



# A short survey of key silage-making practices on Northern Ireland dairy farms, and farmer perceptions of factors influencing silage quality

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## Abstract

Northern Ireland dairy farmers ( $n = 174$ ) were surveyed to identify key silage-making practices, and factors perceived to influence the quality of grass silage made on their farms. The majority of farmers (65%) harvested grass for silage three times/year: 62% normally used a contractor, while 47% routinely used a silage additive. Delays to mowing and delays to harvesting due to adverse weather or poor ground conditions were perceived to have a large or very large impact on silage quality (68% and 53% of farmers, respectively). Inadequate wilting, poor-quality swards on owned land, on rented land and “contamination” of first-cut grass with autumn or winter growth herbage were all perceived as having a large or very large impact on silage quality (32%, 27%, 40%, 30% of farmers, respectively). Over the previous decade, 11%, 41% and 37% of farmers claimed a small, moderate or large improvement in silage quality, mainly due to earlier cutting of grass and ensiling better quality swards.

## Keywords

Farmer perceptions • grass silage quality • survey

## Introduction

The nutritional quality of grass silage, the predominant winter forage for ruminant livestock in western areas of Great Britain and Ireland, varies considerably between farms. Analysis of grass silage samples from Northern Ireland (NI) farms between 1998 and 2017 showed that while average dry matter (DM) content increased, digestible organic matter in the DM (DOMD) remained unchanged (Patterson *et al.*, 2021). Given the advances in silage-making machinery and practices since the 1960s (Wilkinson & Rinne, 2018), the degree of improvement in silage nutritive quality has been disappointing. To help address this, a short survey of NI dairy farmers was conducted to provide an overview of key silage-making practices, to examine farmer perceptions of factors that influence the quality of grass silage they produce and to highlight management practices, which if addressed, provide opportunity to improve silage nutritive quality.

## Materials and methods

A survey of farmers was conducted during a 2-day “Dairy Open Event” held at the Greenmount Campus of the NI College of

Agriculture, Food and Rural Enterprise (CAFRE) on 24 and 25 January 2018. Of the 814 farmers who attended, 761 were from NI, representing 681 individual dairy farms. On completion of the event tour, attendees were randomly approached by a member of staff (a team of six people) from the Agri-Food and Biosciences Institute (AFBI), and if identified as an active NI dairy farmer, were asked to complete a short questionnaire. Over 90% of those approached agreed to participate. The questionnaire took less than 10 min to complete, with 174 farmers completing the questionnaire. Disclosure of personal details or herd information was not required.

The survey captured information on silage-making practices, including (1) number of main harvests taken annually, (2) main silage harvesting equipment used (self-propelled forage harvester [SPFH], trailed harvester, self-loading forage wagon [SLFW], wrapped bales), (3) contractor use (normally, sometimes, never) and (4) silage additive use (normally, sometimes, never). The survey also recorded the participant’s perceptions on a 1-to-5 scale (1 = no effect, 2 = some effect, 3 = moderate effect, 4 = large effect and 5 = very large effect) of the impact of the following factors on the quality of grass silage made on their farm: the effect of delayed cutting,

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(1) due to poor weather or poor ground conditions, (2) to allow herbage nitrogen (N) levels to fall, (3) to allow swards to bulk up to reduce harvest costs, (4) due to the contractor not being available, and (5) the effect of delayed “lifting” due to poor weather or poor ground conditions, (6) grass not being allowed to wilt for long enough, (7) ensiling autumn or winter growth grass along with first-cut silage, (8) ensiling poor-quality grass harvested from owned ground, (9) ensiling poor-quality grass harvested from rented ground, (10) ensiling slurry residues along with grass, (11) soil contamination of grass during raking-up, (12) inadequate compaction of herbage and (13) insufficient labour available when making silage. Farmers were also asked a number of other questions relating to the following: (1) “other” factors which have a negative effect on silage quality on their farm, (2) contractor payment systems, (3) whether cutting date would change if contractors charged on a yield basis, (4) how they managed autumn or winter growth grass and (5) whether they believed silage quality on their farm had improved over the past 10 yrs (none, small, moderate or large improvement). Farmers who indicated that there had been an improvement were asked for the main reasons for the improvement. Results were summarised in Microsoft Excel (Microsoft, Redmond, WA, USA), and response frequencies were determined. Responses to “open” questions were grouped under the relevant headings, and numbers under each heading counted.

