Research Focuses On Soybean Harvest Loss

Reducing Soybean Harvesting Losses

Harvesting losses of soybeans - normally amounting to nearly 10 percent of the crop–can be reduced substantially through improved combine design.

One innovation for improving efficiency of combines is an air-conveyor header developed by agricultural engineer W. Ralph Nave, in cooperation with colleagues of the Illinois Agricultural Experiment Station, Urbana. Mr. Nave, of USDA's Agricultural Research Service, installed air jets several inches ahead of a floating cutterbar to help insure a smooth flow of plant material and shattered beans over the cutterbar and onto an extended grain platform. In field tests, the combine modification reduced harvest loss to less than 3 percent of the yield when beans contained 12 percent moisture.

The engineering development may become one of few improvements in soybean harvesting since the 1920's. In 1927, an on-farm survey by researchers of the Illinois Station showed that harvest losses of soybeans in the State averaged 11.6 percent of the crop. In a 1968 survey of Illinois, Arkansas, and Mississippi farms, Mr. Nave and Illinois agricultural engineers found average losses were still high–9 2 percent.

Since soybeans became a major crop in the United States, the standard grain combine has been less than ideal for harvesting. Mr. Nave says, because soybeans are physically unlike small grains. Consequently design change is needed.

Design change, however, is not all that is needed to curtail harvest loss, Mr. Nave adds. In the 1968 survey he observed that some farmers lost up to 2 bushels of soybeans per acre because of improper adjustments of their combines.

Another major loss was soybeans left on the stubble. Harvest loss, Mr. Nave says, can sometimes be reduced by as much as 25 percent if a farmer has a floating cutterbar and watches his cutting height closely. But the survey showed that the biggest losses always occurred at the combine header.

To identify causes of combine header losses, Mr. Nave used several techniques. One was to film the action of header components--cutterbar, cross auger, and reel–with a high-speed movie camera mounted on the combine. In the movies, soybeans could be seen in slow motion, shattering, bouncing, and rolling toward the ground.

For field studies, he also built a pull-type framework containing header components. By removing parts of the apparatus, he could study losses caused by movement and vibration of the components.

Employing the experimental header on three varieties of soybeans grown in central Illinois, Mr. Nave cut the plants about 3½ inches above the ground and found that the cutterbar was accountable for about 81 percent of the header loss. The reel and cross auger accounted for 6 and 13 percent, respectively.

Based on this informaiton, Mr. Nave built a header test stand in the laboratory and tested the theory of using compressed air to prevent shattered beans from landing on the ground. With the indoor arrangement, he was not dependent upon weather and had control of variable conditions of significance to the study.

Plant material was stored, until use, under controlled humidity and temperature. Soybean stalks, with their bases clamped between two boards, could be conveyed to the operating header assembly at simulated ground speeds of combines.

The most practical and effective use of compressed air proved to be directing air at a velocity of 2,500 feet per minute toward the cutterbar from nozzles positioned 15 inches apart and 6 inches in front of the cutterbar, Mr. Nave said.

Harvest losses were reduced significantly only when beans were dry enough to harvest without need for artificial drying. When the laboratory unit was equipped with air jets and a standard cutterbar, header loss of beans containing 13 percent moisture was reduced to 25 percent of the loss observed without air jets. Air jets and a floating cutterbar, together reduced loss by 45 percent.

One season's results of field testing in 30-inch soybean rows have compared closely with laboratory data, Mr. Nave said.

In harvesting narrower (8-inch) rows, Mr. Nave and ARS agronomist Richard L. Cooper are finding that even more shattered soybeans can be saved by the air jets. Plants in the narrow rows were more evenly spaced than those in wide rows, allowing the air stream to work more smoothly.

In harvesting plots of soybeans in narrow rows, the scientists noted that skid pads on the floating cutterbar do not ride a definite row of stubble as they do on both cultivated and non-cultivated wider rows. Accordingly, the stubble is cut closer to the ground, saving some beans.

Unfortunately, soybeans planted in low population and narrow rows tend to set pods close to the ground, and the cutterbar sickle cuts through many of these pods, causing shatter loss. Combine headers equipped with air jets may help provide a solution to the problem.