Harvest loss in ryegrass seed crops

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Abstract

Harvest loss in farmers' perennial ryegrass crops was assessed using collection trays over 3 harvest seasons. In two years losses were portioned between cutting losses, losses in the windrow, pick-up losses and losses during threshing. In the 3rd year 9 farmer fields were monitored and total harvest loss assessed. Harvest losses averaged 570 kg/ha, representing 24% of the saleable seed at harvest. Losses associated with cutting were large, especially from disc mowing. Losses in the windrow during drying varied, but in a crop that had rain on the swath the loss was >400 kg/ha. Despite the harvest losses the average crop yield was 1920 kg/ha. Reducing harvest losses is a key management objective to achieving high seed yields.

Introduction

There is a large gap between the number of developing seeds two weeks before harvest and the number of saleable seeds produced (Rolston *et al*. 2007). Two components of this gap are the occurrence of undersized seed and seed losses at harvest. There have been few studies made on harvest losses in perennial ryegrass (*Lolium perenne*) seed crops, and they mainly compare direct heading with windrow swathing (Nellist & Rees, 1967; Hampton & Hebblethwaite, 1985). Reviews on harvest approaches for herbage seed include Hopkinson & Clifford (1993) and Simon et al. (1997). Previous studies have often looked at harvest loss indirectly by measuring seed yield responses to different harvest approaches. In Oregon the effect of cutting with dew (early morning) or without dew (afternoon) was assessed in annual ryegrass (*L. multiflorum*), and seed yields were 250 kg/ha higher with cutting with dew (Silberstein *et al*. 2005). In perennial ryegrass seed loss under swathing at different seed moistures (36 to 29%) was associated with a reduced seed yield of 65 kg/ha (4%), while seed numbers equivalent to 9 kg/ha (46 seeds/0.11m^2) were counted on the ground (Silberstein *et al.* 2005).

In New Zealand many seed crops are cut at ca. 38 to 42% seed moisture content (SMC) using multi-disc mowers, while some are swathed using self-propelled windrowers with either belt or auger feeds. Threshing of the crop usually occurs 5 to 9 days after windrowing when the SMC is between 12 and 14%. Seed loss stages in harvesting are described by Hopkinson & Clifford (1993). Trials to determine the magnitude of seed loss and to determine what stage in the harvest operation contributes most loss were started in 2006/07 harvest season. The four stages in the harvest process were defined as (i) cutting (disc mowing or windrowing); (ii) drying in the swath; (iii) combine pick-up - the loss as the swath is lifted onto the combine draper front; and (iv) offal trail - seed not separated from the straw and lost over the back riddles.

Seed maturity assessed by measuring seed moisture content (SMC) has also been shown to affect seed yield, presumed in part to be associated with reduced seed loss (Simon *et al*. 1997). Harvest loss in ryegrass seed crops in New Zealand has not been previously studied. In this paper we report on harvest loss assessments made with collection trays.

Method

The seed losses were studied in 13 fields managed by seed growers in the Canterbury region of New Zealand and covers a 3 years (Table 1). Harvest loss was assessed with oblong aluminum foil trays either 16x20 cm for crops sown in 30 cm rows; or 10x18 cm in crops sown in 15 cm rows. In sites 1-4 on the day of cutting 6 trays were placed with the upper lip at the soil surface in a line at 3m intervals in the direction of machinery travel. An 8 cm staple was used to anchor the tray and a hole to allow rain water to drain. At sites 5 to 13, 15 trays were used, and on average 13 trays were recovered. Where components of loss were assessed (4 sites), these trays were replaced after each step carefully removing trays to avoid shaking extra seed into them. The collected trays were placed into paper bags, dried and the seed cleaned using screens and air to produce a saleable seed sample that was weighed and the loss per ha calculated. Loss figures were adjusted down to account for the “drawing-in” of the crop during cutting by 20% and 35% respectively for disc mowing and windrowing respectively. The yield of the field was based on the machine dressed yield provided by the seed company contracting the seed.