## Results and discussion

### **Key silage-making practices**

The majority (65%) of farmers questioned take three main harvests of grass for silage annually, while 22% take two harvests (Figure 1A). Silage produced within a two-harvest system will normally have a lower digestibility given that the DOMD of perennial ryegrass (*Lolium perenne* L.) declines by about 2.5 g/kg per day up to the point of ear emergence, and by approximately 4 g/kg per day thereafter (Green *et al.*, 1971). Silage digestibility is the single most important determinant of silage nutritive quality, with each 1% increase in silage DM digestibility (DMD) resulting in an additional 0.33 kg of milk (Keady *et al.*, 2013). The potential benefits of more frequent harvesting were recognised in that 12% of those questioned take four harvests, while one farmer operated a five-harvest system.

That grass is harvested by an SPFH on 63% of the farms surveyed (Figure 1B) implies that most of the grass cut for silage is precision-chopped. Recent research by Tayyab *et al.* (2018, 2019) reporting higher dry matter intake (DMI), higher DMD and higher milk yields in cows offered grass silages with very short chop length. While the use of SLFW can help improve labour and improve fuel use efficiency (Frost & Binnie, 2005), SLFWs were used by only 13% of the farmers.

In comparison to precision-chopped silage, DM intakes and milk yields may be lower in cows offered silage harvested using an SLFW, if not adequately chopped (Randby, 2005).

The high reliance on contractor use (62% of farmers normally use a contractor: Figure 1C) aligns with the use of an SPFH to harvest grass, and reflects the disincentive of the large capital investment needed to purchase and maintain modern silage-making machinery. This may also reflect the decreasing availability of labour that is common on many dairy farms (O'Donovan *et al.*, 2008). Only 29% of farmers never use a contractor.

Despite the known benefits of silage additive use, especially inoculants, across multiple studies (Keady, 1998; Oliveira *et al.*, 2017), less than half (47%) of farmers surveyed always used an additive, with 35% never using an additive (Figure 1E). The relatively low uptake of additive use may reflect resistance to the additional costs of using an additive, and a lack of confidence in the outcome.

