Assessment of the Condition of Iowa Augers, Auger-related Injuries, and Farmers’ Perceptions about Auger-related Injuries

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Keywords
Machinery, Guards, Safety, Inventory, Agriculture.

Disciplines
Agriculture | Bioresource and Agricultural Engineering

Comments
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C. V. Schwab, S. A. Freeman, T. Pollard

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This study provides an insight into auger-related injuries, Iowa farmers' perceptions of auger-related injuries and the condition of augers used in Iowa agriculture. Specific auger-related injury data (437 records) from the Iowa Department of Public Health (IDPH) was examined and interpreted. The most likely body part injured was the finger and 11:00 A.M., 3:00 P.M., and 5:00 P.M. were the times of the day with the highest number of injuries reported. In addition, a survey was administered to 400 farmers to ascertain their awareness of auger-related injuries and to determine the condition of their augers. Farmers' perceptions of what body part is most likely to be injured by an auger and the level of severity expected from those injuries coincided with injury records from 1993 to 1997. A total 34% of the primary and secondary augers reported were unshielded or without guarding. This assessment provides insight for development of intervention countermeasures to reduce auger-related injuries.

Keywords. Machinery, Guards, Safety, Inventory, Agriculture.
Augers are one of the most visible agricultural implements on Iowa farmsteads. Portable augers are almost always stored outside year round. Their size and shape make them easily visible from roadways. While filling bins, portable augers are seen up against the storage bins and at other non-use times they are parked elsewhere on the farmstead. Some types of augers are permanently attached to the storage bin.

Augers vary in size from 4 to 14 in. in diameter and from 20 to 100 ft in length. An auger can be independent and movable, an integral piece of another implement (e.g., as a fixed component of a grain wagon), or part of a complex grain handling system (e.g., grain dryer, storage bin system, etc.). Augers can be powered from a variety of energy sources. However, most augers are powered by electrical motors, internal combustion engines, hydraulics or via the power-take-off (PTO) mechanism on tractors.

In 1972, the auger was identified as the most dangerous farm machine on a per hour of use basis (Doss and Pfister, 1973). Since that time, grain handling machinery has consistently been one of the leading causes of death and injury (Snyder and Bobick, 1995). The auger is often involved in electrocution when overhead power lines are contacted. However, the primary auger-related peril is the shear or cutting point hazard. This common machine hazard exists where a single edge (flighting) moves against a stationary edge (tube). The rotation of the flighting in the tube which creates the hazard is fundamental to the operation of the auger and the actual reason for its existence (Murphy, 1992).

Effective intervention development for auger-related injuries require formative research to identify existing conditions and operators' perceptions. This research documents the conditions, factors, demographics, and types of auger-related injuries in Iowa as collected by the Iowa Department of Public Health. The research also includes a survey of Iowa farmers that shows their level of awareness about auger injuries and the conditions of their augers.

**Survey Methods**

A survey instrument was developed and refined by an advisory committee. The survey instrument was pre-tested with a limited group of subjects. Pretest subjects were grain farmers and non-farmers, but from a farm background. The survey instrument was then mailed to 400 individuals randomly selected using a systematic sampling method.

Potential participants were selected from the county plat books containing a variety of maps, showing land divisions, owner's name of record by parcel, a list of the rural residents, and sometimes addresses with phone numbers. The criteria for selection were based solely on the fact of having a residence outside of any incorporated town and being listed in the plat book.

Neither the size of farm or direct ownership of farmland was a factor in the selection process. Thus some non-farmers were mailed survey forms (i.e., people who live in a rural area but are not engaged in farming). This selection process also included individuals engaged in agriculture, but not necessarily grain production and also to those retired from agriculture but who continue to live at their rural residence.

Four individuals were selected from every Iowa County using a systematic selection process based on random numbers and the residents listed in the plat book index. With Iowa's 99 counties, that yield 396 participants, so one extra person was selected from the four geographically largest counties. The four largest counties are Kossuth, Pottawattamie, Woodbury, and Plymouth.
The survey instrument with accompanying cover letter was mailed on 12 May 1998, with return postage affixed to the actual survey which when folded and sealed became the return mailer. Reminder follow-up post cards were sent out fifteen days later. The deadline for receiving the completed surveys was 13 June 1998.

