Nutrients in Rice Grain and Straw at Harvest

Background

Knowing the amount of nutrients in a rice crop at harvest time is important for several reasons.

1. It provides an idea of the crop's nutritional needs. Some of these nutrients are applied routinely in fertilizer applications, while others are readily available from the soil or irrigation water.

2. It helps us understand how to better manage soil nutrient balances. Grain (and the nutrients in it) are removed from the field at harvest while straw may or may not be removed.

3. The nutrient composition of straw has implications for how it can be used.

Nutrient Concentration of Grain and Straw

Table 1 provides the nutrient concentration of grain and straw at harvest, the amount of nutrients in a crop that yields 10,000 lb/ac (100 cwt/ac), and the amount of nutrient in a ton of grain and straw at harvest. The concentration data are from Dobberman and Fairhurst (2000) and are based on numbers from Asia; however, based on our research in California, we have found the values to be similar.

Key Takeaways

1. At harvest, most of the crop N and P is in the grain. This is why N and P fertilizer are typically applied in the largest amounts.

2. How much straw is in a rice field and how much is removed if it is bailed? For most modern high yielding varieties, the amount of straw is roughly equal to the grain yield. That is, if the grain yield is 10,000 lb/ac then there is about 10,000 lb/ac of straw. The amount of straw removed during a bailing operation depends on how low the straw

Table 1. Nutrient concentration, the amount of nutrient in a crop that yields 10,000 lb/ac (100 cwt/ac), and the amount of nutrient in a ton of either straw or grain at harvest. Source of concentration data (Dobermann and Fairhurst, 2000).

Nutrient	Concentration	Amount in 100 cwt/ac yield	Amount per ton	Concentration	Amount in 100 cwt/ac yield	Amount per ton
	%	lb/ac	lb/ton	%	lb/ac	lb/ton
	Grain			Straw		
Nitrogen	1.1	110	22	0.65	65	13
Phosphorus*	0.2	20	4	0.1	10	2
Potassium*	0.29	29	5.8	1.4	140	28
Calcium	0.05	5	1	0.3	30	6
Magnesium	0.15	15	3	0.2	20	4
Sulfur	0.1	10	2	0.075	7.5	1.5
Silicon	2	200	40	5.5	550	110
Zinc	0.002	0.2	0.04	0.003	0.3	0.06
Iron	0.025	2.5	0.5	0.035	3.5	0.7
Manganese	0.005	0.5	0.1	0.045	4.5	0.9
Copper	0.001	0.1	0.02	0.0003	0.03	0.006
Boron	0.005	0.5	0.1	0.001	0.1	0.02

* To convert P to P_2O_5 multiply P by 2.29. To convert K to K_2O multiply K by 1.2.

is cut before bailing. It is unlikely that all the straw is removed; typically, 40 to 80% of the total amount of straw may be. In a field that yields 100 cwt/ac that would amount to 2 to 4 ton of straw being removed per acre.

3. The straw contains a lot of K and Si. Given these high concentrations, when rice straw is burned there is a lot of ash which can be an issue for some applications. Potassium is a big concern as continual removal of straw will result in soil K deficiencies.

4. Retaining straw in the field during the fallow. It is common practice to leave the straw in the field during the winter fallow period. Growers need to make sure that the rice straw decomposes during the winter. This is facilitated by incorporating the rice straw and flooding the field. Doing this ensures nutrients from the straw are retained in the field and available for the next crop. Good decomposition is important so that the straw does not bind (immobilize) N fertilizer the following growing season.

5. What if straw is removed? When the straw is removed (Fig. 1), nutrients are also removed that need to be replaced (Table 1). Potassium is removed in the largest quantities, but N is also removed. While not all of the N in rice straw is available in the next season, research has found that fertilizer N inputs can be reduced by about 25 lb N/ac if straw is retained in the field. Silica is also removed in large quantities, but it is not normally deficient as adequate amounts are usually provided from soil and irrigation water.

6. What happens if rice straw is burned? Many of the nutrients remain in the field when the straw is burned; however, most N and S are lost in the burning process. Furthermore, since ash can be blown around the field, the nutrients contained in the ash may not be uniformly distributed in the field.

Figure 1. Rice straw bailing in the Sacramento Valley.

For more on this topic:

- ✓ Dobermann, A. and T.H. Fairhurst. 2000. Rice: Nutrient Disorders and Management. International Rice Research Institute
- ✓ Agronomy Research and Information Center-Rice: rice.ucanr.edu
- ✓ Phosphorus Budget Calculator for rice: rice.ucanr.edu/P_Budget_calculator
- ✓ Nader, G.A. and P.H. Robinson. A. 2010. Rice Producers' Guide to Marketing Rice Straw. https://anrcatalog.ucanr.edu/pdf/8425.pdf

Agronomy Research and Information Center

http://agric.ucdavis.edu/

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