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### Title

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## Rice Straw for Use in Dairy Heifer Rations

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Recent increases in feed costs have prompted dairy owners and nutritionists to explore new ways to optimize rations for growing heifers. In free-choice rations, dairy operators often use forages and wheat straw to provide bulk and limit feed intake. The use of rice straw, produced in high quantities in the Sacramento and northern San Joaquin Valleys, has been part of our research on dairy heifer rations since 2004. In our studies we have learned a lot about how to make rice straw a valuable feed in heifer rations as well as ways to overcome the main hurdle that has made it hard to use: incorporation of long rice straw stems into Total Mixed Ration (TMR) mixers requires substantially longer mixing times and often damages mixing equipment, necessitating shutdowns and repairs.



**Figure 1.** The traditional straw used in dairy heifer rations, wheat straw (left), is shown alongside cutter-baled rice straw (right).

California is the second-largest rice producing state in the United States, and the area north of Sacramento is one of the most highly concentrated rice growing regions in the country. Rice straw, a co-product of rice harvest, is mostly incorporated into soil by disking to improve soil quality and add nitrogen, which reduces the amount of nitrogen fertilizer input required for the following year's crop, thus reducing overall costs. It is estimated that 3 to 5 percent of the area's rice straw is baled for various uses, including cattle forage, erosion control, and straw bale construction. Many dairy owners now realize that rice straw can be used in rations for replacement heifer diets to provide dry matter and bulk to slow ruminal rate of passage when combined with byproduct feeds. The key for success is to purchase rice straw that has been baled with a cutter baler set to cut it in 3- to 5-inch lengths that allow it to be added to TMR mixers without chopping.

The rice and rice straw harvest runs from August to November. Straw that is baled within 10 days of harvest may qualify as a feedstuff, but longer times in the field inevitably lead to bleaching and excessive drying that compromise fiber quality. Rice straw can be baled more quickly through early September, mostly because there are more hours of daylight and generally less rain than later in the year.

## Harvest and Cutting Options

Rice straw is produced by a variety of methods, including

1. **Straw walker harvester**, baling the windrows for a long-stem product.
2. **Rotary style harvester**, which, depending on the make of the harvester and its ground speed during harvest, can shred the straw to varying degrees. The harvested straw windrows can then be baled.
3. **Flail chopping** chops the dried windrows of straw to reduce their stem length before baling.
4. **Cutter baler** is a baler equipped with a cutter apparatus that slices the straw into 3- to 5-inch lengths.
5. **Swathing** usually means cutting the plant near ground level and then baling to remove all of the straw.

Rice straw baling and stacking costs in 2008 ranged from \$25 to \$40 per ton, while baling with a cutter or flail chopping before baling added an additional \$5 to \$9 per ton. This added expense of cutting straw is worthwhile at baling as it reduces the chopping expense of making the straw into acceptable feed later at the dairy.

Historically, the major problem associated with feeding rice straw to cattle, especially as unprocessed, long-stem bales (method 1, above) is

that it still needs to be chopped prior to feeding. The high silica content of rice straw makes this a slow and energy-intensive process that creates dust and dulls chopper knives.

Dairy rice straw feeding demonstrations have shown that it is *critical* that rice straw be cutter baled (method 3, above) if it is to be used in heifer rations. This approach greatly improves its mixing performance and eliminates selective consumption of the TMR by cattle, which can defeat the purpose of feeding a nutritionally balanced TMR. Demonstrations have shown that rice straw baled with less than 12 percent moisture using a cutter baler could be fed at 2 to 4 lb per head per day when combined with other feeds in a TMR mixer. Rice straw that has *not* been sliced or chopped to reduce its stem length to 3 to 5 inches should not be purchased by a dairy unless they plan to chop it before mixing. Longer straw lengths (i.e., over 5 inches) result in unevenly mixed TMR, longer mixing times, and a greater risk that mixer parts will break when long straw wraps around mechanical shafts. More information on the results from our dairy rice straw feeding demonstrations are available online (for 2008) at [www.carrb.com/08rpt/Nader%20RU5%2008.pdf](http://www.carrb.com/08rpt/Nader%20RU5%2008.pdf) and for 2007 at [www.carb.com/07rpt/2007%20Nader%20RU-5.pdf](http://www.carb.com/07rpt/2007%20Nader%20RU-5.pdf).

Many rice growers already own flail choppers and are not interested in purchasing a cutter baler. However, our dairy demonstrations with flail-chopped rice straw showed that, when fed at 2 to 3 lb per head per day, the straw did not mix completely into the TMR, but instead formed “balls” (figure 3) that were not eaten by the heifers (figure 4). At 5 lb per head per day, the flail-chopped straw increased mixing times. If rice growers wait until the windrowed straw has reached 10 percent moisture before they flail chop and bale it, they may be able to reduce these problems. Figures 3 and 4 illustrate the problems of “balling”, which enables animals to sort against rice straw.