Results

Harvest losses were large, averaging 570 kg/ha with a range from 190 to 1300 kg/ha (Table 1). The largest loss was in a field that the grower was late in cutting; while the lowest loss was in a windrowed crop, swathed in damp conditions. When the loss is expressed as a percentage of the saleable seed available for harvest, an average loss of 24% (range 6 to 43%) was recorded (Table 1). If the worst loss (43%) is excluded because of known late cutting, the average loss was 22%. Despite these losses the average seed yield was 1920 kg/ha (Table 1).

When cutting method was compared the average harvest loss was 29% versus 16% for disc mowing (n=8) and windrowing (n=5) respectively and significantly different (P=0.02 for a one-way ANOVA).

A breakdown of loss by harvest stages undertaken with four trial sites identified that losses at cutting and losses during drying in the swath accounted for 49 and 43% of the losses respectively (Table 2). The large loss during swath drying in Trial 3 was associated with a 25 mm rain event the day before the crop was due to be combined (Table 2).

Discussion

Larger than expected harvest losses were recorded in these assessments. Growers have control over some of these losses, especially losses associated with cutting. Weather-related losses, e.g. from rain after cutting, cannot be controlled. The data strongly suggests that seed losses are less when crops are windrowed compared to mowing, and when the 2009/10 data is available the number of data sets that can be compared will double.

Table 1. Site number, year of assessment, method of cutting, harvest loss, field seed yield and loss calculated as percentage of total saleable seed available for harvest.

Site	year	Method	Loss	SY	% loss
1	2005/06	mow	660	2400	22
2	2007/08	mow	1300	2500	34
3	2007/08	windrow	560	2500	18
4	2007/08	windrow	190	3100	6
5	2008/09	mow	350	950	27
6	2008/09	mow	430	2000	18
7	2008/09	windrow	370	1660	18
8	2008/09	mow	600	1700	26
9	2008/09	windrow	510	2670	16
10	2008/09	mow	640	1290	33
11	2008/09	windrow	560	2200	20
12	2008/09	mow	940	1230	43
13	2008/09	mow	270	790	25
	Average		570	1920	24

Table 2. Percent of harvest loss attributed to each step of harvest process.

Site	1	2	3	4	Average
Step		% loss			
cutting	32	60	32	74	49
drying	50	32	75	15	43
combine	12	7	12	12	11
offal	6	2	6	x[1]	5

[1]not measured

The lowest loss recorded, 6%, is probably an unrealistic goal for all growers to reach. However if growers could reduce average harvest losses by 50% of the levels reported, average seed yields would increase by 265 kg/ha and improve crop profitability significantly. A greater understanding of how to manage losses is needed, including cutting methods (especially windrowing versus mowing), speed of cutting, effect of crop dividers, seed moisture and environment (temperature, humidity and dew) interactions, degree of lodging. A combination of harvest timing, machine options and agri-chemicals may be required to reduce harvest loss. A preliminary evaluation of a harvest aid “Pod-Lock” in 2008/09 did not improve seed yields.

In NZ disc mowers became popular as a replacement for reciprocating knife mowers, coinciding with larger crop fields, increasing crop bulk from high N rates (250 to 300 kg N/ha) and before the introduction of straw shortening plant growth regulators (PGR). These factors combined to result in crops with considerable new vegetative growth through the lodged crop. The combination of these factors made traditional mowing slow and the adoption of disc mowing was rapid. In recent years with the adoption of lower N rates (150 kg N/ha) and the use of trinexapac-ethyl (TE) as a PGR, lodging and regrowth can be prevented and the crop architecture at cutting changed. Further trials were initiated during the 2009/10 harvest season but data are not yet available. The trials include a comparision of harvest losses associated with changed crop architecture using TE. Seed yields are increased with delayed lodging achieved with TE (Rolston *et al*. 2007). However some growers argue that while more erect crops are easier to cut, they are more vulnerable to seed shattering from high wind events. Understanding the effect of wind during seed maturity will be an important component to developing methods to reduce harvest loss.

Reducing the time between cutting and combine harvesting is associated with higher yields (and presumably lower losses), but requires access to seed drying facilities (Hampton & Hebblethwaite, 1985). Future harvest loss trials should look if an interaction occurs between cutting method and days from cutting to threshing. Windrows have more bulk and are generally slower to dry.

Conclusion

The average harvest losses were large, 24% of saleable seed available for harvest. The size of loss was also very variable between fields; suggesting management options could reduce losses.

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