

CORN AND SOYBEAN HARVESTING LOSSES

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SUMMARY:

This paper summarizes a study of corn and soybean field harvest losses for the Fall of 1989. Farmers had a visible corn loss of approximately 1% of estimated yield per acre and a visible soybean loss of approximately 4% of estimated yield per acre. This is much lower than previous research shows. There is however the potential for reducing these losses to less than 1 bushel per acre with current harvesting machine technology.

KEYWORDS:

machinery, machinery management, harvesting machinery, farm management

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INTRODUCTION

In today's competitive agricultural economy, all possibilities for income enhancement need to be studied and evaluated as to the potential they offer for increased net farm income. New markets, marketing strategies, packaging, crops, production practices, and a reevaluation of current practices, etc. all need to be studied as to the impact they might have on enhancing net farm income. Better utilization of existing harvesting technology is one area that needs to be studied, and offers the potential for enhancing income through both increasing gross income and reducing costs. Increasing tank yields (reducing grain losses) and maintaining grain quality are two important areas within today's harvesting technology that need to be studied as to the potential they offer for income enhancement. Past research shows visible harvest losses to be approximately 8% of yield for corn and 10% of yield for soybeans. Substantial realization of lower harvest losses would assist farmers to become lower cost producers, improve profitability, and gain competitive advantages. Being the low cost producers of quality products is a proven strategy for developing new markets and expanding existing markets.

OBJECTIVE

The objective of this study was to measure combine field harvesting losses for corn and soybeans from both a quantity and quality standpoint. Specific objectives were as follows:

1. Measure corn and soybean field harvest losses from both a quantity and quality standpoint.
2. Determine corn and soybean harvesting machine demographics.
3. Study the relationship between selected combine, operator, and field condition variables and harvest losses.

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PROCEDURES

Fifteen teachers of vocational agriculture were selected to serve as data collectors with thirteen participating in the study. Information sheets (one for corn and one for soybeans) were developed by the authors for data collection and reporting. An evening workshop with the teachers was held by the researcher to go over the information sheets, discuss the procedures to be followed during data collection, and answer any questions the teachers had regarding the research effort. The teachers were given the following general instructions:

1. Accuracy and attention to detail were paramount.
2. Sampling should represent a cross section of farmers and not be just good, average, or poor farmers.
3. Two repetitions from different areas of the field and at least 300 feet from the end of the field should be taken on all machine and field condition variables requiring measurements.
4. Grain samples should be taken from the combine grain tank at a location farthest from the grain entry point.
5. Grain samples should be placed in a plastic bag, stored in a refrigerator if stored for over two hours, and taken to the local elevator for quality analysis.
6. Lodging was identified as any plants broken off that contained seed or any plants broken or leaning over with seed that was 45 degrees or less with the ground.
7. Data collection procedures which were developed by Delbert (Bud) Byg were to be used to determine visible corn and soybean harvest losses.

The researcher conducted spot checks on three teachers to observe any errors or problems in data collection procedures.

RESULTS

The results of this survey are based upon 122 combines. Fifty-three of the combines were operating in corn and sixty-nine were operating in soybeans. For corn, the combines were used on an average of 509 acres with a range of from 38 to 5400 acres. For soybeans, the combines were used on an average of 527 acres with a range of from 40 to 4500 acres.

Tables 1 and 2 show total machine loss for corn and soybeans. An average of 1.5 bushels per acre visible loss was found in corn with a range of from zero to 5 bushels per acre loss. In soybeans, the average visible loss was 1.4 bushels per acre with a range of from 0.2 to 4.1 bushels per acre loss. Approximately 40% of the corn combines had 1 bushel or less visible loss per acre, and approximately 41% of the soybean combines had 1 bushel or less visible loss per acre.

Table 1. TOTAL MACHINE VISIBLE LOSS, CORN

Loss, Bu	Number	Cum. Percent
≤0.5	6	14.0
0.51-1.0	11	39.5
1.1-1.5	8	58.1
1.51-2.0	6	72.1
2.1-2.5	4	81.4
2.51-3.0	4	90.7
>3.0	4	100.0

Mean = 1.5 Md. = 1.3 Mode = 1.5 S.D. = 1.1 Range = 0.1-5.0

Table 2. TOTAL MACHINE VISIBLE LOSS, SOYBEANS

Crop Loss, Bu	Number	Cum. Percent
≤0.5	6	8.8
.51-1.0	22	41.2
1.1-1.5	14	61.8
1.51-2.0	13	80.9
2.1-2.5	3	85.3
2.51-3.0	6	94.1
>3.0	4	100.0

Mean = 1.4 Md. = 1.3 Mode = 0.5 S.D. = 0.85 Range = 0.2-4.1

As shown in Tables 3 and 4, the average moisture content for corn was 21.7% with a range of from 12.6 to 30.0 percent, and for soybeans the average moisture content was 13.2% with a range of from 9.7 to 19.6 percent.

