12 – Maintaining Yield and Grain Quality

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Harvesting

Harvest management preserves rice quality and yield that contribute directly to profit. Timing field draining and harvest are keys to high head rice yields. Refer to "Water Management" section to improve drain timing in preparation for harvest.

General Rule: For good head rice yields, avoid extremely early- or late-season seeding. Apply nitrogen at recommended rates and distribute it uniformly.

Other harvesting factors that affect head rice yield include grain moisture content, field rewetting of grain, severe threshing impacts and excessive foreign matter (trash) in rice.

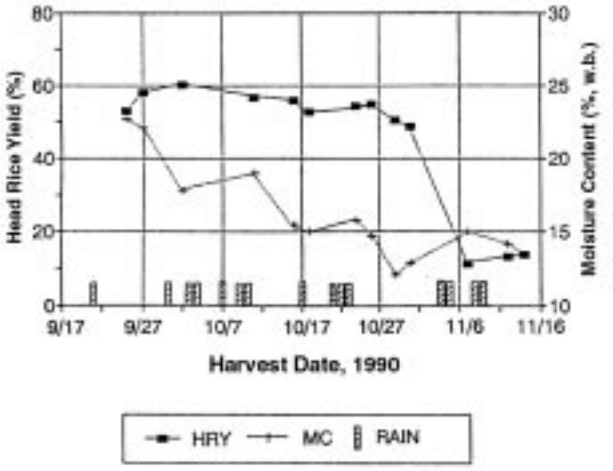

Figure 12-1. Effect of harvest timing and rainfall on Lemont head rice yields.

Grain Moisture

Rice quality may be lower if rice is harvested either at high or low moisture contents. The ends of wet rice kernels grind off and become dust as they are processed. Rice may crack if it dries to below 15 percent moisture content. Rapid rewetting, once rice reaches 15 percent or less moisture content, is a key cause for lowered head rice yields. Certain varieties, such as LaGrue and Jefferson, may be more susceptible to head rice reductions than a variety like Cypress if rice drops below 15 percent moisture and is rewetted (rainfall) in the field.

Plant no more rice acreage of one maturity range than you have harvest capacity. The best way to extend combine capacity is by planting varieties with different maturities. Planting over a longer period than you plan to combine rice helps somewhat to spread rice maturity across more days in the fall.

General Rule: The recommended harvest range to avoid quality or yield reductions is 17 to 21 percent moisture. Plan combine capacity to be able to complete harvest by the time rice reaches 16 percent.

Head Rice Yield

Head rice yield is the weight percentage of rough rice that remains as whole rice (three-fourths kernel or greater) after complete milling. Environmental conditions, such as drought, low sunlight intensity, disease, inadequate or excessive nitrogen and draining water early in hot weather, all intensify stress on rice kernels. The tendency of kernels to break under stress differs somewhat among varieties.

Milling yield is the weight percentage of rough rice that remains as milled rice; i.e., the sum of head rice and "brokens." The value of broken fractions varies with market demand, but Table 12-1 illustrates that high milling yield and low foreign material content may provide $30 to $45 more income per acre.

General Rule: One percentage point reduction in head rice costs up to 2 1/2 cents per bushel. One percentage point reduction in broken rice costs about 1 3/4 cents per bushel.

Table 12-1. Example of Foreign Material and Low Milling Yield Effects on Rice Price and Net Profit

Description	Sample 1	Sample 2
Sample weight, grams	162	162
Foreign material, grams	0	10
Head rice weight, grams	94	88
Brokens weight, grams	19	18
Milling yield percentage	58/70	54/65
Value per hundredweight[1]	$6.85	$6.37
Difference in price/cwt	$ 0.48	
Value difference at 124 bu/A	$26.78	
Value difference at 190 bu/A	$41.04	

[1]Prices based on long grain loan value of $10.71/cwt. for whole kernel and $5.35/cwt. for brokens.

Foreign Matter

Trash (blanks, stems, weed seed, etc.) often contains more moisture than the grain. Milling yield is lowered by the amount of foreign material in the rough rice sample. Foreign material contributes to heating on trucks and "fines" block air flow in bins. Consider cleaning rice that has high foreign material content. Another alternative is marketing rice with high foreign material content separate from cleaner rice to maximize income.

Rice Grades

Rice grades are U.S. No. 1 through 6 and sample grade, based on quality discount factors. These include weed seed, red rice, seed mixture, damaged kernels, chalky kernels, etc., shown in Table 12-2. Price discounts for milled rice in Table 12-3 are a general guide.

