

## **2010 Summary of Grain Entrapments in the United States**

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Since 1978, Purdue University's Agricultural Safety & Health Program has been documenting grain entrapment<sup>1</sup> cases throughout the United States. Over 800 fatal and non-fatal grain entrapment cases have been documented and entered into a National Grain Entrapment Database, with the earliest case dating back to 1964. This article summarizes reported grain entrapment cases documented during 2010 with observations concerning the increasing frequency of these events<sup>2</sup>.

Based upon the cases documented to date, no less than 51 grain entrapments occurred in 2010. In addition, there was at least one reported incident of a first responder who required medical treatment due to respiratory issues occurring during a rescue and recovery operation. This is the highest number ever recorded; the previous highest number of cases occurred in 1993 when 42 were documented. The 2010 total compared to 33, 34 and 38 cases documented during 2007, 2008 and 2009 respectively.

The trend for this type of incident, unlike many other types of farm-related injuries and fatalities, continues to increase, as shown in Figure 1. From 2009 to 2010, there was an increase of 13 cases or over 34%. From the low point of 18 cases in 2001, the increase has been over 183%. Between 1994 and 2002, the five-year average decreased from a then-record of 29.2 recorded entrapments per year to 18.8 in 2002 (the lowest since 1987). Since 2002, however, the five-year average has increased steadily back to 29.2 incidents per year in 2008, 32.0 in 2009 and now 36.0 in 2010. This is a jump in the five-year average of 12.5% from 2009 to 2010, and an increase of over 91% from the low point of 18.8 in 2002.

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<sup>1</sup> Flowing grain entrapments include both fatal engulfments and partial entrapments that required assistance in order for the victim to be extricated.

<sup>2</sup> A preliminary report for 2010 was released in early November 2010 when the total number of cases at that time exceeded the highest number of incidents ever recorded. This report summarizes all incidents documented in 2010.

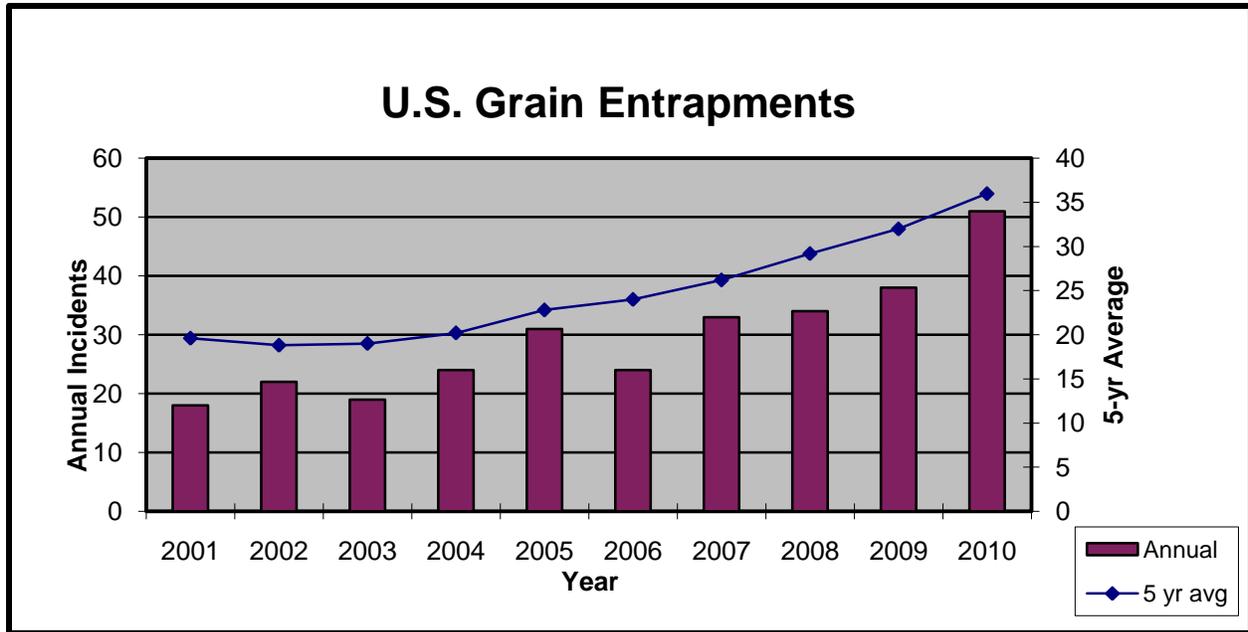


Figure 1: Number of annual grain entrapments<sup>3</sup> recorded in the National Grain Entrapment Database and the 5-year average between 2001 and 2010.

