appear to be problems in seed crops of both legumes and grasses (Rowarth *et al.* 1990). The increase in occurrence of field madder reflects the fact that no herbicide has been developed which will kill this weed in autumn sowings without harming the

Table 3 Herbicides with label claim for use in New Zealand white clover seed crops (A. Foley pers. comm.).

Common name	Product name (and % active ingredient)		Product rate (litres/ha)	Weed control of:
benazolin	Galtak	(50)	0.45 ▪ 0.60	chickweed
bentazone	Basagran	(48)	2 - 3	chamomile, mayweed, storksbill
carbetamide	Carbetamex 70	(70)	4 - 5	grass weeds and sheep's sorrel
2,4-D Hi ester*	various	(40)	0.5 ▪ 2.0	broad leaf
2,4-DB	various	(40)	6 - 8	broad leaf
fluazifop-P-butyl	Fusilade	(12.5)	2	grass weeds
haloxyfop	Gallant	(10)	2.5 ▪ 5	grass weeds, storksbill
MCPB	various	(40)	3	broad leaf
paraquat*	various	(20)	1.5 -2	grass weeds, broad leaf
propyzamide	Kerb	(40)	1.8-3	grass weeds, sheep's sorrel, and speedwell
quizalofop-ethyl	Zero	(10.7)	0.75 ▪ 2	grass weeds
sethoxydim	Alloxal S	(20)	1.5 -2	grass weeds

*spring sown and second year crops only

Table 4 Reasons for downgrading or rejection from certification of white clover seedlots at laboratory examination, Official Seed Testing Station, 1989' and 1985/86².

	Seedlots downgraded or rejected (%)	
	1989	1985/86
Excess field madder	6.0	–
Excess other species	2.8	–
Presence of Californian thistle	0.4	–
Total due to weeds	9.2	7.4
Total due to other reasons³	2.9	7.1
Total	12.1	14.5

Number of seedlots tested = 537.
² Number of seedlots = 1404 (Young & Hampton 1987).
³ Downgraded or rejected because seedlot failed to meet pure seed standard (because of inert matter and/or seed of other crops).
– not available

seed crop. However for either spring or second year crops, treatment with a combination of 2,4-D Hi ester (1.7 l/ha: 1.2 kg ai/ha) and Galtak (1.25 l/ha; benazolin ethyl at 625g ai/ha) has proved successful (L. Jackson pers. comm.). The increase in occurrence of the other species suggests either that herbicide resistance is developing or that continued use of some chemicals is causing the weed flora to change to resistant species. The problem is exacerbated by the increasing trend towards autumn sowing of row-spaced crops which facilitates better weed establishment in the zone of zero competition. Only 12 chemicals are registered or have label claim for weed control in white clover seed crops (Table 3). In practice, farmers use a wide range of chemicals, a guide to which has been published (Rolston 1987). More research is necessary to establish which chemicals are useful in white clover seed production in the same way that chemicals for ryegrass seed crops are being screened in a large multi-company herbicide trial at DSIR Lincoln in 1990. However, farmers can minimise the necessity for controlling weeds in white clover crops by eliminating problem species within the non-clover portion of the rotation where satisfactory chemicals are available.

The importance of weed seed contamination in downgrading or rejection from certification of white clover seedlots can be seen in Table 4. Of the 12.1% of seedlots downgraded or rejected during laboratory examination in 1989, 9.2% (i.e., three-quarters of total changes) were due to weed seed contamination. Half of the changes were due to field madder alone.

In 1985/86, 14.5% of white clover seedlots were downgraded or rejected and 7.4% (51% of total changes) were due to weed seed contamination (Young & Hampton 1987). The slight increase may be due to yearly fluctuations; another survey in the future will indicate whether this is so. Over 4% of the white clover seed crops were rejected because of the presence of seed of 'other crops' (often suckling clover (*Trifolium repens*)) (Table 4). The most difficult seed to separate from white clover is that of other clovers such as suckling clover which is controlled only marginally by the use of 2,4-D Hi ester (applicable to second year or spring sown crops only).

Buried seed of white clover *per* se is of extreme, importance in the issue of cultivar change (Clifford et al. 1991), but these 'weed' seeds cannot be identified during seed testing. Considerable research has been done on the problem of how to minimise the establishment of volunteer plants from seed losses at earlier harvests of an old cultivar thereby altering seed quality of the change crop (Clifford et al. 1985; Lancashire *et al.* 1985; Hampton et al. 1987).

The occurrence in white clover seedlots of weeds designated undesirable by the New Zealand Agricultural Merchants Federation and the Official Seed Testing Station (Scott 1980; Young 1984) is shown in Table 5. Californian thistle is the most commonly occurring undesirable weed but in general, specified undesirable weeds occur less commonly in white clover seed crops than in ryegrass seed crops (Rowarth et al. 1990).

Weed seed contamination has implications not only for internal certification requirements but also for export potential.-Several. of. the. commonly occurring or designated undesirable weed contaminants are included in the list of prohibited or restricted weeds in the seed quarantine regulations of other countries, preventing export to those destinations: the EC will not import white clover seed containing wild oats or dodder seed, or seed lines containing more than 10 dock seeds in a 20 g sample; Australia prohibits the entry of any seed containing, for example, yellow gromwell, hoary cress, nodding thistle or hemlock; the US prohibits the importing of seed containing hoary cress, Californian thistle or dodder.

Table 5 Percentage occurrence of specified undesirable weeds in officially sampled certified and uncertified white clover seedlots analysed at the Official Seed Testing Station during 1989.

Common name	Botanical name	Occurrence (%) All samples (703)'	Certified (537)	Uncertified (166)
hoary cress	*Cardaria druba*	0.1	0.2	0
Californian thistle	*Cirsium arvense*	1.1	1.3	0.6
hemlock	*Conium maculatum*	0.1	0	0.6
dodder	*Cuscuta epithymum*	0.1	0.2	0

Numbers of samples relate to original only.

Conclusions

These results show that one in 11 white clover seed lots submitted for laboratory examination as part of the certification scheme is downgraded or rejected because of failure to meet weed seed standards. Such downgradings or rejections occur after all the expenses of producing and cleaning the seed have been incurred and can drastically affect the sale of, and financial returns on, these seedlots (Rolston et *al.* 1985).

Overseas regulations are becoming increasingly strict, and the export of contaminated seed will become more and more difficult. The full potential for expansion in overseas markets will not be reached unless New Zealand herbage seed producers adhere to advice first given in 1912 (Cockayne) and keep their seed fields clean.

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