SDSU Extension
iGrow Soybean
BEST MANAGEMENT PRACTICES

Chapter 39:
Preventing Soybean Combine Fires

Daniel Humburg

Combine fires are a serious threat that can cause millions of dollars in damage (Fig. 39.1). The purpose of this chapter is to provide information that can be used to reduce fires during soybean harvest. Fire risk can be reduced by checking and cleaning equipment. The risk is highest when wind speed is high and relative humidity and the soybean moisture percent is low. Additional key factors that can be used to reduce fires are below in Table 39.1.

Figure 39.1. A typical combine fire. (Source: http://www.howardandsons.com)

Table 39.1. Keys to reducing or minimizing combine fire risks.

- Park the combine during periods of high risk.
- Remember your safety comes first.
- Conduct a pre-harvest and daily cleaning.
- Fires require, fuel, an ignition source, and oxygen.

Fire risks have increased because:

- Many steel combine components have been replaced with combustible components.
- Combines are larger and process more biomass.
- Chain and belt drives have been converted to hydrostatic systems, which increase the risk of oil leaks and combustible hoses that can sustain a fire.
- The wide-scale use of powered sensors and controls systems which may provide the spark to ignite dust and chaff.

Warm and dry weather conditions can produce conditions that are highly conducive to fires. For example, in 2011 conditions existed that were conducive to combine fires. The highest fire risks were observed on days with high temperatures, low relative humidity, high winds, and low soybean moisture contents (Fig. 39.3) (Uilk, 2012). The combination of dry crops, warm temperatures, and high winds produced 100 combine fires in just 15 counties in northwest Iowa and southwestern Minnesota (Fig. 39.2). Similar conditions were also observed in South Dakota and northeast Nebraska. These data suggest that there are some conditions where it might be wiser to suspend harvesting and do something else. The benefit of an early or timely harvest may not outweigh the risk of the loss of the machine and the field surrounding it.

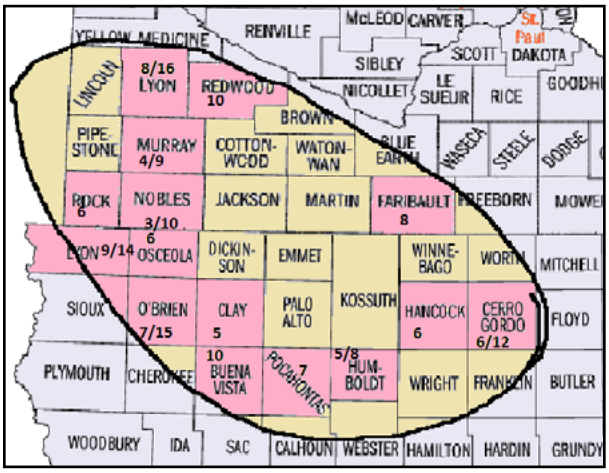

Figure 39.2. The number of fires on equipment (first number) and field fires (second number) in Southern Minnesota and Northern Iowa. Pink counties are areas where fire data was obtained. Assessments were not conducted in orange or grey counties. (Source: Uilk, 2012)

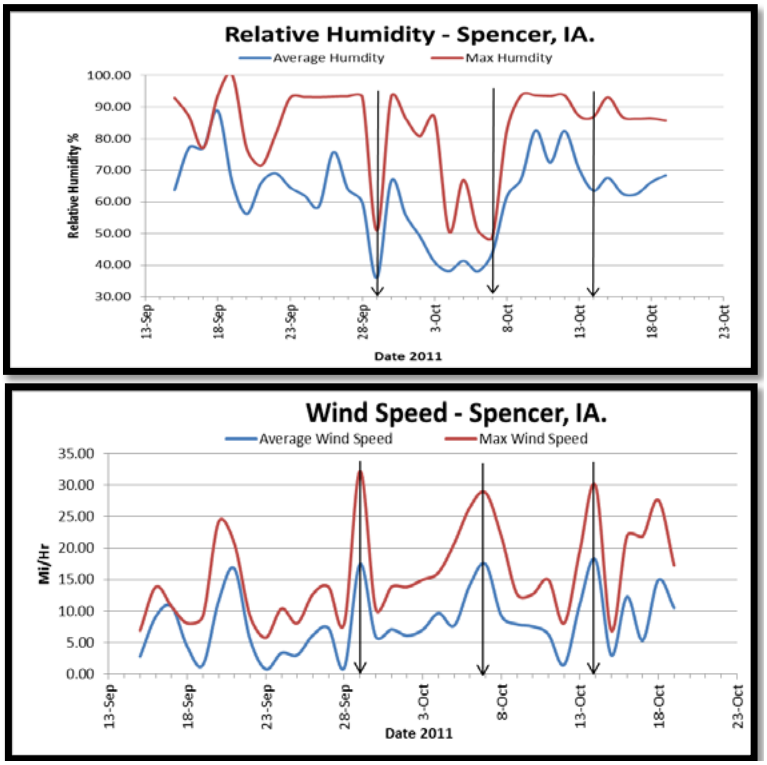

Figure 39.3. Relative humidity and wind speed in miles per hour (Mi/Hr) for Spencer, IA, during 2011 fall harvest season. High numbers of harvest fires were reported on September 29, October 7, and October 14. Arrows indicate periods of high fire potential. (Source: Uilk, 2012)

Combine fires require a fuel and ignition source. The fuel source may be a plastic wiring harness, or other synthetic part. An arc from a short circuit in the wires within the wiring system can provide the spark that ignites the fire. These types of fires are rare. Producers can minimize this risk by maintaining the machine in its original configuration.