Table 12-3. Price Discount Estimates for USDA Grades of Milled Rice

Grade	$/bushel
1	—
2	.05
3	.15
4	.30
5	.45
6	.80
Sample	1.25

Table 12-2. Grades and Grade Requirements for the Classes of Rough Rice, USDA, 1996

Grade	Maximum limits of							Color requirements
	Seeds and heat-damaged kernels			Red rice and damaged kernels (singly or combined)	Chalky kernels			
	Total (singly or combined) Number in 500 grams	Heat-damaged kernels and objectionable seeds Number in 500 grams	Heat-damaged kernels Number in 500 grams	Percent	In long grain rice Percent	In medium or short grain rice Percent	Other types[1] Percent	
U.S. No. 1	4	3	1	0.5	1.0	2.0	1.0	Shall be white or creamy.
U.S. No. 2	7	5	2	1.5	2.0	4.0	2.0	May be slightly gray.
U.S. No. 3	10	8	5	2.5	4.0	6.0	3.0	May be light gray.
U.S. No. 4	27	22	15	4.0	6.0	8.0	5.0	May be gray or slightly rosy.
U.S. No. 5	37	32	25	6.0	10.0	10.0	10.0	May be dark gray or rosy.
U.S. No. 6	75	75	75	15.0[2]	15.0	15.0	10.0	May be dark gray or rosy.

U.S. Sample grade shall be rough rice which:

(a) Does not meet the requirements for any of the grades from U.S. No. 1 to U.S. No. 6, inclusive; or

(b) Contains more than 14.0 percent of moisture; or

(c) Is musty, or sour, or heating; or

(d) Has any commercially objectionable foreign odor; or

(e) Is otherwise of distinctly low quality.

[1]These limits do not apply to the class Mixed Rough Rice.

[2]Rice in grade U.S. No. 6 shall contain not more than 6.0 percent of damaged kernels.

Rice Stripper Headers

Stripper headers have flexible "fingers" that detach kernels by flailing through standing rice. Eight rows of fingers are fastened to a rotating cylinder. Rice panicles are combed through large, keyhole-shaped openings, leaving the rice plant nearly intact while the grain flips into the header.

The stripper header cannot harvest soybeans. For soybeans, a flexible cutterbar is an excellent supplement to a stripper. Growers report that a rigid cutterbar is not needed unless one cuts grain sorghum.

Stripper Operation

Skill is important with this new technology. Operating the header too low gathers unnecessary leaf foliage. A high setting misses low heads, rapidly increasing gathering loss. Trim both sides of the levee first to gather low heads of rice. An expert operator develops a "feel" for setting rotor height to avoid bumping the levee.

The ease of grain detachment and the height of rice heads determine adjustments. Earlier morning and later evening operation are possible because little leaf or stalk enters the combine. Combine capacity increases, especially when stalks are moist or where rice has blown down recently.

Stripper Adjustments

Combine settings vary from those recommended with a cutterbar. The thresher/concave gap is less, making these components' condition vital. Worn or damaged components or skewed concaves should be corrected. To handle more rice, open sieves a bit wider and increase fan speed to increase airflow. In addition, check for good airflow distribution across the sieves.

Do not fail to obtain a separation loss monitor; mount the sensor in the shoe discharge, and keep it calibrated. Overspeeding a stripper/combine rapidly increases separation losses (Figure 12-2).

Start with a rotor speed between 400-600 rpm (slower than wheat) and "fine tune" for conditions. To extend the life of the stripping fingers, select a rotor speed that is just aggressive enough to remove all the kernels. Excessive speed adds flag leaves to the grain; inadequate speed leaves rice in the field. Losses increase as fingers wear. Threshing rice from the stalk requires excessive rotor speed if worn fingers are not replaced.

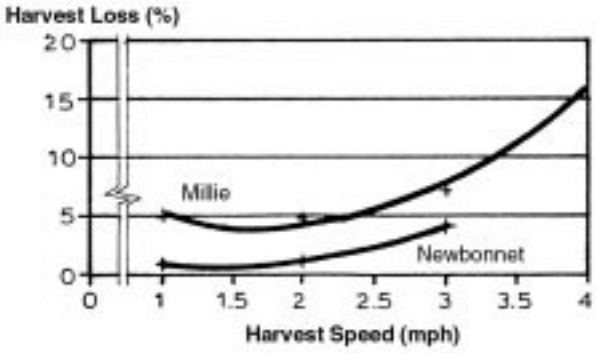

Figure 12-2. Shelbourne Reynolds Stripper field losses above those of a 1680 Case IH operated at 3/4 to 1 mph.