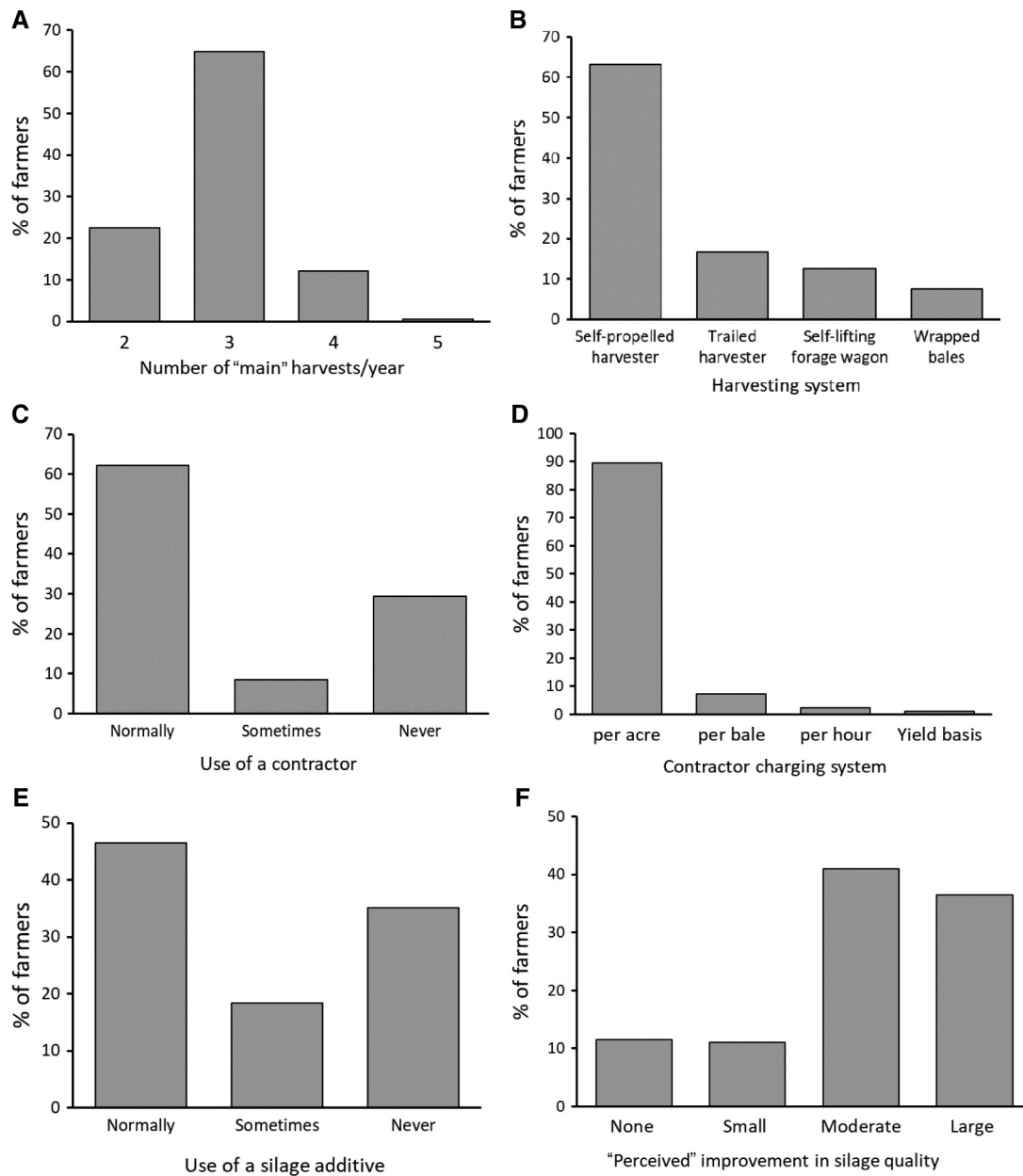
### **Farmer perceptions of factors influencing grass silage quality**

Farmer perceptions on how a range of factors impact on the quality of grass silage made on their farms (expressed as a percentage of all valid responses) are presented in Tables 1 and 2.

#### *Weather, herbage nitrogen levels, contractor availability and charging*

Although silage making is more weather resilient than hay making, 68% of the farmers identified delays in mowing grass due to adverse weather or associated poor ground conditions, as having a large or very large impact on the quality of their silage (Table 1). Similarly, over half (53%) perceived such conditions as also adversely affecting silage quality through delays to harvesting the mown grass. The impact of weather-related delays on grass cutting was regarded as minor (i.e. some or none) by only 9% of farmers. Mowing delays reduce the digestibility of silage produced (Keady *et al.*, 2013), but delays in harvesting also lead to excessive losses of energy-rich organic matter and a concomitant increase in ash content that further reduces digestibility. Delays in harvesting mown herbage also reduce the stability of silages after silo opening (Wilkinson & Davies, 2013).

Delayed application of organic and inorganic N fertiliser to grass swards destined for silage can lead to excessively high nitrate-N levels in the mown grass, with negative consequences for silage preservation, especially in difficult-to-ensile herbage (O'Kiely *et al.*, 2001). However, the majority of farmers (over 50%) perceived that delaying cutting to allow herbage N levels to fall had either “no” or “some” effect on silage quality (Table 1), with only 7% of farmers identifying this as having a very large effect. This problem can largely



**Figure 1.** Survey outcomes in relation to: (A) number of main harvests taken per year, (B) percentage of farmers using different harvesting systems, (C) percentage of farmers using a contractor, (D) percentage of farmers subjected to different contractor charging systems, (E) percentage of farmers who normally use an additive and (F) percentage of farmers according to perceived improvement in silage quality on their farm over the past 10 yrs.

be avoided by ensuring an adequate interval between N application and cutting.

