PROJECT NO. RU 10

PROJECT PROPOSAL
COMPREHENSIVE RESEARCH ON RICE
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PROJECT TITLE: **Improving the feeding value of rice straw**

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Background

This research follows two previous feeding trials that have tested methods of improving the feeding value of rice straw. The first trial in 2015 evaluated the feeding of high moisture straw. In this trial it was determined that high moisture straw would increase yearling cattle intake and subsequent body weight gain. Unfortunately the high moisture straw had drawbacks including the need to bale directly behind the combine, and proved difficult to handle not long after baling. Additionally, stacks of high moisture straw tended to sag and potentially fall over, requiring them to be shorter than traditionally dry harvested stacks.

Figure 1 Baling the dry straw in 2017

The following year we attempted to circumvent the drawbacks of handling high moisture straw by adding treatments to low moisture straw that could potentially improve intake. The treatments including ammoniation, lactic acid sprayed prior to baling, molasses sprayed prior to baling, and a control. Of these treatments only the ammoniation treatment increased weight gain and intake over the control. However, average daily gains of the ammonia treated straw were 0.57 lbs/day higher in this group, demonstrating a substantial increase in weight gain.

These two trial years offer very different approaches to rice straw management, Lacking is a direct comparison of these methods. The current year project was intended to combine the previous two trials by implementing dry and wet control treatments and comparing them to a dry ammonia treatment and a wet lactic acid treatment. The results summarize the culmination of trials to date.

Treatments in 2017 included:

1) High moisture
2) High moisture + lactic acid
3) Low moisture
4) Low moisture + ammonia treatment

Trial Methods

Figure 2 High moisture bales binding during harvest

Straw was baled during the rice harvest of 2017 in Williams California. Dry straw moisture at the time of harvest was 9% and wet straw moisture levels averaged 51%. Both dry straw treatments were flail chopped prior to baling. The wet straw was not mechanically able to be chopped due to its high moisture content.

Baling of the wet straw was very cumbersome as it would not feed through the baler. After multiple attempts we were forced to stop baling, a problem we had not encountered in the past. Due to this unforeseen difficulty we were forced to forgo the high moisture + lactic acid treatment. Fortunately we were able to bale enough straw to still include the high moisture only treatment.

The low moisture bales were removed from the field immediately after baling and wrapped in plastic. Separate stacks were wrapped for both treatments. The ammonia treatment was ammoniated at 2% by weight with ammonia gas and left to allow the ammonia to dissipate throughout the stack for 30 days. Unfortunately part of the stack caught fire a week after harvest. Interestingly, the stack did not get hot, but we did determine that the fire started at the point where the probe had been inserted. We hypothesize that the concentration of ammonia at this specific spot was the cause, and prevention methods that include more points of probing during the treatment process would eliminate the potential for fire. Fortunately, we were able to salvage enough unburned straw from the stack to include this treatment in the trial.

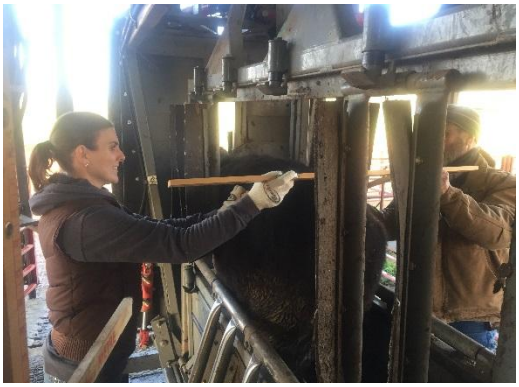


Figure 3 Hip width measurement

The dry straw was hauled to the Sierra Foothill Research and Extension Center 30 days after harvest.

The high moisture straw was hauled and covered on the day of harvest due to worries of handling if it was allowed to sit.

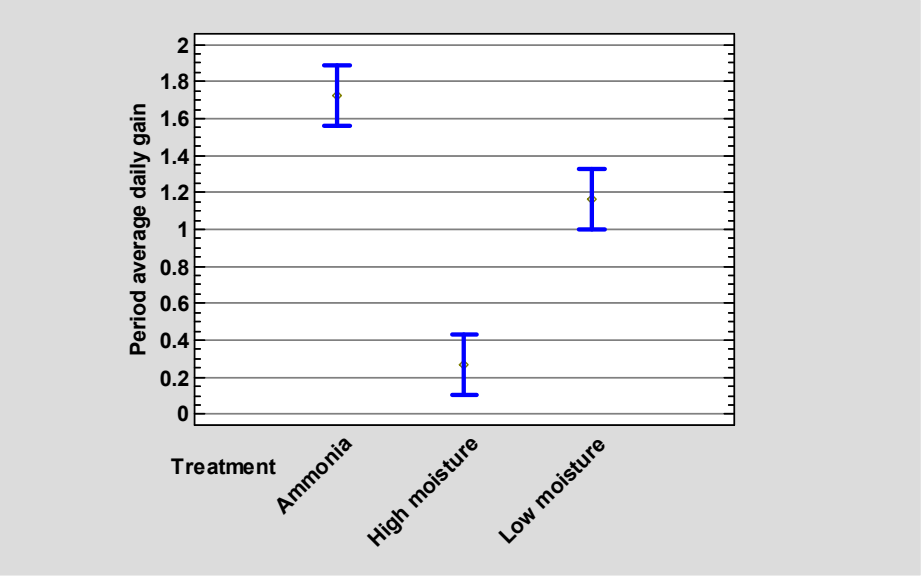
The cattle feeding portion of the trial began on November 13th, and lasted for 60 days. Cattle were weighed, hip height and widths measured at the trial onset, mid-point, and end. Two reps of each treatment each had their own pens with ten cattle that were stratified by weight, assigned to each pen. Feed was weighed to track daily intake per pen every day of the trial. A grain mix of 6.7 lbs/day was included to supplement the cattle during the trial. This was formulated so that if cattle ate the grain mix and nine pounds of straw per day they should gain a pound of weight per day. Quality sampling of each forage treatment was done at the same time as the cattle working.

