Grain Harvesting Losses In North Dakota

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Grain harvesting equipment inevitably produces some loss because of varied harvesting conditions and incorrect adjustment and operation of the harvesting equipment. A grain combine operator should strive to minimize losses through proper machine operation, which will help maximize profits.

In this study, loss determinations made on 50 grain combines randomly field selected provide an estimate of how much harvesting losses are presently being incurred by North Dakota grain producers on four major small grains: hard red spring wheat, durum, barley and oats.

Methods

Samples of the material thrown from the straw walkers and shoe were collected by placing a 3' x 6' collection frame below the moving combine as it was harvesting. Samples were taken more than 300 feet from the edge of the field to minimize edge effects, and in areas where the slope was small.

Grain found in the material on the frame after the combine passed over it was evaluated and labeled as cylinder and separation losses. These losses were due primarily to incorrect cylinder speed, improper cylinder-concave setting and incomplete separation on the straw walkers and in shoe area.

Grain kernels and heads on the ground below the collection frame also were collected and evaluated. These losses were attributed to platform or front end losses and natural losses. Wind and other natural elements were principal causes of the natural losses.

In evaluating each of the samples collected, the number of kernels was determined and converted to a loss in terms of bushels per acre (bu/ac). Conversion factors needed in evaluating bushel per acre loss, listed in Table 1, were determined through area relationships and grain quality data for the 1973 harvesting season (4, 6).

Table 1. Number of kernels per square foot equaling one bushel per acre loss.

Grain	Number of Kernels
Hard Red Spring Wheat	19.8
Durum	15.6
Barley	14.3
Oats	10.3

When collecting the samples, the machine ground speed and moisture content of the grain also were determined and recorded. Ground speed was obtained by converting the time required for the combine to travel 100 feet into miles per hour. An electronic moisture meter was used to evaluate the moisture content of the grain harvested. Data collected from the machine operator or grain producer included crop variety, estimated yield, header or swather width and machine age.

Results

Average results from evaluating 50 combines are listed in Table 2. Other information included in this table are the number of combines tested in each crop plus standard deviation and range of loss values.

Average losses were slightly over 1 bu/ac, except for barley, which was 1.79 bu/ac. A question may be asked, "are these levels of harvesting losses excessive?" Dodds, who has done extensive work analyzing and studying harvesting losses, indicated total losses should not exceed 1.3 bu/ac (5). Based on this value, some of the machines were operating with excessive loss levels, especially with barley. Some (38 per cent) of the machines in all crops were operating beyond this level.

For some indication where the losses are occurring, table and natural losses and cylinder and separation losses were analyzed. Dodds indicated the cylinder and separation losses should not exceed 0.5 bu/ac (5). The average for hard red spring wheat and durum were within this range, but 42 per cent of all the harvesters exceeded this loss level. All but one combine in barley exceeded this level. For the front end and natural losses, Dodds indicated these losses should be less than 0.80 bu/ac, which includes losses for the cutter bar and reel of the swather and losses for the pickup on the harvester (5). Again 42 per cent of the combines tested exceeded this level, but were not necessarily the same units that exceeded separation and cylinder losses. None of the combines harvesting oats exceeded this loss level. With barley, all but two combines exceeded these loss levels. The barley losses were much higher than the loss levels suggested by Dodds, but reviewing field tests completed by the Agricultural Development and Advisory Service (ADAS) personnel in England, the North Dakota results for barley were comparable. The ADAS reported front end loss for barley averaged 1.98 bu/ac and threshing losses averaged 0.99 bu/ac (1). These values are higher

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Table 2. Average Loss Results

	Hard Red Spring Wheat	Durum	Barley	Oats
Number of combines evaluated	21	10	11	8
Table and				
Natural Loss (bu/ac)	0.70	0.66	1.13	0.54
Range	0.21-1.42	0.06-1.57	0.56-2.04	0.25-0.80
Standard Deviation	0.32	0.56	0.43	0.21
Cylinder and				
Separation Loss (bu/ac)	0.37	0.39	0.66	0.60
Range	0.14-1.02	0.24-0.80	0.43-0.94	0.25-0.92
Standard Deviation	0.28	0.16	0.14	0.27
Total Loss (bu/ac)	1.07	1.05	1.79	1.14
Range	0.35-1.80	0.45-2.18	1.23-2.60	0.54-1.70
Standard Deviation	0.40	0.64	0.45	0.35

than results reported in the North Dakota tests listed in Table 2.

Results of investigation into some of the other conditions existing at harvesting time were included here to determine a correlation between loss and grain moisture content, estimated grain yield and combine ground speed. Moisture content of the grains are listed in Table 3. Through a statistical study using analysis of variance, moisture content was found to have a significant effect on the harvest losses. Of course, moisture content was expected to be an important factor, but despite our small range, the moisture content was significant.

Table 3. Moistures Content of Grain

Grain	Average	Range
Hard Red Spring Wheat	12.60	11.8 - 13.2
Durum	13.24	12.5 - 14.1
Barley	13.38	12.4 - 14.4
Oats	10.75	10.0 - 11.5

The effect of speed was analyzed in a similar manner. Harvesting losses were independent of the ground speed of the combine. Here the range of speeds must be taken into consideration, since excessive speeds certainly result in higher loss. Average speed of all 50 combines tested was 2.66 mph (miles per hour), and ranged from 1.20 to 3.80 mph. Speeds most often recommended are 4 miles per hour (5). All machines were operating below this range. Apparently, many operators could actually increase the forward ground speed without increasing losses significantly. The relation between the estimated yield and losses was not significant, based on the statistical analysis.

If these average loss values are used, an estimation of the total harvesting losses may be made for the state based on production information. Based on the 1973 North Dakota Crop and Livestock Statistics Annual Report and results of these tests, estimated losses are 8 million bushels of hard red spring wheat, 3 million bushels of durum, 6 million bushels of barley and 1.7 million bushels of oats in North Dakota for the 1973 harvesting season (2). Harvesting losses cannot be reduced to zero, but these losses may be reduced significantly through proper machine adjustment and operation.

Conclusions

Average losses for hard red spring wheat, durum and oats were slightly more than 1 bu/ac. Average barley loss was 1.79 bu/ac, which appeared to be excessive. Many of the grain combines in North Dakota were operating with excessive losses. Ground speeds of some combines could be increased, since the data analysis indicated speed in the ranges studied had no effect on loss and many machines were traveling at speeds well below the maximum recommended speed of 4 mph. Moisture content of the grain had a significant effect on the losses and should be observed closely.

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