As in past years, it should be noted that this summary does not reflect all grain-related entrapments, fatal or non-fatal that have occurred, due to the lack of a comprehensive reporting system and a continued reluctance on the part of some victims and employers to report partial entrapments where extrication was required but no public report was made. Based upon the calculated ratio of non-fatal to fatal incidents documented in Indiana over the past 30 years, which has had an aggressive surveillance program to identify these events, the total number of actual cases could be 20-30 percent greater nationwide.

In 2010, the states with the most grain documented entrapments, fatal and non-fatal, were Illinois (10), Minnesota (8), Wisconsin (7), and Iowa (5). This geographic distribution parallels the long-term trend for these events to occur primarily in the Corn Belt. Overall, entrapments were documented in 17 states in 2010.

Historically, 70% of all documented entrapments, where the site was known, have occurred on farms currently exempt from the OSHA Grain Handling Facilities standards (29 CFR 1910.272) with the balance taking place at commercial grain facilities. Beginning in 2007 and 2008 this distribution of cases changed substantially with 49% of documented cases occurring on exempt farms and 51% at non-exempt commercial sites. In 2009, where the location was known,

<sup>3</sup> Data for 2006 was updated from previous reports to 24 incidents based on additional information and reports received. It was previously reported as 20 incidents.

19 (63%) entrapments occurred on farms and 11 (37%) entrapments were at commercial facilities; the classification of the location was unknown for 8 incidents. This more historical trend continued in 2010, with 35 (69%) of the incidents occurring on exempt farms and 16 (31%) of the incidents occurring at commercial facilities<sup>4</sup>. All documented victims were male, and there continues to be a trend towards more managerial level employees / operators / owners being involved in entrapments.

In 2010 there were six incidents (12%) involving youth under the age of 16, as shown in Figure 2. All but two were at farm locations currently exempt from the OSHA Grain Handling Facilities standard. Overall, age was known for 43 of the 51 incidents in 2010, with the oldest victim being 81, and the youngest seven years old. The average age was 45 years old, and the median age 49.