Of the 400 questionnaires mailed, 8 were returned as undeliverable. Six were returned having an expired mail forwarding address. The other two were marked “attempted-not known” or “not deliverable as addressed”. Surveys returned by the U.S. Post Office had the address re-verified in the most recent plat and phone books. All addresses were determined to be accurate with the listings, but due to moves, deaths, publishing inaccuracies, etc. were no longer deliverable.

Total returned surveys numbered 93, for an effective response rate of 23%. The return rate is attributed to the time of year the surveys were mailed, which was right in the middle of the spring planting period. Another factor for the return rate was that the survey was estimated to take up to 15 min to complete. Information from the Iowa State University Statistical Service (Dr. Jean Opsomer, 1998, personal interview) indicated that surveys estimated to take longer than 10 min often result in lower return rates.

**Injury Data Collection**

The Iowa Department of Public Health (IDPH) collects injury data on anyone who has a non-household injury, receiving hospital or clinic medical care where the injury occurred on a farm and was related to the production, handling, processing, transporting, or warehousing of any agricultural product. Injuries incurred in farm environments (visiting or recreation) are included in the data (Schootman and Harlan, 1996).

The reporting is done on a voluntary basis by the hospital treating the farm-related injury. The one page form requests data on gender, ag-machine involved, age of victim, farm location of injury, type of injury, location of injury, severity of injury, type of tool, chemical, machinery, animal or other agent involved with the injury. IDPH supplements this data with information from death certificates, other physician reports, media, and law enforcement agencies.

The IDPH system undercounts the actual injury occurrence rate (Schootman and Harlan, 1996). An indication of this was in IDPH statistics that showed Polk (Des Moines, Iowa) and Scott (Davenport, Iowa) counties, the two largest population areas in the state, had no recorded auger-related incidents for the five-year period 1993 to 1997. While these are predominately urban counties, many injured from rural areas are often taken directly to urban trauma centers (A. Gurwell M.D., 1998, personal interview). Further, these urban centers are surrounded by production agricultural areas. Iowa has rural border areas where the closest hospital is often in an adjoining state, so the injured receive treatment out of state. For the above reasons and others, official numbers may be lower than actual and are under representative of the actual auger-related injury rate.

**Injury Data**

**Age**

The average age of farmers injured by auger was 43 and the median age was at 42. In the year by year (1993-1997) breakdowns, the average and median ages were relatively constant, remaining in the early 40s. The maximum ages were age 76 in
1997 and 85 in both 1993 and 1995. The youngest person recorded to sustain an auger injury was a 2 year old in 1996.

**Month of Injury**

Monthly auger injury data (table 1) indicate that in any given month of the year some producers are using their augers in a concentrated manner, while other producers might not be using their augers at all.

October, the traditional peak harvest month for Iowa had the highest injury rate with 28% of recorded injuries. The low injury months were March and December with a recorded 4% of injuries. The rate of injury around harvest (September to December) accounts for over half of all auger-related injuries. The highest recorded percentage of injuries for these harvest months was in 1994 with 55%, the least was in 1993 with 37%.

**Gender**

Males represented 95% of the injured. In the five-year period (1993 to 1997), the highest male percent was 98% in 1993. The lowest male percentage was 93% in the following year, 1994. These numbers are reflective of the rural workforce that is predominantly composed of male farmworkers. Women represent less than 4% of farm operators (Schootman and Harlan, 1996).

**Severity of Injury**

Estimated time off work is an indicator of the seriousness of auger-related injuries. Half (51%) of those injured are incapacitated for a short period of time, taking from no time off work up to one week off work (table 2). That leaves the remaining 49% being incapacitated from work for more than one week. Death of the injured is identified in this table as 'Expired'. The year with the highest reported auger-related deaths was 1995 when 8% of the injuries were fatal. Hospitalization rate for auger-related injuries is another indication of seriousness. The hospitalization rate is three out of four of the injured being admitted to the hospital for at least a day. The five-year period varied from 80% admitted in 1997 to a low of 68% admitted in 1994.