Table 3. MOISTURE PERCENT, CORN

Moisture, %	Number	Cum. Percent
≤15.0	1	2.0
15.1-20.0	14	30.0
20.1-25.0	26	82.0
25.1-30.0	9	100.0

Mean = 21.7 Md. = 21.0 Mode = 21 S.D. = 3.2 Range = 12.6-30.0

Table 4. MOISTURE PERCENT, SOYBEANS

Moisture, %	Number	Cum. Percent
<12	8	11.6
12.0-13	35	62.3
13.1-14	8	73.9
14.1-15	10	88.4
>15	8	100.0

Mean = 13.2 Md. = 13.0 Mode = 13.0 S.D. = 1.5 Range = 9.7-19.6

Tables 5 and 6 show the test weights for corn and soybeans. An average of 54.6 pounds for corn and 56.8 pounds for soybeans are on the low side. This is most likely the result of late planting dates due to a very wet Spring in 1989.

Table 5. TEST WEIGHT, CORN

Weight, lbs	Number	Cum. Percent
≤ 50.0	2	4.0
50.1-52.0	6	16.0
52.1-54.0	11	38.0
54.1-56.0	21	80.0
56.1-58.0	7	94.0
58.1-60.0	3	100.0

Mean = 54.6 Md. = 55 Mode = 54 S.D. = 2.3 Range = 49.2-58.8

Table 6. TEST WEIGHT, SOYBEANS

Weight, lbs	Number	Cum. Percent
≤ 55.0	6	9.1
55.1-56.0	19	37.9
56.1-57.0	22	71.2
57.1-58.0	8	83.3
58.1-59.0	6	92.4
59.1-60.0	5	100.0

Mean = 56.8 Md. = 56.6 Mode = 56.0 S.D. = 1.5 Range = 54.0-60.0

Table 7 shows the average BCFM in corn was 1% with a range of from 0.0 to 9.8 percent. Approximately 81% of the corn sampled had 1.0% or less BCFM.

Table 7. BCFM, CORN

BCFM, %	Number	Cum. Percent
≤1.0	29	80.6
1.1-2.0	1	83.3
2.1-3.0	1	86.1
3.1-4.0	1	88.9
4.1-5.0	1	91.7
>5.0	3	100.0

Mean = 1.0 Md. = 0.0 Mode = 0.0 S.D. = 2.4 Range = 0.0-9.8

As shown in Table 8, the spits and cracks in soybeans averaged 1.4% with a range of from 0.0 to 11.0 percent. Approximately 58 % of the soybeans sampled had 1% or less splits and cracks.

Table 8. SPLITS & CRACKS, SOYBEANS

Splits & Cracks, %	Number	Cum. Percent
≤ 1.0	35	58.3
1.1-2.0	8	71.7
2.1-3.0	5	80.0
3.1-4.0	8	93.3
4.1-5.0	3	98.3
>5.0	1	100.0

Mean = 1.4 Md. = 0.9 Mode = 0.0 S.D. = 1.9 Range = 0.0-11.0

Tables 9 and 10 show the dockage in dollars per bushel that could be expected from the corn and soybean samples as determined by local elevators. The average dockage for quality in corn was 19 cents per bushel with the majority of that due to excess moisture and the average dockage for quality in soybeans was 1 cent per bushel. Dockage ranged from zero to 49 cents per bushel for poor corn quality and 0 to 11 cents for poor soybean quality.

Table 9. DOCKAGE - \$/BU, CORN

Dockage, \$/bu	Number	Cum. Percent
< .10	14	32.6
.11-.20	8	51.2
.21-.30	11	76.7
.31-.40	8	95.3
.41-.50	2	100.0
Mean = 0.19 Md. = 0.19 Mode = 0.00 S.D. = 0.13 Range = 0.00-0.49		

Table 10. DOCKAGE - \$/BU, SOYBEANS

Dockage, \$/bu	Number	Cum. Percent
< .05	53	89.8
>.05	6	100.0
Mean = 0.01 Md. = 0.00 Mode = 0.00 S.D. = 0.03 Range = 0.00-0.11		

As shown in Tables 11 and 12, the average combine speed, determined over a measured distance, was 2.8 miles per hour in corn with a range of from 1.3 to 4.4 miles per hour, and in soybeans the average speed was 3.2 miles per hour with a range of from 2.0 to 5.6 miles per hour.

