Investigation # 99WV025-01
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Dairy Farm Worker Dies Following a Tractor Rollover in West Virginia

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SUMMARY

On May 24, 1999, a 38-year-old male dairy farm worker (victim) died of injuries sustained when the tractor he was driving rolled over while transporting a round hay bale. The victim was using an older tricycle configured tractor. The tractor was equipped with a front end loader and a set of after market forks, which were chained on. Just prior to the fatal incident, he had elevated the bale, backed away from the storage pile, and was pulling forward parallel to the pile. He was traversing a 15 degree grade with his right rear wheel on the down hill side. The ground surrounding the storage area was littered with small lumps of hay which had fallen off of previously transported bales. As the left rear wheel (uphill side) rolled over one of the lumps, the tractor's center of gravity shifted forward and downhill. This shift placed the tractor's center of gravity outside of the tractor's stability baseline causing the tractor to roll downhill to the right landing on the victim and pinning him to the ground. The tractor did not have a rollover protective structures (ROPS) or a seat belt. Another worker heard the noise, looked up, and saw the upside down tractor on the victim. He ran to the owner's house. As the owner checked for vital signs, the owner's wife called 911. The EMS arrived within minutes. The tractor was removed from the victim and he was transported to the local hospital where he was pronounced dead. The coroner estimated that the victim had died immediately after tractor impact. Damage to the steering wheel and to the victim's head suggest that the tractor's steering wheel crushed the victim. The WV FACE investigator concluded that to reduce the likelihood of similar occurrences, the following guidelines should be followed by tractor owners:

- ***Equip all tractors with rollover protective structures (ROPS) and a seat belt.***
- ***Convert tricycle configured tractors to a wide front end configuration.***
- ***Evaluate the work area for hazards which can compromise a tractor's stability prior to each operation.***
- ***Evaluate the location and its terrain prior to establishing round bale storage areas.***

INTRODUCTION

On May 26, 1999, the WV FACE Program was notified by a newspaper clipping service of a farm work-related fatality that occurred on May 24, 1999. The WV FACE field investigator traveled to the dairy farm on June 23, 1999 and met with the county extension agent to review the fatality incident site. Photographs were taken at the site. The death certificate and medical examiner's report were obtained. The victim's employer was interviewed regarding the incident.

The employer in this incident was a dairy farmer who had been in business for 29 years. The employer had a total of seven employees. Three of the seven employees where present at the time of the incident. There was no formal designated safety director or formal written safety program. Although formal

safety training sessions were not held, the employer did indicate that one-on-one "on the job" safety related instructions were given when deemed necessary.

The victim had worked for the employer for 13 years and was an experienced tractor operator. He had performed the bale moving task with the tractor and its fork related set-up many times during this period.

The victim's job at the time of the incident was to transport the large round bales for a routine cattle feeding operation. Although the victim had used this tractor for this task in the past, at the time of the incident, this tractor was considered to be a back-up unit. The primary tractor, which was larger and newer, was off-line for the week due to repairs.

INVESTIGATION

On May 24, 1999, a 38-year-old male dairy farm worker (victim) was transporting a round hay bale for a routine cattle feeding. The bale was being moved from the farm's designated round bale storage area which was located next to a drainage ditch. The bales where stored parallel to the ditch. This configuration allowed for a non-level travel/work zone area on the ditch side of the bales. In fact, the measured grade was 15 degrees (see Image 1). The work zone on the other side of the stored bales was wide and level. The victim was using an older tricycle configured tractor. The tractor was a 1965 John Deere model 3020. It was equipped with a factory installed model 46A end loader attachment (see Image 2). Additionally, a set of after market forks were chained on to lift the bales (see Image 3). After approaching the storage pile, on the drainage ditch side in a near perpendicular direction, he engaged and elevated a bale. He than backed away from the storage pile and was pulling forward parallel to the pile. He was traversing the 15 degree grade with his right rear wheel on the down hill side. The ground surrounding the storage area was littered with small lumps of hay which had fallen off of previously transported bales. It is unclear as to how high the bale had been elevated. As the left rear wheel (uphill side) rolled over one of the lumps, the tractor's center of gravity shifted forward and downhill. This shift placed the tractor's center of gravity outside of the tractor's stability baseline and caused the tractor to roll downhill to the right landing on the victim and pinning him to the ground. The tractor did not have a rollover protective structures (ROPS) or a seat belt. Another worker heard the noise, looked up, and saw the upside down tractor on the victim. He ran to the owner's house. As the owner ran and checked for vital signs, the owner's wife called 911. The EMS arrived within minutes. The tractor was removed from the victim and he was transported to the local hospital where he was pronounced dead.

CAUSE OF DEATH

The cause of death listed on the death certificate was multiple head, neck and chest trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Equip all tractors with rollover protective structures (ROPS) and a seat belt. [Owners of older model tractors should contact their county extension agent, equipment dealer or

equipment manufacturer to determine if retrofit ROPS and operator restraint systems are available for their equipment. Such systems should be installed by the manufacturer or an authorized dealer].

Discussion: Preventing death and serious injury to tractor operators during rollovers requires the use of ROPS and a seat belt. These structures, either a roll-bar frame or an enclosed roll-protective cab, are designed to withstand the dynamic forces acting on them during a rollover. In addition, seat belt use is necessary to ensure that the operator remains within the "zone of protection" provided by the ROPS. OSHA regulations require that all tractors built after October 25, 1976, and used by employees of a farm which employs 11 or more must be equipped with ROPS and a seat belt. In West Virginia, many older tractors (pre-1976) are in use on family farms and are used by the farm owner or used on farms that have less than 11 employees and therefore do not fall under OSHA regulations. Given the slopes and environmental conditions in West Virginia, all farmers should voluntarily have their older tractors retrofit with a properly designed, manufactured, and installed ROPS and a seat belt. A ROPS retrofit kit is available for the John Deere model 3020 tractor. If the tractor involved in this incident had been fitted with a ROPS and a seat belt, and the seat belt had been in use, this fatality might have been prevented.