Wherever rice height differs, front hood and header height adjustments are profitable. The hood should contact rice heads at their midpoint. Count gathering losses carefully to determine a hood/rotor gap that maximizes rice recovery. A gap between the hood and the rotor that is too wide or too narrow increases gathering loss.

Harvester influence on rice yield and milling quality have been evaluated in an experiment. A Shelbourne Reynolds SR6000 stripper was compared to rice header, Model 1010 on Case IH 1680 combines. Figure 12-2 summarizes the field loss of the stripper compared to the rigid header on a Case IH 1680 combine operating at 3/4 to 1 mph. After selecting header and combine adjustments, all plots were harvested without fine tuning. Newbonnet averaged 200 bushels per acre, and Millie averaged 175 bushels per acre green weight. By adjusting the stripper properly, yield losses of both types of headers are very comparable when operated at the proper speed. There were no differences in the quality of rice harvested with a stripper compared to a cutterbar.

Thresher Speed

Operating thresher speed either too fast or too slow can reduce profit. Research with a Case IH 1680, equipped with a specialty rotor, indicated 1000 rpm rotor speed was preferable with Newbonnet; 850 rpm produced the least loss with Lemont. Lower speed failed to separate some rice. A proper concave gap (position #3 on a Case IH 1680) was more important than rotor speed in Lemont; the reverse was true in Newbonnet.

Table 12-4. Selected Threshing Options

Spike Tooth Cylinder • Excellent for lodged rice. • Difficult to remove “tough” kernels from stalk.	**Rasp Bar Cylinder** • Low foreign material in rice. • Best where soybeans are dominant crop. • Requires excellent operator.
Axial-Flow™ Rotary • Low threshing damage expected. • Threshing adjustments are less critical. • Accommodates down rice better than rasp bar.	**Shelbourne Reynolds Stripper** • Accommodates damp rice with less horsepower. • Positioning stripper height and hood are critical. • Gathers newly-downed rice well.

™Axial-Flow is a trademark of CNH Global.

The optimum thresher speed depends on moisture content, volume of material entering the combine, weeds, etc. Fine tuning forward speed and header height is especially important to minimize field loss. An overspeeded thresher may lower milling yield. Harsh impacts with threshing components are more likely to damage high- or low-moisture rice. Also, at high-moisture contents, rice is more difficult to thresh.

Threshing components should be inspected for proper installation, wear or damage.

General Rule: Use the lowest practical thresher speed for varieties that tend to break more easily, especially for rice moisture levels below 16 percent. Use more spike bars or narrow the concave spacing to obtain more aggressive threshing with a conventional cylinder. Table 12-5 suggests remedies for threshing problems.

Separation

The John Deere CTS Combine has a rotary separator that reduces rice loss that “walks” out in the mat of straw in combines with strawwalkers. This design increases capacity for harvesting rice because combine speed was limited by loss over the walkers. The CTS models offer little advantage over John Deere 9500s and 9600s in other crops.

General Rule: Rice lost from the back of the combine typically results from overloading the separator. To remedy:

1. Raise the header as high as feasible.
2. Check threshing adjustments.
3. Slow down. Even though listed last, this is a sure remedy.

Combine Diagnostics

Proper adjustment and operation of the combine are simplified if rice is harvested in the recommended 17 to 21 percent moisture range. Continually adjust the header height to reduce material other than grain in the combine. Slow forward speed when entering weedy areas or spots of minor sheath blight infection.

Possible gathering remedies for difficulties with a cutterbar header are listed in Table 12-5. If you experience a difficulty listed at the top, refer to entries in that column in numerical order. Solving a problem may require a combination of entry remedies described along the left.

Possible remedies for some combine difficulties are listed in Table 12-6. If you have a rotary thresher, a stripper header or a John Deere CTS, certain of these diagnostics do not apply to those combines. The diagnostic layout is similar to Table 12-5. If you experience a difficulty listed at the top, refer to entries in that column in numerical order. Solving a problem may require a combination of remedy entries described along the left.