Table 11. COMBINE TRAVEL SPEED, CORN

Speed, MPH	Number	Cum. Percent
1.0-2.0	4	7.7
2.1-3.0	28	61.5
3.1-4.0	17	94.2
>4.0	3	100.0
Mean = 2.8 Md. = 2.9 Mode = 2.8 S.D. = 0.6 Range = 1.3-4.4		

Table 12. COMBINE TRAVEL SPEED, SOYBEANS

Speed, MPH	Number	Cum. Percent
1.0-2.0	2	2.9
2.1-3.0	26	41.2
3.1-4.0	34	91.2
4.1-5.0	3	95.6
>5.0	3	100.0

Mean = 3.2 Md. = 3.1 Mode = 3.5 S.D. = 0.8 Range = 2.0-5.6

Tables 13 and 14 show the make of the machines checked in the survey. Approximately 50% of the machines were John Deere with the remainder being about equally split between Case-IH, Gleaner, and Massey Ferguson.

Table 13. MAKE OF MACHINE, CORN

Make	Number	Percent
John Deere	29	54.7
Case-IH	7	13.2
Gleaner	7	13.2
Massey Ferguson	9	17.0
New Holland	1	1.9

Table 14. MAKE OF MACHINE, SOYBEANS

Make	Number	Percent
John Deere	34	49.3
Case-IH	10	14.5
Gleaner	12	17.4
Massey Ferguson	8	11.6
New Holland	2	2.9
White	2	2.9
Claas	1	1.4

Tables 15 and 16 show the machine year of manufacture, and Tables 17 and 18 show the total machine meter hours for the machines sampled. Approximately 68% of the machines operating in corn were ten years or older in age and 61% of the machines operating in soybeans were ten years old or older. The average operating age for corn combines was 1904 meter hours with a range of from 52 to 5200 hours. Approximately 45% of the machines had over 2000 meter hours of use. The average operating age for soybean combines was 1658 meter hours with a range of from 15 to 5000 hours. Approximately 34% of these machines had over 2000 meter hours of use.

Table 15. MACHINE YEAR OF MANUFACTURE, CORN

Year	Number	Cum. Percent
≤1970	4	7.5
1971-75	7	20.8
1976-80	25	67.9
1981-85	9	84.9
>1985	8	100.0

Mean = 78.7 Md. = 78 Mode = 78 S.D. = 5.9 Range = 1965-1989

Table 16. MACHINE YEAR OF MANUFACTURE, SOYBEANS

Year	Number	Cum. Percent
≤1970	5	7.5
1971-75	8	19.4
1976-80	28	61.2
1981-85	14	82.1
>1985	12	100.0

Mean = 79.5 Md. = 79 Mode = 78 S.D. = 6.0 Range = 1962-1989

Table 17. COMBINE METER HOURS, CORN

Hours	Number	Cum. Percent
<500	8	17.0
500-1000	4	25.5
1001-1500	7	40.4
1501-2000	7	55.3
2001-2500	7	70.2
2501-3000	5	80.9
3001-3500	5	91.5
3501-4000	2	95.7
4001-4500	1	97.9
>4500	1	100.0

Mean = 1904.2 Md. = 1800 Mode = 1800 S.D. = 1182.8 Range = 52-5200

Table 18. COMBINE METER HOURS, SOYBEANS

Hours	Number	Cum. Percent
<500	9	14.8
500-1000	7	26.2
1001-1500	12	45.9
1501-2000	12	65.6
2001-2500	12	85.2
2501-3000	4	91.8
3001-3500	2	95.1
3501-4000	1	96.7
>4000	2	100.0

Mean = 1658 Md. = 1750 Mode = 1200 S.D. = 1014.3 Range = 15-5000

Tables 19 and 20 show the condition of the machines as determined by a quick visual appraisal. As shown, approximately 85% of the machines were classified as in good or excellent condition.

Table 19. MACHINE CONDITION, CORN

Condition	Number	Percent
Excellent	19	41.3
Good	20	43.5
Average	6	13.0
Fair	1	2.2

Table 20. MACHINE CONDITION, SOYBEANS

Condition	Number	Percent
Excellent	25	36.8
Good	33	48.5
Average	8	11.8
Fair	2	2.9

Table 21 shows the combine features found on the machines checked. Only 21% of the combines operating in corn had grain loss monitors and only 25% of those operating in soybeans had grain loss monitors. Forty-two percent of the soybean combines had a quikcut cutterbar. Almost all soybean combines had a floating head, flexible cutterbar, and adjustable reel.