A majority of the farmers (58%) considered contractor unavailability to have little impact on the quality of the silage made on their farm (Table 1). This may reflect the relatively large number of contractors now operating in NI, the scale of the machinery used, and the flexibility and

willingness of contractors to make every effort to service customers' needs. In contrast, 23% of farmers surveyed acknowledged that delaying cutting (to allow swards to "bulk up" and reduce harvesting costs) was having a large or very large impact on the silage quality on their farms. A follow-up question identified that 89% of the farmers who used a contractor were charged on a per acre basis and 2% on the

**Table 1:** Farmer perceptions (% of farmers) of the impact of factors influencing the timing of cutting and harvesting of grass on the quality of grass silage made on their farms ( $n$  = number of responses)

	Impact <sup>1</sup>				
	1	2	3	4	5
Delaying cutting due to poor weather or poor ground conditions ( $n$ = 174)	2.3	6.3	23.6	33.3	34.5
Delaying cutting to allow herbage nitrogen levels to fall ( $n$ = 174)	35.6	21.3	22.4	13.8	6.9
Delaying cutting (allow swards to bulk up to reduce harvest cost) ( $n$ = 173)	42.8	23.1	11.0	11.6	11.6
Delaying cutting due to the contractor not being available ( $n$ = 122)	32.8	25.4	13.1	18.0	10.7
Delaying “lifting” due to poor weather or poor ground conditions ( $n$ = 173)	13.3	11.0	22.5	31.8	21.4

<sup>1</sup>Impact = none (1); some (2); moderate (3); large (4) and very large (5).

**Table 2:** Farmers’ perceptions (% of farmers) of the impact of a range of ensilage practices on the quality of the grass silage made on their farms ( $n$  = number of responses)

	Impact <sup>1</sup>				
	1	2	3	4	5
Grass not being allowed to wilt for long enough ( $n$ = 174)	13.2	18.4	36.2	23.6	8.6
“Contamination” of first-cut herbage at ensilage with grass that grows during late autumn or winter ( $n$ = 174)	36.8	12.6	20.7	18.4	11.5
Ensiling poor-quality grass harvested from owned ground ( $n$ = 174)	39.1	17.2	17.2	18.4	8.1
Ensiling poor-quality grass harvested from rented ground ( $n$ = 174)	31.2	12.7	16.2	28.3	11.6
Ensiling slurry residues along with grass ( $n$ = 174)	53.5	14.9	8.6	11.5	11.5
Soil contamination of grass during raking-up ( $n$ = 174)	34.5	23.9	15.5	12.6	11.5
Inadequate compaction of herbage (due to silo filled too quickly; $n$ = 169)	44.4	19.5	17.2	12.4	6.5
Insufficient labour being available when making silage ( $n$ = 174)	42.5	23.6	15.5	13.2	5.2

<sup>1</sup>Impact = none (1); some (2); moderate (3); large (4) and very large (5).

basis of “hours worked” (Figure 1D). It appears that many farmers rationalise that cost savings (per tonne of herbage harvested) made by harvesting a greater yield of crop can offset the disadvantages of feeding a silage of lower quality. Nevertheless, 64% of the farmers indicated that they would consider cutting their grass earlier if their contractor offered a yield-based charging option. Technology already exists on many modern harvesters to assess yield, and it is likely that a move to a yield-based charging approach could contribute to greatly improving the quality of silage made on many NI dairy farms.

#### Ensilage practices

The benefits of rapid wilting are well known, with Keady (2013) concluding that rapid wilting of herbage from 16% to 32% DM increased silage DM intake by 17% and milk solids output by 3%. While the mean DM content of first-cut grass silages in NI increased by 7% units between 1998 and 2017 (Patterson *et al.*, 2021), in the current survey 32% of farmers perceived inadequate wilting of mown grass to have a large

or very large impact on the quality of the silage made on their farms (Table 2).

The impact on silage quality arising from “contamination” of primary growth herbage with herbage that has grown in the same sward during the previous autumn or winter does not appear to have been examined experimentally. Nevertheless, 30% of farmers perceived that this “autumn or winter growth” herbage had a large or very large detrimental impact on the quality of their first-cut silage. In response to a follow-up question, almost 84% of the farmers stated that they try to remove this grass, the majority (77%) by grazing with sheep, with the sheep normally removed from fields before the end of December.