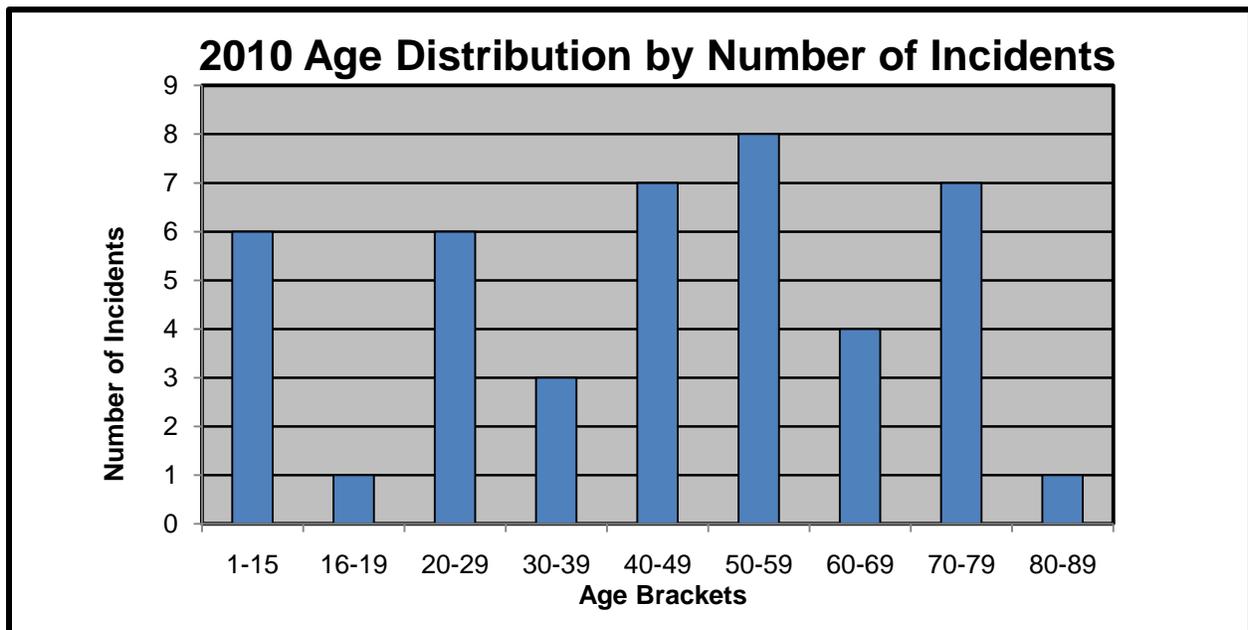


Figure 2: Age distribution of victims by number of incidents recorded in the National Grain Entrapment Database for 2010.

As shown in Figure 3, in 2008 and 2009 the ratio of fatal to non-fatal incidents decreased when compared to earlier years. From 1964-2005, 74% of documented entrapments resulted in death. During 2008, 45% of the entrapments resulted in death with 42% of the entrapments in 2009 resulting in death, and 51% of cases resulting in death in 2010. It should be noted that 5 of the 6 cases involving youth under 16, (83%) resulted in death. Even though the reporting of

<sup>4</sup> In the past, it was difficult to discern whether an incident occurred on an exempt farm or at a commercial facility due to incomplete reporting. In 2010, documentation allowed for a determination in each case.

child-related incidents from exempt facilities is very incomplete, the high percentage of incidents involving youth that result in fatalities should be of concern. It is believed that more victims may be surviving these incidents due to increased emphasis on safer confined space entry procedures, such as using an observer during confined space entry, as well as an increased emphasis on first responder training on grain entrapment extrication. At least two of the incidents documented in 2010 involved extrication using commercially available grain rescue tubes which were not widely available until 2007/2008.

