Chaff and Straw Spreader for a Plot Combine

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ABSTRACT

Uniform distribution of crop residue is critical in long-term no-till and conservation-till cropping systems experiments. Many farm-scale combines utilize factory or aftermarket chaff and straw spreaders, but most plot combines for research lack this capability. We fabricated a high volume air system to evenly distribute chaff and straw behind a plot combine. The combine engine powered a high-pressure radial blade blower fan to deliver air via a dual manifold through rubber flex hose to two distribution pipes mounted under the sieves. Visual comparisons from the harvest of several crop species demonstrated that chaff and straw were effectively spread with the attachment compared with checks. Total cost and time for fabrication and installation of the chaff and straw spreader attachment was $710 for materials and 15 h of labor.

Successful no-till and conservation-till cropping systems require uniform distribution of chaff and straw from the combine (Veseth et al., 1986). Uniform spreading of residue makes planting the next crop easier, reduces immobilization of nutrients during decomposition by microbes, increases the efficiency of herbicides, and reduces diseases (Cook and Veseth, 1991).

Commercially available plot combines are not equipped with chaff and straw spreaders, although some late-model machines do have straw choppers. Farm-scale combine chaff and straw spreaders are too large and heavy and have excessive power requirements so they cannot be retrofitted to a plot combine. In addition, plot combines (except for a few extremely large models that contain features of farm-scale machines) utilize a transverse rub bar cylinder/concave screen threshing system that lacks the straw grinding ability of rotary threshing systems common on modern farm-scale combines.

A plot combine is specifically useful to allow for accurate harvest of plot research compared with a farm-scale combine and weigh wagon even if plot lengths range from 75 to 150 m as they do in our long-term cropping systems experiments. Our objective was to design and build a chaff and straw spreader for a plot combine for harvesting several different crops.

FABRICATION AND INSTALLATION

An air delivery chaff and straw spreader with dual manifold distribution was fabricated for a Hege 140 plot combine (Hege Maschinen, Niederlassung, Germany). The Hege 140 reported here has a custom-built 1.5-m-wide cutting platform and standard 0.78-m-wide sieves. There is a large flat platform behind the engine and above the sieves that was used to mount a high-pressure radial blade blower fan (Dayton model #4C131A) (Fig. 1). The fan is powered by a belt drive from a 14-cm-diameter accessory pulley on the engine to a 20-cm-diameter pulley on the fan shaft. A slot was cut in the engine cover to align and install the belt between the engine and fan pulleys. A simple spring-loaded idler sheave was added to the belt drive assembly to maintain belt tension and minimize vibration.

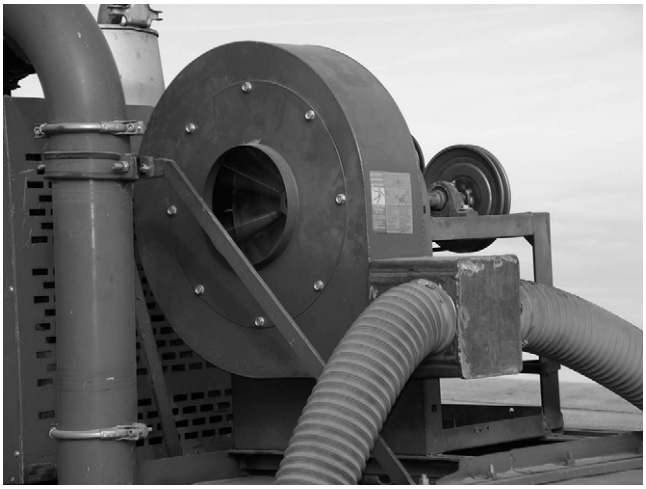

Fig. 1. Fan with attached dual outlet manifold and flexible ducting hose mounted behind the engine of a Hege 140 plot combine.

The fan wheel is 11 cm wide with a 34-cm diameter. With the 52-hp combine engine at full throttle driving the fan pulley at 2000 revolutions min^{-1}, the fan moves 30 m^3 of air min^{-1} at 248 Pa. A simple dual outlet manifold was constructed from 18 × 15 cm rectangular steel tubing, capped with flat plate, and ported with two 10-cm-diameter rings used to attach flex hose (Fig. 1) to provide air delivery along both sides of the combine.

A flexible 10-cm-diameter wire-wound rubber ducting hose was used to connect the fan manifold to the two distribution pipes. The distribution pipes were fabricated from 9-cm-diameter polyvinyl chloride (PVC) pipe with five 2.5-cm-diameter

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Abbreviations: PVC, polyvinyl chloride.