<table>
<thead>
<tr>
<th>Month</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan.</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>Feb.</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>Mar.</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Apr.</td>
<td>26</td>
<td>6</td>
</tr>
<tr>
<td>May</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>Jun.</td>
<td>27</td>
<td>6</td>
</tr>
<tr>
<td>Jul.</td>
<td>27</td>
<td>6</td>
</tr>
<tr>
<td>Aug.</td>
<td>41</td>
<td>9</td>
</tr>
<tr>
<td>Sept.</td>
<td>36</td>
<td>8</td>
</tr>
<tr>
<td>Oct.</td>
<td>124</td>
<td>28</td>
</tr>
<tr>
<td>Nov.</td>
<td>46</td>
<td>11</td>
</tr>
<tr>
<td>Dec.</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>437</td>
<td>100</td>
</tr>
</tbody>
</table>

* Data source is the Iowa Department of Public Health.

Table 1. Number of reported auger-related injuries by month from 1993 to 1997*
Parts of the Body Involved

The most common body part involved in auger-related injuries is the finger, at a reported 42% of all injuries (Table 3). Total upper extremity injuries (finger, hand, and arm) were two out of every three reported injuries (66%). The toe/foot/ankle/leg/knee account for 16% of the recorded injuries. The head was injured in 9% of the reported cases.

Occupation of Injured

Full-time farmers had the highest injury rate (57%) among the other 6 occupation/relationship classifications (Table 4). The grouping “farm family members” that includes retired farmers but excludes spouses was second at 21% of the injuries. Farm service people were involved in 6% of auger-related injuries. When the part-time farmers (3%), farm service person (6%), farm spouse (< 1%), and farm employee/worker (11%) are added in, 98% of those injured had business on the property or were involved in production agriculture.

Injury Description

Laceration/Avulsion injury is the most common at 40% as shown in Table 5. The Laceration/Avulsion category characteristics ranged from isolated cuts to extensive body damage, both requiring medical interventions. Fractures are the second most common injury at 15%. Amputations, which by definition would be considered a

Table 2. Estimated time off work from auger-related injuries (1993-1997)*

<table>
<thead>
<tr>
<th>Time off work</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>None to 1 week</td>
<td>222</td>
<td>51</td>
</tr>
<tr>
<td>1 to 4 weeks</td>
<td>131</td>
<td>29</td>
</tr>
<tr>
<td>1 to 3 months</td>
<td>41</td>
<td>9</td>
</tr>
<tr>
<td>3 to 6 months</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Over 6 months</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Expired</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>437</td>
<td>100</td>
</tr>
</tbody>
</table>

* Data source is the Iowa Department of Public Health.

Table 3. Parts of body involved in auger-related injuries (1993-1997)*

<table>
<thead>
<tr>
<th>Body Part</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finger(s)</td>
<td>184</td>
<td>42</td>
</tr>
<tr>
<td>Hand</td>
<td>56</td>
<td>13</td>
</tr>
<tr>
<td>Arm</td>
<td>47</td>
<td>11</td>
</tr>
<tr>
<td>Head</td>
<td>40</td>
<td>9</td>
</tr>
<tr>
<td>Leg/Knee</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>Multiple</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>Foot/Ankle</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Toes(s)</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Shoulder</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Other †</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>437</td>
<td>100</td>
</tr>
</tbody>
</table>

* Data source is the Iowa Department of Public Health.
† The category “Other” consisted of: Back, Chest, Genital, Internal, and Trunk.
severe injury, are third at 13%, with the collective abrasions/bruises/contusions at fourth with 9% of the injuries. The other injuries each comprise less than 10% of the reported 437 auger injuries. The data from the Iowa Department of Public Health identified five electrocutions involving grain augers.