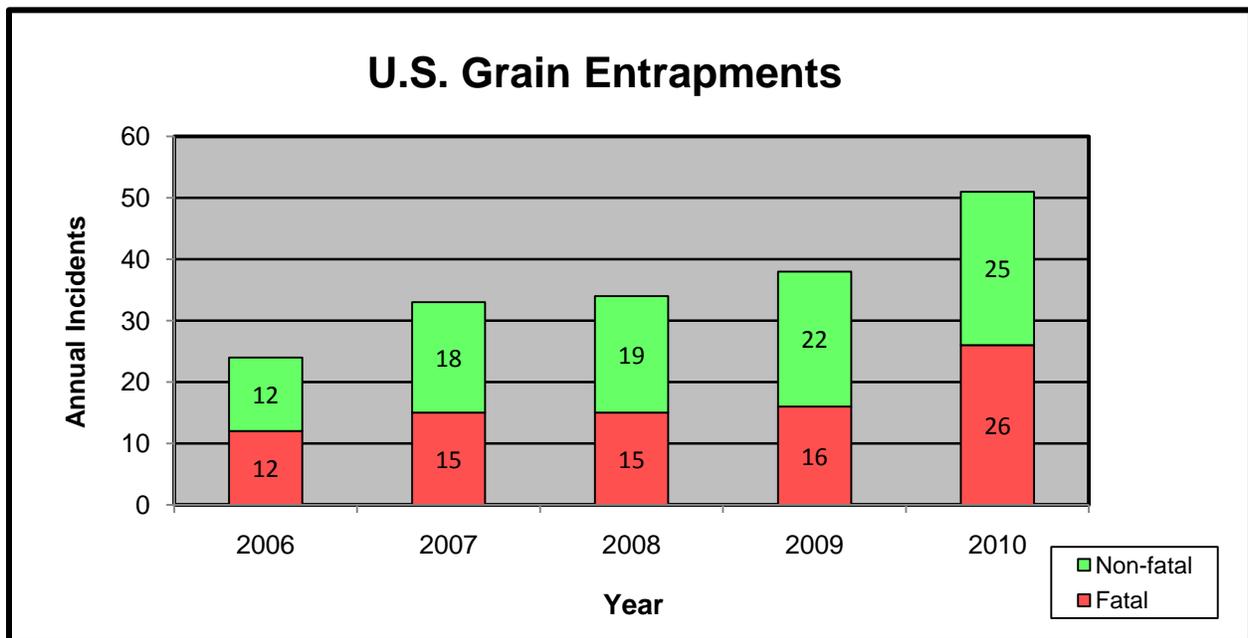


Figure 3: Fatal vs. non fatal incidents recorded in the National Grain Entrapment Database between 2006 and 2010.

During 2010, the primary medium of entrapment, when identified, remained yellow corn (37 incidents, 73%). Over the past thirty years corn has been involved in approximately 45% of the grain-related entrapments where the medium was known. If further inquiry was conducted on the unknown cases, it is believed that the portion involving corn would be higher. Other bulk materials that were documented in entrapments included processed feed, soybeans, sorghum, barley, sunflower seeds, and peanuts.

In 2010, the primary causes leading to entrapment of most victims were identified as entering a bin to loosen crusted, spoiled or frozen grain while unloading equipment was running (26 incidents, 51%), or falling into grain transport vehicles while they were being either loaded or unloaded (3 incidents, 6%). There continues to be a direct relationship between out-of-condition, or spoiled, grain and a greater probability of entrapment.

The 2009 crop was record in size and the 2010 crop was not too far behind in the amount harvested<sup>5</sup>. While the harvest conditions were much better for 2010, the less than ideal conditions of 2009 resulted in more reports of out-of-condition or spoiled grain in storage and increased incidents of plugged flow. In addition, the domestic corn demand for ethanol has resulted in the largest build up of storage capacity across the Midwest in history. These factors have resulted in more corn being stored for longer periods of time than in past years and possibly an increased potential for grains to go out of condition leading to another increase in grain entrapments unless there is a change in current work practices. There exists a continuing need for an industry wide consensus on the importance of developing engineering safety design and practice standards for grain storage structures. The commercial grain industry and grain bin manufacturers are urged to increase their employee and farmer/customer education efforts to prevent grain entrapments from occurring. In addition, there is the need to strengthen employee and emergency responder training efforts to ensure having in place appropriate response strategies in case of grain entrapments. Excellent training resources such as the videos “Don’t Go with the Flow” and “Your Safety Matters” are available from the National Grain & Feed Association ([www.ngfa.org](http://www.ngfa.org)); they were developed in response to the observed upswing in grain entrapment incidents at commercial fatalities during the early 1990s. Farmer/producer oriented safety resources are also available from sources such as [www.grainquality.org](http://www.grainquality.org), National Corn Growers Association ([www.ncga.com](http://www.ncga.com)), or from local Extension offices.

Every flowing grain entrapment is a preventable incident. The recent record crops from 2009 and 2010 should be a reason to celebrate and not the cause for tragedy and sorrow. The grain entrapment problem can be addressed through the use of appropriately designed storage facilities, proper grain storage practices, proper use of personal protective equipment, implementation of safe work practices and having in place effective emergency response capabilities.

*Note: This summary was compiled by Steve Riedel and Bill Field, Department of Agricultural & Biological Engineering, Purdue University. For additional information on grain entrapments, contact Bill Field at 765-494-1191.*

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<sup>5</sup> According to USDA, National Agricultural Statistics Service crop production data for 2009 and 2010, corn harvested in 2009 amounted to 13.11 billion bushels and soybeans harvested were 3.36 billion bushels. In 2010, corn harvested amounted to 12.45 billion bushels and soybeans harvested were 3.33 billion bushels.