Recommendation #2: Convert tricycle configured tractors to a wide front end configuration.

Discussion: The victim was using an older tricycle configured tractor. Tricycle configured tractors are inherently less stable and have stability baselines which leave little room for error (see Figure 1 below).

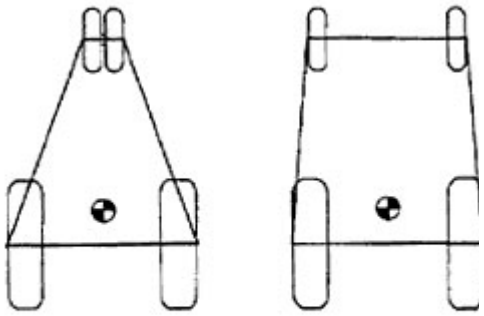

Figure 1. The stability baselines of a tricycle and a wide front-end tractor respectively

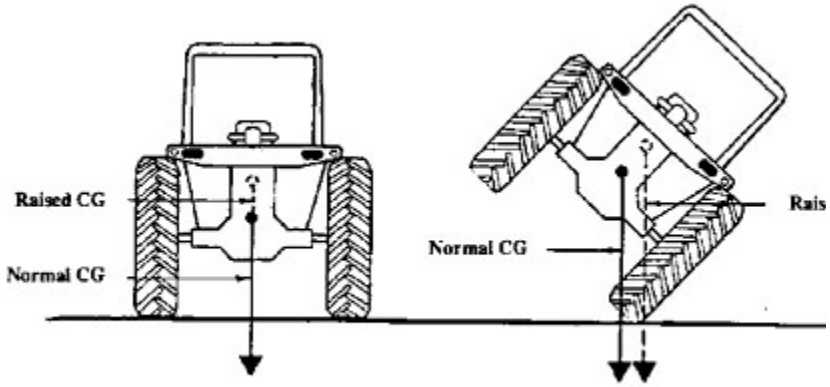

Figure 2. A higher center of gravity allows a side overturn to occur more quicl

This inherent instability is amplified when dealing with elevated front end loads, such as round hay bales. Theses types of loads not only move the center of gravity forward toward the tip of the stability triangle, they also raise the CG (see Figure 2 above). A forward and raised CG on a tricycle tractor traversing a hillside leaves little room for abrupt changes in the tractor's attitude. When the tractor's uphill rear wheel abruptly ran over the small clump of hay within its path, the tractor's CG was pushed beyond the stability baseline causing the tractor to roll over towards the downhill side. Given the fact that the task being performed involved a front end elevated load in conjunction with a sloped terrain, use of a wide front end configured tractor may have allowed the CG to remain within the stability baseline and therefore prevented rollover.

Recommendation #3: Evaluate the work area for hazards which can compromise a tractor's stability prior to each operation.

Discussion: The randomly distributed clumps of hay, which were a byproduct of previous bale moving activities, were littering the tractor's work zone. In essence, these clumps turned a fairly smooth and predictable working surface into a uneven and highly unpredictable working surface. This highly uneven surface caused the tractor's CG to be in a constant state of change. Evaluating the tractor's work zone prior to material handling activities may have given the operator the opportunity to identify and abate the hazardous work zone by removing the clumps.

Recommendation #4: Evaluate the location and its terrain prior to establishing round bale storage areas.

Discussion: The bale was being moved from the farm's designated round bale storage area which was located next to a drainage ditch. The bales where stored parallel to the ditch. This configuration allowed for a non level travel/work zone area on the ditch side of the bales. In fact, the measured grade was 15 degrees. Establishing a storage area whose travel/work zone has a 15 degree slope, places the tractor operator at greater risk for CG shifts. This risk is increases when the work zone activity involves elevated loads. Positioning the storage area on level terrain would have facilitated easier access to the bales and lowered the risk for CG shifts leading to rollover.

REFERENCES:

1. Office of the Federal Register: Code of Federal Regulations, Labor, 29 CFR Part 1928.51 (b), U.S. Department of Labor, Occupational Safety and Health Administration, Washington, D.C., April 25, 1975.
2. National Institute for Occupational Safety and Health, National Agriculture Safety Database, October 1997.

ILLUSTRATIONS

Image 1. The line represents the measured 15 degree slope down towards the drainage ditch. The tractor was driving away from this perspective.

Image 2. Tractor involved in fatal rollover.
Note the tricycle configured front end and the end loader attachment.

Image 3. This is one of two forks which was attached to the tractor's end loader bucket permitting bale removal.
The white box represents the end loader bucket.

FATALITY ASSESSMENT AND CONTROL EVALUATION PROGRAM

The WVU Center for Rural Emergency Medicine, through a contract with the West Virginia Department of Health and Human Resources, conducts investigations on the causes of work-related fatalities within the state. The goal of this program is to prevent future fatal work-place injuries. West Virginia FACE intends to achieve this goal by identifying and studying the risk factors that contribute to work-place fatalities, by recommending intervention strategies, and by disseminating prevention information to employers, employees, trade associations, unions, equipment manufacturers, students, teachers, and others with an interest in work-place safety.

Please use information listed on the Contact Sheet on the NIOSH FACE website to contact In-house FACE program personnel regarding In-house FACE reports and to gain assistance when State-FACE program personnel cannot be reached.