**Figure 2.** Cutter-baled rice straw that has been evenly mixed into the Total Mixed Ration (TMR).



**Figure 3.** Flail-chopped rice straw causes uneven mixing.



**Figure 4.** Flail-chopped rice straw in a TMR remains uneaten after 24 hours.

## Nutrient value

The nutrient value of rice straw is much lower than that of alfalfa hay, making it is generally inappropriate in rations of lactating cows. However the nutrient levels and feeding values of individual rice straws do vary considerably. California rice straws generally run about 67 percent ( $\pm 5\%$ ) neutral detergent fiber, 50 percent ( $\pm 3\%$ ) acid detergent fiber (ADF), and 5 percent ( $\pm 1\%$ ) crude protein (CP), with all values determined on a dry matter (DM) basis. Factors that impact rice straw nutritional value include plant maturity at harvest (e.g., grain head moisture), the soil in which the rice is grown, rice variety, and nitrogen fertilizer management. Extensive UC research has indicated that a rice straw with an ADF value below 50 percent (DM basis) can be considered to be feed quality for replacement heifers.

The range of nutrient values for two years of sampling (2002 and 2003) of 77 stacks of baled rice straw in Northern California are in Table 1. These data demonstrate the wide variability in the nutrient content of rice straw.

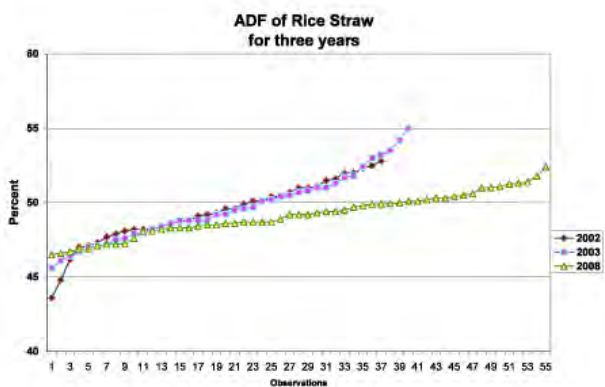
Figures 5 and 6 provide a sample of the degree of variation in nutritional value in 133 stacks of Northern California rice straw sampled during 2002, 2003, and 2008. The quality of rice straw was different each year, and in 2008 the CP and ADF levels both were much lower than in the earlier years. These data demonstrate that the nutrient quality of the straw can vary significantly from year to year.

**Table 1.** Nutrient content range of California rice straw, based on samples taken from bale stacks over two years (2002 and 2003).

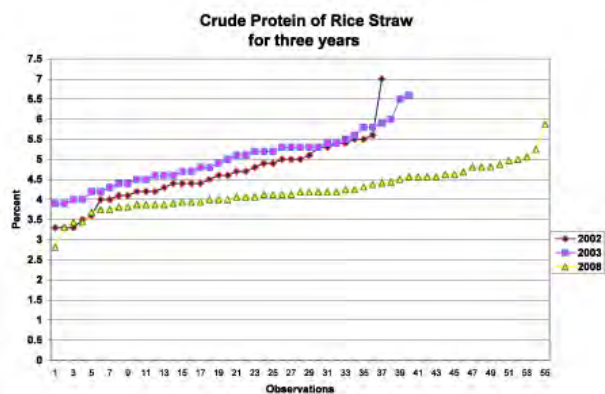
Content level	Nutrient component*								
	DM	OM	Fat	CP	ADICP	NDF	dNDF	ADF	TDN
	------%-----				------% DM-----				
Average	93.93	83.59	1.94	4.81	12.60	67.57	38.33	49.49	40.90
Maximum	95.30	87.50	2.90	7.00	19.10	72.50	47.20	55.00	50.50
Minimum	91.70	76.50	0.90	3.30	7.60	60.00	29.30	43.60	31.10

	Chemical element†										
	Ca	P	Mg	K	S	Na	Cl	Cu	Fe	Zn	Mo
	-----%-----							-----ppm DM-----			
Average	0.30	0.095	0.199	1.738	0.076	0.15	0.52	4.3	396	28	0.844
Maximum	0.50	0.170	0.295	2.700	0.150	0.50	1.20	13.0	3400	60	3.700
Minimum	0.19	0.051	0.120	1.100	0.037	0.01	0.097	1.5	130	13	0.250

\*Nutrients: DM = dry matter, OM = organic matter, CP = crude protein, ADICP = acid detergent insoluble CP (an estimate of the indigestible CP fraction), NDF = neutral detergent fiber, dNDF = digestible NDF (an estimate of the digestible NDF fraction), ADF = acid detergent fiber, TDN = total digestible nutrients.  
 †Chemical elements: Ca = calcium, P = phosphorus, Mg = magnesium, K = potassium, S = sulfur, Na = sodium, Cl = chlorine, Cu = copper, Fe = iron, Zn = zinc, Mo = molybdenum.



**Figure 5.** Acid detergent fiber (ADF) levels in 2002, 2003 and 2008.



**Figure 6.** Crude protein (CP) levels in 2002, 2003 and 2008.

## Getting Started

If you are interested in using rice straw in your heifer TMRs, you can find suppliers online at [www.ricestrawmarket.org](http://www.ricestrawmarket.org).

It is important to recognize that rice straw producers seldom bale straw in anticipation of sales, but most accept orders from July to September for delivery after mid-September. Ask for delivery to the dairy in the fall, since many rice producers store their straw on the rice levees where rain-soaked soil can make later shipments difficult.

## For More Information

You will find related information in these titles and in other publications, slide sets, CD-ROMs, and videos from UC ANR:

*Feeding Rice Straw to Cattle*, Publication 8079

*Dairy Nutritionists' Roles in Nutrient Use: Recommendations for Feed Nutrients Records Analyses*, Publication 8278

*Use of Feed Inventory Records to Reduce Nutrient Loading at Dairy Operations: Producer Options*, Publication 8277

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