Any repair or replacement of parts should include examination of the electric and hydraulic systems adjacent to the repair to make sure that wires and hoses are routed or restrained such that they will not chafe or be cut by moving parts. Hydraulic systems frequently produce small leaks, or oily residues from repairs and replacement of parts. Hydraulic oil combined with crop dusts provides a ready fuel that will burn if ignited. It is very common for the fuel source to be crop residue or soybean dust. Soybean dust is fine fluffy material that finds its way to almost all machine parts. A combine that is not thoroughly cleaned following the corn harvest will have highly combustible dry corn silks tucked into numerous places.

Crop dusts or residue can be ignited by an multitude of sources. Some of these include:

1. exhaust manifold and turbocharger of the engine that produces exhaust gasses with temperatures that exceed 1000°F
2. a failing bearing can easily ignite crop residues
3. friction between plant parts
4. electrical shorts or arcs
5. possibly static electricity (Polin, 2012a, 2012b)

It is not clear whether static charges build sufficiently to ignite crop residue in soybean crop residue. Research is being conducted to evaluate this risk.

Preventing fires: Removing the fuel and ignition sources

Preventing fires begins with minimizing fuel sources. The combine should be kept as clean as possible during harvest. Periodically cleaning the machine reduces the amount of accumulated residues that can be ignited. CaseIH recommends cleaning the machine after shut down at the end of the day (Case IH, 2011). We recommend that during periods of high fire risk consider cleaning the combine more frequently. Some producers use compressed air, while others use portable gas powered leaf blowers to blast dust, chaff, and leaves from the machine at regular intervals, or when there is downtime from harvest.

Cleaning should be thorough and focus on areas that are subject to heat or ignition sources. High risk ignition zones include: the engine and engine compartment, the hydraulic pumps and pump drives, gear boxes, batteries, and cables. When cleaning, scan for problems of any kind that may require maintenance.

The nature of soybean harvest makes it difficult to completely eliminate all fuel sources. There will be dust and chaff that accumulate on machine surfaces between maintenance events. The synthetic materials in current combine designs will burn if ignited. Hydraulic oil finds its way out of fittings and creates oily films that dust and chaff stick to.

Fire prevention starts before harvest and should include a pre-harvest inspection and cleaning. Corn husks, silks, chaff, and straw should be cleared from the machine. When cleaning, check for leaky hydraulic fittings. While it is not practical to prevent 100% of hydraulic leaks, any fittings that show a pattern of leakage should be tightened, repaired, or replaced. The pre-harvest inspection should also include inspecting the combine's wiring harnesses.

The number of sensors, control valves, and electric actuators has increased on modern machines, and this complex system now reaches all parts of the combine. Look for places where wires are not adequately restrained, or where they might chafe from contact with moving parts. A short circuit of one or more of these wires can shut down the machine function when an ISOBUS message error occur, but it can also provide ignition of the wire insulation and the crop material around it. Repair and secure any wires that show motion wear or chaffing.

Pre-harvest checkout of the combine and daily service generally includes lubricating any bearings that have grease fittings. Another pre-harvest check should include inspecting bearings, where friction can easily cause the bearing to heat and ignite fires. The availability of low-cost infrared thermometers with laser pointers makes it possible to identify bearings that could be problematic during harvest. The combine can be operated empty for a period of time in the farmyard as a part of the pre-harvest inspection.

Warm up all of the mechanisms. Following this warm-up period, an infrared thermometer can be used to quickly check the temperature of many bearings on the machine by simply pointing the laser to the bearing area and reading the measured temperature. Bearings that register substantially hotter than others may indicate wear that suggest that failure is not far off. Replacing a bearing prior to harvest may not only prevent down time during harvest, but could prevent a catastrophic fire. These IR devices can be purchased for less than $50 and can be kept in the combine cab (Fig. 39.4).

Figure 39.4. An example of an inexpensive infrared thermometer. These devices have a laser pointer and can quickly perform non-contact measurements of surface temperatures of bearings and mechanical components. (Source: www.harborfreight.com)

Once harvest is underway, the relative temperature of bearings and mechanical parts can be checked when waiting for a truck or grain cart. The cost of this tool and the time taken to scan for hot spots are small compared to the costs that can result from a fire.

