



Silage review: Safety considerations during silage making and feeding¹

Keith K. Bolsen*†²

*Department of Animal Sciences and Industry, Kansas State University, Manhattan 66502

†Keith Bolsen Silage Safety Foundation, 6106 Tasajillo Trail, Austin, TX 78739

ABSTRACT

Silage-related injury knows no age boundary as workers and bystanders of all ages have been killed in silage accidents. Even the best employee can become frustrated with malfunctioning equipment and poor weather conditions and take a hazardous shortcut, or misjudge a situation and take a risky action. At least 6 hazards are encountered in managing silage in bunker silos and drive-over piles that endanger lives: tractor or truck rollover, run-over by or entanglement in machinery, fall from height, crushing by an avalanche or collapsing silage, silage gases, and complacency or fatigue. These hazards are presented in detail along with accounts of 14 individual case studies involving several of them. Guidelines that can dramatically reduce the risk of serious injuries or fatalities from each of the hazards are presented. Every farm, feedlot, dairy, and silage contractor should have written safety policies and procedures for their silage program, and they should schedule regular meetings with all their employees to discuss and demonstrate safety. The most important goal in every silage program is to send all employees home safely to their families at the end of the day.

Key words: silage, safety, avalanche, fatality

INTRODUCTION

Few farming operations invite as many different opportunities for injury or fatality as a silage program (Murphy, 1994). From 2015 to 2017, an average of 115.31 million metric tonnes of whole-plant corn silage was produced annually in the United States (USDA, 2018). Beginning with harvesting the forage in the field, followed by transportation to the farm and placement into storage, as well as subsequent feed-out of the silage, employees in every silage program are exposed to numerous serious risks.

Silage-related tragedy knows no age boundary as workers and bystanders of all ages have been injured or

killed during silage harvest and feed-out (Murphy and Harshman, 2006). Although silage injury statistics are not easily collated, countless stories are told of power takeoff and harvesting machine entanglements, highway mishaps between farm equipment and automobiles, entanglements in self-unloading wagons and blowers, as well as encounters with silo gas. Increasingly, stories involve bunker silos and drive-over piles (Bolsen and Bolsen, 2012, 2013, 2015b) as silage utilizing operations become larger due to industry consolidation.

Consistently protecting employees, equipment, and property throughout harvesting, filling, and feeding does not occur without thought, preparation, and training. The silage industry has nothing to lose by practicing safety, but it has everything to lose by not practicing it (Murphy, 2007).

The objective of this paper is to present 6 hazards encountered in managing silage in bunker silos and drive-over piles coupled with detailed accounts of case studies involving the hazards. The primary ways these hazards can be avoided are discussed.

HAZARD 1: TRACTOR OR TRUCK ROLLOVER

Historically, tractor rollovers have accounted for about 50% of the approximately 250 tractor-related fatalities reported annually in the United States (National Institute for Occupational Safety and Health, 2004; Figure 1). Management practices that minimize the risk of tractor rollovers include the following:

- (1) Rollover protective structures create a zone of protection around the tractor operator. When used with a seat belt, rollover protective structures prevent the operator from being thrown from the protective zone and crushed by the tractor or equipment drawn by it.
- (2) A straight drop off a bunker silo wall is a significant risk, so never fill higher than the top of the wall.
- (3) Sight rails should be installed on above-ground walls. These rails indicate the location of the wall to the tractor operator, but they are not intended to hold an over-turning tractor.

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²Corresponding author: keithbolsen@hotmail.com

- (4) Install lights to the rail if filling will occur at night.
- (5) When filling bunker silos and drive-over piles, pack tractor operators should always form a progressive wedge of forage, which provides a minimum slope of 1 to 3 for packing (e.g., 1 unit of rise for each 3 units of run).
- (6) To reduce the risk of a tractor rollover, it is important to maintain a minimum slope of 1 to 3 on the sides and ends of a drive-over pile.
- (7) Tractors should be backed up steep slopes to prevent roll backs.
- (8) Use low-clearance, wide-front-end tractors equipped with well-lugged tires to prevent slipping.
- (9) Add wheel weights and weights to the front and back of the tractors to improve stability.
- (10) Never use large rectangular or round hay or straw bales for temporary bunker walls.
- (11) When using front-end loaders to move forage to the bunker or pile, do not elevate the bucket any higher than necessary, thereby helping to keep the center of gravity low.
- (12) When 2 or more pack tractors are used, establish a driving procedure to prevent collisions.

Large-scale beef and dairy operations and silage contractors typically use trucks for transporting chopped forage to the bunker or pile (Murphy and Harshman, 2006). Management practices that minimize the risk of a truck accident include the following:

- (1) Trucks can overturn on steep forage slopes, particularly if the forage is not loaded and packed uniformly.
- (2) Raise the dump body only while the truck is on a firm surface to prevent an overturn.
- (3) As the bed is raised for unloading, it is important that the load center of gravity stay between the frame rails of the truck frame.
- (4) Trucks are less stable as the bed is raised, particularly if the surface is not perfectly flat.
- (5) A tire rut or depression from a previous load, low tires on one side of a truck, uneven loading of a truck, or a wind gust increase the risk of a truck tipping over during unloading, especially when 2 or more of these hazards combine at a single time point.

Case Study 1

A teenage boy and an older man were unloading sweet corn silage from the back of a tandem axle truck on a farm in Minnesota (cited by Bolsen and Bolsen,

2017). As the box of the truck was raised, the load suddenly emptied and trapped both individuals under the silage. The older man managed to free himself, but the teenager was found unconscious beneath the silage. The boy was pronounced dead a short time later at the hospital.

HAZARD 2: RUN-OVER BY OR ENTANGLEMENT IN MACHINERY

Case Study 2

The 29-yr-old son of a Nebraska silage contractor was talking with an employee who was in the cab of a large forage harvester near the edge of a field (Beatrice Daily Sun, 2008). The employee, who thought the contractor's son had left the area, drove the machine out of the field. A few minutes later, another employee found the contractor's son lying unconscious in the field, and he died 2 h later in the hospital. Although the details surrounding the fatal accident are unclear, the son appeared to have been run over by a rear tire of the forage harvester.

Guidelines that promote safe harvesting practices and prevent serious injuries and fatalities caused by being crushed or entangled in machinery include (adapted from Murphy and Harshman, 2006):

- (1) Keep machine guards and shields in place to protect the operator from an assortment of rotating shaft, chain, and V-belt drives; gears and pulleys; and rotating knives on forage harvesters, wagons, and silage feeding equipment.
- (2) Keep nonworkers away from traffic areas.
- (3) Never allow people on foot (especially children) near the moving harvest and transport equipment in the field or people on foot near a bunker silo or drive-over pile during filling or feed-out.
- (4) Adjust rear-view mirrors.
- (5) When inspection or servicing work is needed, shut down the engine and remove and pocket the keys to prevent accidental starting by another person.
- (6) Mount and dismount the tractor or forage harvester using a debris-free access ladder and steps and handholds. Maintain a 3-point contact as you climb and always face the machine.
- (7) Stop the machine before lubricating, adjusting, inspecting, or unplugging. Wait for the cutter head to come to a complete stop before adjusting or unplugging.
- (8) Never approach the blades of a silage defacer while the machine is in operation.
- (9) Wear snug clothing.

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