**Time of Injury**

Almost every hour of the day had a reported injury during the five-year period (table 6). The only times not reported were at 3:00 A.M., 11:00 P.M., and midnight. The most common time for injuries was at 5:00 P.M., which had 47 injuries (11% of the total). The second and third most common times were at 11:00 A.M. with 43 injuries (10% of total) and 3:00 P.M. with 41 injuries (9% of total), respectively. The most prevalent time of injury is right before the noon and evening meals and at 3:00 P.M. The 7:00 A.M. to 7:00 P.M. time period accounted for 95% of the injuries.

**Survey Findings**

The findings of the farmer survey are presented in sections corresponding to the areas of inquiry (personal data, work environment, injury experience, perceptions about auger-related injuries; body parts involved, severity of injuries, and time of
injuries). The full participation rate was 93 surveys returned (N = 93); of these respondents there were 57 farmers who owned augers and/or stored grain (N = 57). Thirty-six surveys were not included because the individual was retired, or not engaged in grain production.

Few survey instruments were returned with 100% of the questions answered. Even some of the more complete surveys were missing some data due to oversight or lack of knowledge about an issue. Other surveys inexplicably had some questions or sections skipped. In the findings reported here, N is the number of responses for individual items.

**Personal Data**

The respondents ranged in age from age 30 to age 85, with a median age of 55 years and an average age of 55 years. The individuals had been farming for an average of over 36 years with a median time engaged in farming of 36 years.

Considering those that responded to the occupation question, 73% (N = 48) reported themselves full-time farm operators. The remaining 27% considered themselves part-time farmers and full-time workers in off-farm employment. The questionnaire only provided two work status choices and was focused on individuals engaged in production agriculture. Thus a few respondents may have left this item blank if they didn't consider themselves as either a full-time farmer or a part-time farmer with full-time off farm employment. This was a self-defining category as no specific definition was provided for the terms full-time and part-time.

**Table 6. Time of day auger injury occurred (1993-1997)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:00 A.M.</td>
<td>1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>2:00 A.M.</td>
<td>1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3:00 A.M.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4:00 A.M.</td>
<td>1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>5:00 A.M.</td>
<td>1</td>
<td>&lt;1</td>
</tr>
<tr>
<td>6:00 A.M.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>7:00 A.M.</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>8:00 A.M.</td>
<td>29</td>
<td>7</td>
</tr>
<tr>
<td>9:00 A.M.</td>
<td>31</td>
<td>7</td>
</tr>
<tr>
<td>10:00 A.M.</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>11:00 A.M.</td>
<td>43</td>
<td>10</td>
</tr>
<tr>
<td>12:00 P.M.</td>
<td>31</td>
<td>7</td>
</tr>
<tr>
<td>1:00 P.M.</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>2:00 P.M.</td>
<td>39</td>
<td>9</td>
</tr>
<tr>
<td>3:00 P.M.</td>
<td>41</td>
<td>9</td>
</tr>
<tr>
<td>4:00 P.M.</td>
<td>36</td>
<td>8</td>
</tr>
<tr>
<td>5:00 P.M.</td>
<td>47</td>
<td>11</td>
</tr>
<tr>
<td>6:00 P.M.</td>
<td>33</td>
<td>8</td>
</tr>
<tr>
<td>7:00 P.M.</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>8:00 P.M.</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>9:00 P.M.</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>10:00 P.M.</td>
<td>2</td>
<td>&lt;1</td>
</tr>
<tr>
<td>11:00 P.M.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12:00 A.M.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>437</td>
<td>100</td>
</tr>
</tbody>
</table>

* Data source is the Iowa Department of Public Health.
Work Environment

The number of acres of corn and soybeans produced determined the size of the farming operation. The exact size of the farm owned and/or leased was not requested, nor in the case of other farming activities was the land devoted to those other enterprises considered. The average acreage reported devoted to corn and soybeans was 469 acres with the median at 350 acres. The smallest amount was listed at 20 acres and the largest was reported at 2,000 acres. In fact, nine farmers reported planting over 950 acres of corn and soybeans.