Performance Evaluation

Loss monitors and yield monitors have become valuable management tools; calibrating them properly maximizes their benefit. Loss monitors require validating for changes in seed moisture. Sensitivity settings are relative; but a loss monitor is an excellent diagnostic tool to confirm that your combine is at its capacity. One indicator of excess forward speed is separation loss; the signal from a loss monitor helps harvest more acres without getting too much rice riding out the rear on the rice straw and chaff “mat.”

Table 12-5. Rice Gathering Diagnostics

	Difficulty						
Possible Remedy	**Down crop difficult to pick up**	**Crop falling off cutterbar**	**Outer ends of reel wrapping**	**Reel carrying straw around**	**Rice shatter at reel**	**Clogging and poor cutting at knife**	**Uneven or bunched feeding**
Increase travel speed		7			3		
Reduce travel speed	4					9	8
Clean knife and bottom of guard						1	
Replace or sharpen knife		5				2	
Operate reel close to cutterbar	1	1				7	
Move reel back		3					1
Use reel speed conforming to travel speed							2
Increase reel speed	3	2					
Check knife register and guard condition						6	9
Modify guards and/or sickle section (ends)	5					3	
Cut rice “butts” first (lodged rice)	6	8				8	
Reduce reel speed				1	1		
Angle reel fingers back 30° or more	2						
Use optional dividers or reel end guards			2			4	
Lower platform to reduce cutting height		4					
Reposition platform auger		6					5
Adjust retracting fingers in auger							4
Raise or move reel forward			1	2			
Pickup fingers angled back too much				3	2		
Check for slipping drive belt						5	3
Feeder drum stops set too high							6
Use optional auger flight extension							7

Table 12-6. Rice Combine Diagnostics

	Difficulty									
Possible Remedy	**Cracked rice or "blue heads"**	**Unthreshed heads**	**Cylinder overloading/slugging**	**Backfeeding of cylinder**	**Rice loss over straw walker**	**Straw overloading chaffer**	**Rice loss over chaffer**	**Excessive trash in tailings**	**Excessive clean rice in tailings**	**Excessive trash in bin**
Increase travel speed	5									
Reduce travel speed		4	6	8	1	6	7			
Check for slipping drive belt			1	1	4				3	
Reduce cylinder speed	1					1	4	4		4
Uneven feeding – reduce slugs entering cylinder	4	5	2	2						7
Excessive tailings – correct air or open sieves	3						1		1	
Increase cylinder speed		1	7		9					
Adjust governor or injector pump for proper speed			5	3	6				4	6
Increase concave spacing	2		4			2	5	5		5
Reduce concave spacing		2			10					
Front curtain retarding straw (reposition)				4	8					
Straw walker or beater not on speed				5	5					
Raise beater grate fingers				6						
Curtain damaged or too high					7					
Walker grids filled with trash					2					
Lower chaffer sieve						3	3			2
Open chaffer sieve						4				
Increase air blast or improve distribution						5		1		3
Reduce air or improve distribution							2		2	
Remove trash in sieve openings						7	6	6	5	8
Reduce chaffer opening								2		1
Reposition sieve – see operator's manual									6	
Raise platform to reduce stalk handled		3	3	7	3			3		

Combine Loss Monitors

Grain loss monitors may help optimize operating adjustments and forward speed. Grain loss sensors must be installed properly in the straw and chaff discharge to intercept rice leaving the combine. The sensitivity is set so that only grain and not straw segments trigger the indicator. To check whether a sensor is functional, tap it lightly while someone watches the monitor needle in the cab. For precision, reset the indicator for swings in rice moisture content. Calibrate the monitor for rice by occasionally checking behind the combine to prove that actual separation loss is proportional to the signal in the cab.

Temporary monitor fluctuations should be overlooked. However, observing a monitor and the field conditions will quickly highlight conditions that increase rice separation loss. An alert operator "fine tunes" thresher speed and forward speed to use his combine capacity while avoiding excess field loss.

Yield Monitors

A yield monitor basically provides dry weight yields, based on data gathered from the moisture sensor and the grain flow sensor. The processor estimates yield at every point in the field. It is vital to calibrate for rice to get useful management data. Take several rice samples to a moisture meter like those used at grain terminals. Calibrate the yield monitor, compare the readings and confirm the moisture content of each. Yield monitor information helps to identify the benefits of good water management, variety selection and pest management. New uses continue to develop.