Table 21. COMBINE FEATURES

Feature	Number of Combines	Percent
Combines in Corn:		
Adjustable Feeder Speed	42	79.2
Grain Loss Monitor	11	20.8
Combines in Soybeans:		
Floating Head	64	92.8
Flexible Cutter Bar	58	84.1
Quikcut Cutterbar	29	42.0
Adjustable Reel	66	95.7
Grain Loss Monitor	17	24.6

Tables 22 and 23 show the lodging percentages found in the corn and soybean fields in which the machines surveyed were operating. An average of approximately 2% lodging was found in corn and 4% lodging was found in soybeans with ranges of from zero to 14% lodging in corn and zero to 80% lodging found in soybeans. Approximately 93% of the corn had 5% lodging or less and 85% of the soybeans had 5% lodging or less.

Table 22. **LODGING, CORN**

Lodging, %	Number	Cum. Percent
<1.0	34	64.2
1.0-2.0	6	75.5
2.1-3.0	4	83.0
3.1-4.0	3	88.7
4.1-5.0	2	92.5
5.1-6.0	1	94.3
>6.0	3	100.0

Mean = 1.6 Md. = 0.7 Mode = 0.0 S.D. = 2.6 Range = 0.0-13.5

Table 23. **LODGING, SOYBEANS**

Lodging, %	Number	Cum. Percent
<1.0	30	44.1
1.0-2.0	15	66.2
2.1-3.0	6	75.0
3.1-4.0	3	79.4
4.1-5.0	4	85.3
>5.0	10	100.0

Mean = 3.8 Md. = 1.3 Mode = 0 S.D. = 10.4 Range = 0-80.0

Tables 24 and 25 show a general visual classification of the weed pressure found in the corn and soybean fields checked. The majority of the fields showed few to no weed problems at harvest.

Table 24. WEED CONDITIONS, CORN

Weeds	Number	Percent
None	37	71.2
Few	15	28.8

Table 25. WEED CONDITIONS, SOYBEANS

Weeds	Number	Percent
None	31	47.7
Few	27	41.5
Several	5	7.7
Heavy	2	3.1

Tables 26 and 27 show operator age and Tables 28 and 29 show operator self-reported ability in combine operation. Farmers had an average age in the middle to late forties with a range of from 16-83 years of age, and rated themselves as good or excellent combine operators.

Table 26. OPERATOR AGE, CORN

Age, Years	Number	Cum. Percent
<20	3	5.7
21-30	6	17.0
31-40	9	34.0
41-50	11	54.7
51-60	13	79.2
61-70	6	90.6
>70	5	100.0

Mean = 47.3 Md. = 46 Mode = 45 S.D. = 16.1 Range = 16-83

Table 27. OPERATOR AGE, SOYBEANS

Age, Years	Number	Cum. Percent
<20	3	4.4
21-30	5	11.8
31-40	19	39.7
41-50	22	72.1
51-60	10	86.8
61-70	5	94.1
>70	4	100.0

Mean = 44.3 Md. = 42 Mode = 41 S.D. = 13.8 Range = 16-83

Table 28. OPERATOR SELF-REPORTED ABILITY, CORN

Ability	Number	Percent
Excellent	20	40.0
Good	24	48.0
Average	6	12.0

Table 29. OPERATOR SELF-REPORTED ABILITY, SOYBEANS

Ability	Number	Percent
Excellent	24	36.4
Good	36	52.2
Average	6	8.7

CONCLUSIONS

The Fall of 1989, was excellent for harvesting corn and soybeans in that there was not much rain, lots of sunshine, and generally higher than normal temperatures. Thus one might expect to find less than normal harvesting losses. Based upon the analysis of data collected from the 1989 harvest season, the following conclusions are presented:

1. Farmers are doing a better job of combine harvesting than past research indicates. An average visible loss in corn of 1.5 bushels per acre is approximately 1% of estimated yield, and an average visible loss in soybeans of 1.4 bushels per acre is approximately 4% of estimated yield.

2. Farmers can do a better job of harvesting. A visible harvest loss goal of 1% or less of corn yield and 3% or less of soybean yield is readily possible with lodging of 10% or less and little to no weed pressure.
3. The quality of grain collected from the combines was acceptable.
4. There was no practical significance between operator, machine, nor field condition variables and visible harvest loss or grain quality.
5. Combines are being operated well beyond the assumed useful life of 2000 meter hours. Forty-five percent of the corn combines and thirty-six percent of the soybean combines had over 2000 meter hours.

In summary, the individual farmer is the most important element in the reduction of harvest losses. He or she must know what their losses are, they must know what is an acceptable loss, and they must know how to adjust their machine to bring losses to within acceptable limits. Doing so can provide big dividends and oftentimes can be the difference between profit and loss. If Ohio's farmers would decrease visible harvest losses from an average of 1.5 bushels per acre for corn and 1.4 bushels per acre for soybeans to 1 bushel per acre or less, as approximately 40% of the sampled farmers were currently doing, the potential for income enhancement is easily over \$10 million for Ohio's farm producers without additional expenditures or the implementation of new and different management schemes or techniques.

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