Detailed information was collected for the one or two augers that were most frequently used, since many producers had more than two augers. The respondents (N = 52) reported having a minimum of one auger all the way up to 11 augers. The average number of augers per producer was three. The age of the primary or most frequently used auger (59%) was more than eight years old (manufactured before 1990). This only includes augers that the producer knew the exact or general age; some respondents just put down “old”. The oldest most frequently used auger that was identified in this survey was manufactured in 1965.

Intake shielding was in place for 81% of the primary augers. The most common response, when asked why the shielding was not in place, was that the auger was purchased used without the shielding. One producer, that is currently using an auger manufactured in 1965, stated that the shielding was lost sometime before the auger was inherited from his father. Since the shielding issue was a self-reporting non-inspected item, the actual number of unshielded primary augers could be more than the reported 19%. The number of secondary augers with shielding was less than the primary auger. Intake shielding was in place for 52% of the secondary augers. Only 63% of the combined primary and secondary augers were guarded.

The power source for 91% of the primary augers was the PTO shaft of a tractor, the remaining 9% were evenly divided between electric motors, hydraulics, and gas engines. This proportion was different for the secondary augers, where 64% were powered by the PTO and 19% by electric motors, 10% by gas engines and 5% by hydraulics. The most prevalent power source for augers in Iowa is the PTO.

In recent years, many farmsteads have gone to underground wiring, for both safety enhancement and to avoid power interruptions from downed overhead lines. The survey asked the respondents to describe their electrical wiring either as belowground (buried) or aboveground (on poles). Approximately 13% of the respondents reported that the wiring was belowground, 35% reported that they had a combination of aboveground and belowground wiring. As a group it could not be determined which part of the wiring was above or belowground. One respondent did indicate that his farmyard wiring was below ground and near the house the wiring was aboveground. The remaining 52% reported that all wiring was aboveground on poles.

Respondents were asked to identify the three months of their greatest auger usage. Information from the survey indicated harvest time was the most concentrated time of auger use. October was the top month for auger usage, with November being second and December being third. It is of importance to note that every month of the year was listed by at least one respondent as one of the three top months of usage for them. Therefore augers are used year round but concentrated usage is in the final four months of the year (Sept., Oct., Nov., Dec.) around the harvest season.
Injury Experience

Respondents were asked to report if they had ever personally experienced or had witnessed an auger-related injury. Nine auger-related injuries were reported. The personally experienced injuries were:

- An auger drive chain injured fingers during harvest month (Oct.).
- An auger drive chain broke and injured the respondent's eye during harvest (Oct.).
- An auger severed operator's hand (Jan.).
- An auger injury with no description (no date indicated)

The following were respondent witnessed injuries:

- A non-relative had his foot and ankle caught in the auger intake. (no date indicated)
- Neighbor had his arm then leg caught in auger when cleaning out a grain bin (spring).
- Neighbor died after being caught in auger (Nov.).
- A falling auger crushed a non-relative. (no date indicated)
- Respondent's son lost three fingers in an auger (July).

There were also eight close calls reported. The farmers reported experiencing or witnessing an incident in which he/she or someone else narrowly escaped injury. Some of these reports were sketchy, only reporting that the individual had experienced or witnessed a close call. Others were more specific. The following is a summary of the close calls that contained details:

- Son of respondent had the undercarriage winch slip (Oct.).
- The respondent's neighbor had the leg of his overalls caught in the auger and it ripped the clothing off of him. (no date indicated)
- The top end went down, upending the auger. (no date indicated)
- The winch handle came off and the auger crashed down (Nov.).

Combining the nine injuries and eight close calls with augers, 25% of the respondents reported being affected.

Body Part Involved

Respondents (69%) identified that the hand and fingers would be the body part most likely to be injured by an auger. A lesser amount, 31% identified the toes/foot/ankle/leg/knee would be the most susceptible to auger injury. When divided out, body parts in order of susceptibility to injury were identified as follows: fingers (40%), hand (29%), foot/ankle (20%), leg/knee (9%), and lastly the toes (2%). There were other categories that were not selected by any respondents, which were arm, head, and other.