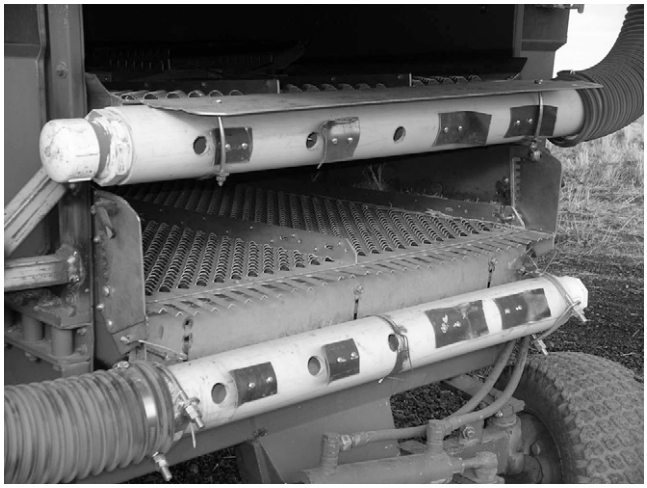

Fig. 2. Air distribution pipes with holes and deflectors mounted just below the upper and lower sieves.

holes drilled at 15-cm intervals. The distribution pipes were centered across the width of the upper and lower sieves (Fig. 2). Four PVC expansion rings were glued to one end of each distribution pipe for coupling the hoses. Small metal deflectors made out of scrap tin were attached with screws near the holes and bent to adjust the air velocity and direction. The distribution pipes were attached to the support structure underneath the sieves with U-clamps. The U-clamps provide a simple means of changing the angle of the air outlets relative to the residue flow from the back of the combine.

OPERATION

Once air velocity, distributor angles, and air deflectors are set, operation of the chaff and straw spreader does not require active operator control. The operator needs to carefully match the forward speed of the combine with the quantity of crop passing through the machine to ensure that neither the combine itself nor the spreader is overloaded with material. This in turn ensures that chaff and straw are evenly distributed across the entire width of the cutting platform (Fig. 3).

As our long-term cropping systems experiments range in size from 4 to 8 ha, the plot combine is only used to harvest a 1.5-m-wide strip through the center of each plot. We then use a farm-scale combine, with cutting bar operated slightly lower than that of the plot combine, to harvest remaining grain within each plot and further distribute chaff and straw. The chaff and straw spreader attachment on the plot combine has been successfully used to harvest wheat (*Triticum aestivum* L.), barley (*Hordeum vulgare* L.), triticale (×*Triticosecale* Wittmack), and canola (*Brassica napus* L.) in both rainfed and irrigated cropping systems experiments.

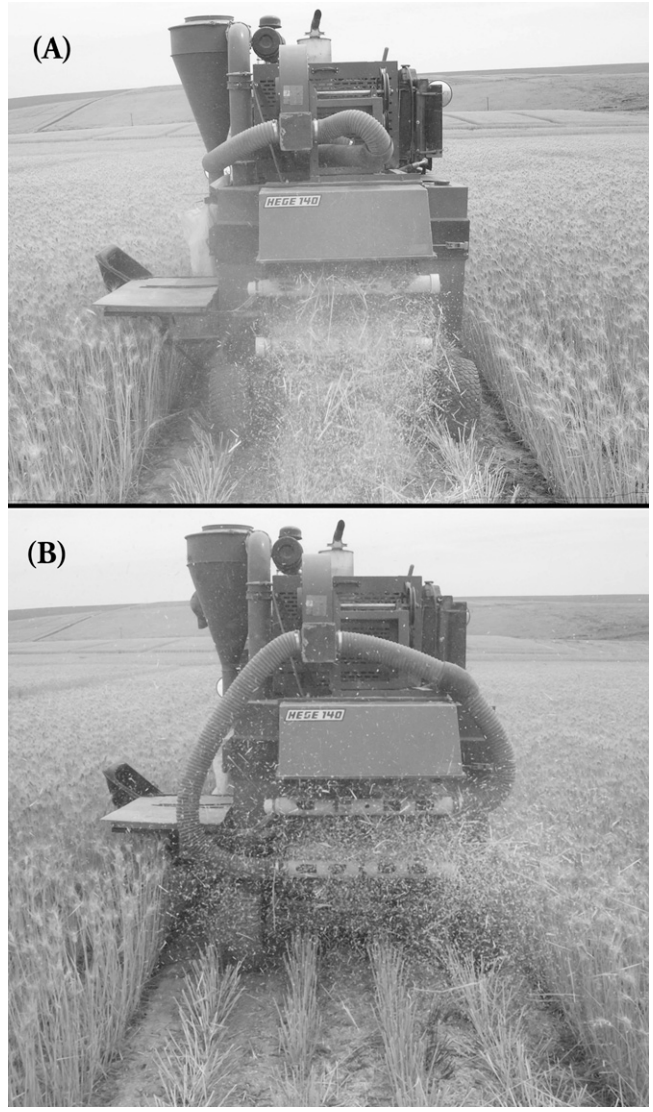

Fig. 3. Distribution of wheat residue behind a Hege 140 plot combine (A) without and (B) with the chaff and straw spreader attachment. The combine was operated at the same forward speed in both photos.

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