Where levees and points are few, yield monitors can be very accurate. Both the differential global positioning system (DGPS) with the mapping capability and the nonrecording, instantaneous, non-DGPS models provide valuable management data. However, the operator must either harvest a constant width (near full header width) or adjust the width frequently for partial header widths. To get accurate acreage data and correct yield per acre data this is essential.

Rice moisture is displayed on the monitor throughout the harvest day. The processor typically adjusts rice weight to 14 percent m.c. if it is calibrated properly. If moisture is not properly calibrated or it is biased by residue, the processor converts the data to incorrect yields. If a light rain settles on the rice heads, it biases the moisture sensor in the clean grain delivery. The processor then adjusts the dry weight down to 14 percent rice and consequently, records lowered yields (without real reason). If the display moisture content rises more rapidly than justified, it is wise to check the metal sensor for residue. Plant residue may stick on the metal sensor without an apparent cause. When sampling in the grain tank, always check that the metal sensor is smooth and shiny (no residue). Until the sensor is thoroughly clean, erroneous readings persist, even for years! Moisture errors are one of the most common errors that exceed 2 percent.

Safe Operation and Overall Combine Management

Always make only one adjustment at a time. Then check combine performance under normal operation. Count losses in the field, evaluate the bin sample and monitor the tailings throughout the harvest day.

If the cutterbar or feed elevator entry plugs, stop the combine engine before reaching into the header to remove the obstruction. Never attempt to manually remove obstructions or perform maintenance with the thresher turning. Replace all shields and covers after repairing or adjusting the combine components. Do not engage power before all guards and shields are in place. Don't fail to give ladders and overhead work your full attention. Falls from combines are the most common combine accidents. They may cause lifetime paralysis and have caused death to a number of farmers.

Never work under a combine header without securely blocking the lift cylinder. Men have been crushed under a header making adjustments when the hydraulic system failed. Others have been pinned when someone else bumped the header lift control.

Use auxiliary flashing lights when operating a combine on a public road. Combines are large and motorists may not be alert to equipment moving less than 25 mph. Make every effort to move on roads during well-lit daylight hours.

Estimating Field Loss

Field loss has often ranged from 4 to 6 bushels per acre. Combines typically experience a few percent loss until they are overloaded. Figure 12-3 illustrates the Axial-Flow combine capacity characteristics in Lemont at 18 percent moisture content.

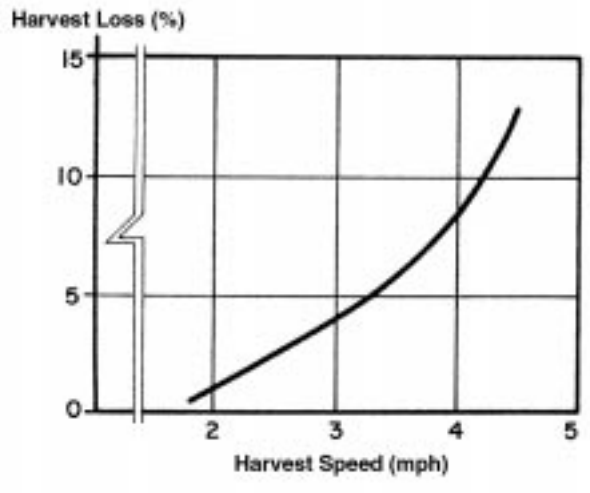

Figure 12-3. Rice loss vs. speed with 1680 Case IH.

One good evaluation of combine operation is to count field loss. Also, check the amount of trash and hulled kernels in the bin and the proportion of trash in the tailings. Table 12-7 is based on sampling a 5 square foot area entirely across the header. Use these sample dimensions for counting loss and divide the number of kernels lying within the sample area by 5 to obtain total field loss per square foot.

The last step is converting this loss number to bushels per acre using Table 12-8. Use the number at the head of the column that is nearest the loss value per square foot and read the entry in the right column.

Table 12-7. Dimensions for Field Loss Estimate

Sample Size to Obtain 5 Square Feet Across Header Width	
Header Width, Ft.	**Sample Dimensions**
18	18 ft x 3 1/4 in
20	20 ft x 3 in
22	22 ft x 2 3/4 in
24	24 ft x 2 1/2 in

Table 12-8. Converting Field Loss Counts into Bushels per Acre

Number of Rice Kernels Uniformly Spread Over One Square Foot	Average Field Loss Bu/A
25	1.3
50	2.5
75	3.7
100	5.1
125	6.4

References

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