Severity of Injury

Respondents were asked to rate the severity of an auger-related injury. Here they were given four categories: life threatening, very severe, moderately severe, and not usually severe. Definitions were provided for all choices with the exception of life threatening. They were very severe (amputations, deep cuts), moderately severe (deep lacerations), and not usually severe (small cuts, bruising). Respondents reported overwhelmingly (94%) that auger-related injuries were life threatening or very severe. The distribution was 47% life threatening injuries and 47% very severe injuries.
Time Injury Occurred

Respondents were questioned about what time of day they believed an auger injury would most likely occur. Eight categories were provided for their selection and were described in general terms. The areas in chronological order were: early morning, mid morning, right before lunch, just after lunch, mid afternoon, right before dinner, just after dinner, and in the evening. Overwhelmingly, the respondents selected evening as the time an auger injury is most likely to occur. In fact, three out of four (75%) identified evening as the time most predisposed for an auger injury. The only other significant time selected was mid afternoon at 12% of the participants. The other choices were all 4% or less.

Discussion

The respondents ranged in age from 30 to 85 years, with an average age of 55 years. The average age of Iowa farm operators in 1992 was 50.3 years, with 30% of the farm operators being 65 years or older (Census of Agriculture, 1992). Farmers are an older group and tend to keep working beyond the current normal Social Security retirement age of 65 (Iowa Department of Economic Development, 1996). In fact, 53% of the survey respondents that were 65 and older identified themselves as full-time farmers.

Injury Experience

In this sample, there were nine witnessed or experienced auger-related injuries, as well as eight witnessed auger-related close calls. Iowa Department of Public Health reported 437 medically treated auger-related injuries from 1993 to 1997. Given the witnessed injuries and close calls by the respondents, the number of actual auger injuries and the low time of exposure, an auger is a dangerous piece of equipment on a farm.

Auger Intake Guards and Shields

About one in five primary augers were reported to be without shielding. When the secondary augers are combined with the primary auger, the number being operated without shielding increased to about one in three augers. An auger without shielding was a self-reported negative issue. This information along with personal and random checks of augers, indicate the number of augers without shields may be even higher than reported. Thus a potentially dangerous condition exists when this implement is being operated without a safety device in place.

Data indicate that many older augers (10+ years) are still in general use, some in fact are the primary auger. Older augers are not expected to have the safety features of more recent augers. Furthermore, the older the auger, the higher the likelihood, that safety shields and guards are absent, disabled or no longer functioning. The study found that over 59% of the augers in use are older than eight years. In fact, some augers in current use date back to the 1960s.

The age of the primary or most frequency used auger can contribute to the absence of intake shielding. Advancements in auger shielding has improved since 1965, the age of three included as the operator’s primary augers. The American Society of Agricultural Engineers adopted “Safety for Portable Agricultural Auger Conveying Equipment” as a tentative voluntary standard on February 1973 (ASAE Standards, 1998). Those augers were manufactured eight years before the
development and adoption of the standard. Other primary augers manufactured between 1965 and 1973 may also lack the advantages outlined within that standard.

When questioned why their auger was without shielding, the answers were indeterminate, vague, or blaming it on the previous owner. That is, they reported that the auger was purchased used and didn’t come with a guard, the guard was lost, or the question was just left unanswered. This is a farmer responsibility issue and not having shields is exacerbating an already dangerous situation. More in depth and specific study would be needed in this area to determine why producers put such a low value on keeping shielding and grates in place.

Replacement of an older unsafe auger is an economic decision. Purchasing a new auger is not a priority, since the auger is still functioning and working, even though somewhat unsafe. Since it is only used a few times during the year, the purchase of a new auger could be delayed. However, advantages such as new safety enhancements, undercarriage, height adjustment mechanism, auger flighting and intake troughs could tip the decision balance toward making the purchase.