The engine exhaust system can also ignite crop residue. Temperatures of exhaust gases leaving the engine approach 1000°F. This means that the engine exhaust manifold

and the turbocharger operate at temperatures that can ignite dusts. It is also possible for fine dusts that come very close to these hot components to ignite in the air. Sparks or embers landing on surfaces with combustible materials can ignite a fire.

Some producers are using aftermarket circuits or "chips" to bypass the factory programs that govern fueling rates of electronically controlled engines. This is done to increase the power output of the engine and capacity of the combine. However, this process inevitably increases the fueling rate and the engine temperature. Components that were a potential ignition source can now become a more severe hazard. Producers should think very carefully before overriding the engine factory settings. While the engine may be capable of producing more power, its life is typically reduced, while the fire hazard is increased.

Putting out a fire

If you detect burning crop residue and find that part of the machine is on fire, what should you do? If the fire is a smoldering in a dust layer or pile, you may be able to extinguish it. Current recommendations call for two 10 lb ABC dry chemical fire extinguishers on the machine. One is stored in or near the cab, and one where it can be reached from the ground.

Better yet, install a 20 lb ABC dry chemical extinguisher where it can be accessed from the ground. In use, the acronym **PASS** is used to remember the procedure for these devices.

Pull the pin.
Aim the nozzle.
Squeeze the trigger.
Sweep across the base of the fire.

It is critical that these extinguishers be kept in good working order. They should be checked by a fire department or other agency qualified to determine that they are fully charged and ready. If an extinguisher is used, even briefly, it must be recharged. The dry chemicals passing through the valve are likely to prevent it from fully sealing and it may gradually lose pressure and effectiveness. Have it professionally serviced. Invert and shake the extinguisher canister once or twice during the harvest season to prevent machine vibration from consolidating the dry chemical at the bottom of the canister (Hanna, 2012).

Some producers prefer a water-charged extinguisher, a water jug, or even a water squirt bottle for smoldering fires in crop residue. The water is effective at putting these out without blasting loose smoldering residue to the surrounding areas. Water is not effective in controlling fires that have spread to hydraulic hoses or synthetic materials that are abundant on current model machines.

If the fire is more than a smolder, your first action should be to call for emergency assistance. If the fire has progressed beyond what can what can be controlled with the ABC extinguishers, get away from the machine and wait for help. The fire can progress very quickly and unpredictably. A half-full poly fuel tank heated by a fire will not explode like a scene from an action film, but the empty portion of it will soften when exposed to a fire and it may burst with enough violence to rapidly spread the fire. Climbing onto a burning machine in an attempt to put it out is not worth the risk of the loss of your life.

During times of high fire risk, it may be wise to position a tractor with a tillage implement where it can be readily accessed if a machine fire should ignite the crop. High winds associated with combine fires can also spread the fire to the crop and potentially the neighboring crops with catastrophic losses. Tilling a soil break around the original fire can contain it and minimize the loss.

Good machine maintenance, preparation, and vigilance can minimize the incidence of fires while harvesting soybeans. However, fires will still occur when conditions become extreme and some part of the machine provides the trigger. In all cases, make your safety your first priority. The machine and the crop are replaceable.

References and additional information

CaseIH. 2011. Axial-Flow 20 & 88 Series Combine Fire Prevention. CaseIH Maintenance and Support. CaseIH Corporation. July 21 2011. Accessed September, 2012. http://www.caseih.com/en_us/maintenance/pages/axial-flow-20-88-series-combine-fire-prevention-tips.aspx

Hanna, M. 2012. Field/Combine Fire Prevention. Iowa State University Extension and Outreach. Iowa State University. Accessed September, 2012. Available at http://www.extension.iastate.edu/guthrie/sites/www.extension.iastate.edu/files/guthrie/Preventing%20Field%20Fires%20Article.pdf

Polin, J. 2012a. 2012. Safety related ignition hazards during biorefinery processing of biomass and agricultural residues. 2012 ASABE Annual International Meeting, Hilton Anatole, Dallas, TX. 30 July 2012. Unpublished conference paper.

Polin, J. 2012b. 2012. Investigation of sunflower dust properties that contribute to combine fires. 2012 National Sunflower Association Research Forum, Fargo, ND. 11 January 2012. Unpublished conference paper.

Uilk, Nicholas. 2012. Combine fires under hot dry harvest conditions. ASABE Paper No. 121337049. 2012 Dallas, TX. July 29-August 1, 2012.

Acknowledgements

Funding for developing this chapter was provided by the South Dakota Soybean Research and Promotion Council, USDA-AFRI, and South Dakota 2010 research program.

Humburg, D. 2013. Preventing soybean combine fires. In Clay, D.E., C.G. Carlson, S.A. Clay, L. Wagner, D. Deneke, and C. Hay (eds). iGrow Soybeans: Best Management Practices for Soybean Production. South Dakota State University, SDSU Extension, Brookings, SD.