Findings

Over the course of the three trials we have found targeting specific moisture levels to be challenging. In some years the straw dried within hours, while in 2017 it was very slow to dry. This made it difficult to specifically target a moisture percentage in the high moisture straw and it proved to be variable, ranging from 40-70+% moisture. Additionally, this treatment requires harvesting behind the combine, which is typically the busiest time of year, making it inconvenient in application. Conversely, the dry straw can be put up upon completion of rice harvest. Besides the previously mentioned issues of handling, these reasons may cause adoption rates of high moisture rice straw to be low.

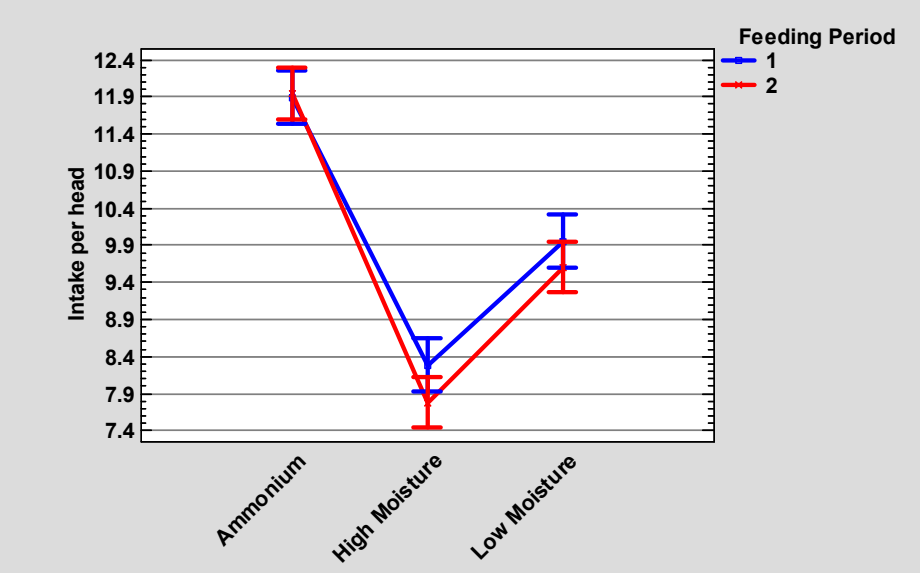
In any case the high moisture treatment was not the most successful treatment in terms of weight gain or intake. The ammonia treatment cattle significantly outperformed all other groups gaining 1.7 lbs/day. This is a substantially better gain when compared to the dry straw cattle that gained 1.2 lbs/day, and the high moisture cattle that only gained 0.2 lbs/day (Figure 4).

Figure 4 Period average daily gain by treatment



The difference in gain was attributable to the difference in intake (Figure 5). The ammonia treatment consumed about 12 lbs/hd/d, as compared to the low moisture treatment which was close to 9.5 lbs/hd/d. The high moisture treatment had the lowest consumption at close to 8 lbs/hd/d. Interestingly, consumption was not highly variable between the feeding periods. In fact feeding period was not a significant variable in terms of intake (P=0.19).

Figure 5 Intake by feeding period and treatment



Hip height was not significantly affected by any of our treatments (P=0.27), which was similar to our findings in previous trials. We did see significant differences in hip width measurements (Table 1), with the ammonia treatment again significantly increasing width over the high moisture treatment. The low moisture treatment was more variable and did not differ from the other treatments.

Table 1. Hip width differences by treatment

Treatment	*Mean*	*Homogeneous Groups*
High moisture	0.727194	X
Low moisture	1.44411	XX
Ammonia	1.9787	X

The difference in intake and resulting weight gain between treatments can only be seen in protein content in terms of forage quality analysis seen at the beginning of the feeding trial. The ammoniated treatment had significantly higher protein than the low moisture treatment, but surprisingly not the high moisture treatment. Energy levels (TDN; Table 3) were significantly lower in the high moisture treatment when compared to the other two treatments. We wonder if this difference may actually be due to the high moisture treatment not being flail chopped prior to harvest.

In addition to forage quality, it appears mold and yeast counts may have significantly affected palatability. Mold and yeast counts were much higher in the high moisture treatment. The lactic

acid treatment that was not completed could potentially have addressed this issue. We have two more quality analysis awaiting arrival from the lab which will tell us if forage quality changed over the feeding periods.

Table 2. Crude protein differences between treatments

Treatment	*Mean*	*Homogeneous Groups*
Low Moisture	3.815	X
High Moisture	4.86	XX
Ammonium	9.475	X

Table 3. TDN differences by treatment

Treatment	*Mean*	*Homogeneous Groups*
High Moisture	43.015	X
Ammonium	50.305	X
Low Moisture	50.635	X

Our research team would like to thank the Rice Research Board for supporting this and previous rice straw feeding trials. Developing low cost forage sources is crucial to beef cattle production, with drought exacerbating the need.