Overhead Electrical Wiring

NIOSH investigations show that electrocutions can result from augers coming into contact with overhead power lines (NIOSH, 1986). The Iowa Department of Public Health identified five electrocutions involving grain augers from 1993 to 1997. However, electrocutions involving augers are often not included in auger-related injury data, therefore special searches must be conducted. The Iowa FACE program did a case report on such a fatality in 1995. In this incident an auger was being cranked down by a 26-year-old male farmhand when the auger tube came in contact with a high voltage power line (Johnson, 1995).

A way of eliminating the auger electrocution hazard is to bury the wiring. This is being accomplished at a slow rate. Only 13% of the farmers reported that their wiring was below ground, another 35% have a combination of below/above ground wiring. The farmers’ acceptance of power line electrocution risks and high cost for burying existing lines are possible factors accounting for the slow rate of burying power lines.

Periods of Auger Usage

Most of the year augers are sitting idle. However, the respondents indicate augers are used year around. Operation depends on the circumstances of each farm. The survey also identified that the most concentrated usage occurs during harvest. The injury data indicates that most of the injuries happen in October. After October the injury rate decreases for November and December. The respondents identified the high use month October is also the month with the highest percentage of injuries. Clearly the other high usage months during harvest also correspond to the high injury data recorded for those months. Similarly, the injuries were reported for every month during the year and every month was identified as month of usage by at least one respondent.

Body Parts Injured

The survey respondents overwhelming stated the fingers/hand/arm would be the mostly likely body part to be injured and secondarily the toes/ankle/foot. The respondents accurately identified those body parts that are most susceptible to injury according to injury data. Iowa farmers are knowledgeable about what body part is most susceptible to injury (i.e., finger/hand/arm). Compared to actual IDPH data
we see 66% of the injuries to this body part versus the producer's perception of 69%. Respondents' accuracy of identifying body parts injured could be attributed to personal experiences of an auger-related injury, witnessing a close call or influenced by media.

**Severity of Injury**

Injury severity is a subjective term. When given four different degrees of severity, respondents overwhelmingly selected either life threatening or very severe (amputation, deep cuts). The respondents accurately identified the level of severity and life-threatening nature of auger-related injuries, as confirmed by the five years of injury data. The producers are knowledgeable in that auger-related injuries are severe, as indicated from IDPH data showing a 75% hospitalization rate and 49% of the injured being incapacitated for more than one week. The respondent's understanding of the consequences associated with auger hazards is one less barrier for an intervention program.

**Time of Injury**

Injury data is recorded by the nearest hour of the day based on a 24 h clock. Consequently, every injury is assigned an hour. The hours proceeding the meal times of lunch and dinner are the more likely times to have injuries. In addition to those times, mid afternoons are likely times for injuries to occur. The peak times identified were 11:00 A.M., 3:00 P.M., and 5:00 P.M. Survey response did not match. Respondents identified evening as the most likely time of auger-related injury. The IDPH data indicates that few injuries occur in the evening. In fact, most reported injuries occurred during the daytime hours (7:00 A.M. to 7:00 P.M.).

With this knowledge, auger operators should be especially wary and vigilant at the times right before meals and mid afternoon. At these times, the individual's energy reserves are low, the operator can be fatigued, or anxious to complete the task prior to having a meal or stopping work. A strategically planned break from work can reduce fatigue and potentially avoid auger-related injuries.

**Conclusions**

This study provides a profile of Iowa auger-related injuries and the condition of the existing auger equipment used in Iowa agriculture. Iowa farmers' perceptions of the most likely body part injured and the severity of that injury coincided with the injury data however the selection of peak time for an auger injury was not accurate. The following facts came from this study:

- Auger-related injuries occur throughout the year but are concentrated at harvest time, especially in October.
- The finger/hand is the most likely body part to be injured.
- Most auger-related injuries occur before meals and mid afternoon.
- A auger-related injuries are correctly considered life threatening by auger operators.
- Iowa farmers are using older augers and 34% of primary and secondary augers are unshielded.
- The majority of Iowa farms have overhead wiring.
References