Perennial ryegrass (*Lolium perenne*), the predominant sown species on NI dairy farms, has a higher digestibility than “weed grasses” which frequently infest older swards (Frame, 1989). Recognising this, 27% of farmers indicated that poor-quality swards on “owned ground” had a large or very large impact on silage quality, increasing to 40% on rented ground. Pasture reseeding rates in NI are in general low, especially on rented

land, a reflection of the 11-month “conacre” system in place, which disincentivises reseeding.

Soil and slurry contamination of grass can have a detrimental effect on silage quality through changes to forage mineral composition and the presence of bacteria which negatively affect silage fermentation (McDonald *et al.*, 1991). While these were not considered to be major issues by the majority of farmers surveyed (Table 2), 23% of farmers perceived that ensiling slurry residues with grass had a large or very large effect on the silage quality on their farms, while the equivalent figure for soil contamination was 24%. Both problems can be avoided by good management.

Relatively few (19%) farmers perceived inadequate compaction of grass in the silo as having a large or very large effect on silage quality. While silos are filled much faster today than in the past, the risk of inadequate silo compaction is likely reduced by use of heavier machinery at filling, and by the greater depth of modern silos.

Given the reliance on contractor use on the majority of farms surveyed, it was unsurprising that insufficient labour was regarded by 66% of the farmers as having some or no effect on their silage quality. On farms where contractors are not used, inadequate labour can lead to problems at busy times, and 19% of farmers perceived inadequate labour at silage making to have a large or very large effect on the silage quality.

In addition to the 13 factors highlighted in Tables 1 and 2, farmers were asked to suggest “other” factors having a negative effect on the silage quality on their farms. Of the 31 valid responses obtained (i.e. issues not already covered by the 13 factors highlighted above), issues relating to “soil nutrients” were highlighted by 32% of farmers, inadequate sunshine/low herbage sugar levels by 23% of farmers and issues related to sealing silos or aerobic stability by 13% of farmers.

#### **Changes in silage quality over the previous 10 yrs**

Of the farmers questioned, 12% believed that there had been no improvement in the silage quality on their farms over the past 10 yrs, while 11%, 41% and 36% believed that there had been a small, moderate or large improvement, respectively (Figure 1F). That 77% of the farmers believed that their silage quality had improved to a moderate or large degree over the previous 10 yrs appeared to contradict the very modest changes in silage quality observed by Patterson *et al.* (2021) over the past 20 yrs. However, the silages in the latter study were obtained from beef, sheep and dairy farms, and it seems reasonable to suggest that dairy farmers have a greater focus on silage quality than beef or sheep farmers.

“Earlier/more frequent cutting of grass” (37%) and “reseeding/improved varieties/weed control” (22%) were listed as the predominant reasons for improved silage quality. The most common “other” reasons given included “improved knowledge/

improved management practices” (11%), “wilting/tedding” (6%), “improved machinery/own machinery” (4%), “improved soil nutrition” (3%) and “grazing by sheep over the winter” (2%). These findings clearly highlight the potential of earlier and more frequent cutting, and improving sward quality, to improve the silage nutritive quality within NI.

It is recognised that those who participated in the survey were a “self-selected” group of dairy farmers, their participation reflecting their attendance at a technology transfer event. While it is possible that this group differed from the NI dairy farmer population as a whole, the author experience is that such events attract a diverse range of farmers. Nevertheless, while the results must be caveated within this scenario, this simple-to-enact survey provided valuable information on current silage-making practices in NI and farmers’ perceptions of key factors impacting on silage quality.

## Conclusions

Weather-mediated delays to cutting and harvesting grass were perceived to have the greatest impact on silage nutritive quality. However, many issues which can be overcome through improved management practices were identified by a substantial number of farmers as having various degrees of negative impacts on the silage quality on their farms. Improvements in silage quality which have occurred on most farms over the past 10 yrs were attributed primarily to the earlier cutting of grass and the ensiling of herbage from better quality swards.

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