

MANAGING FEED EFFICIENCY TRIALS

INTRODUCTION

Profitability in the beef industry depends on a producer's ability to maximize profits by reducing input costs and optimizing output. Selecting for feed efficient cattle is one way producers can increase their profitability. Residual feed intake (RFI) is a moderately heritable measure of feed efficiency which can be used as a selection tool to increase the efficiency of beef herds. RFI is measured as the difference between an animal's actual intake and their expected intake, for a given level of production. Cattle with low RFI values are more efficient than their high RFI counterparts. Differences in this feed efficiency trait are determined when an animal's daily feed intakes are monitored over time. Vytelle's Feed Intake Nodes allow cattle to be measured for individual feed intake which can be used in combination with body weights to produce an accurate RFI value and an RFI expected progeny difference (EPD).

Vytelle currently recommends trials of 49 days in length with an additional 10-14-day warm up period, when using Feed Intake Nodes in combination with In-Pen Weighing Positions, for accurate calculation of average daily gain (ADG) and RFI. Evidence does not yet support EPD or index calculations for RFI when growth and intake data are collected during different (non-coincident) time periods. Recommended testing criteria are shown in Table 1.

RESIDUAL FEED INTAKE CALCULATION

Residual feed intake is a phenotype that quantifies the relative efficiency of animals. Differences in RFI are often attributed to differences in animal maintenance requirements. As mentioned above, cattle with low RFI values are efficient while cattle with high RFI values are inefficient. To calculate RFI, trends in feed intake and weight are collected over a defined period of time for a contemporary group of animals. From this input data, animals performing better (negative RFI) or worse (positive RFI) than the group average may be identified. There are two main requirements for accurate calculation of RFI:

1. ADG and feed intake data for individual animals during the trial period
2. Appropriate selection of contemporary groups

Upon completion of the trial, Vytelle data analysts run RFI calculations and provide RFI trial reports. The trial reports include the following information for each individual animal:

- RFI
- RFI Contemporary Group Ranking
- ADG
- DMI (dry matter intake)
- Start and End Weights
- Trial Dates (warm up, test start dates, test end dates, omitted days)

TABLE 1: SUMMARY OF CALCULATION PARAMETERS FOR RESIDUAL FEED INTAKE (RFI) TESTING

	CRITERIA	FEED INTAKE & CHUTE	FEED INTAKE & IPW ¹
Duration	Test Length	≥ 70 Days	≥ 49 Days ²
	System Adaptation Period ³	10-14 Days	10-14 Days
	Valid Feed Intake Days ⁴	≥ 35 Days	≥ 35 Days
Weight	Range of ADG	0.0-8.8 lb/day (0.0-4.0 kg/d)	0-8.8 lb/day (0.0-4.0 kg/d)
Chute Weights		2 Consecutive Days at Start & End + 1 mid-trial ⁵	2 Chute Weights: 1 Chute Weight at Start & End ^{6,7}
Feed Intake Calculation	Feed Access	Ad Libitum	Ad Libitum
	Missing or Deleted Feed Intakes	Regressed (Linearly)	Regressed (Linearly)
	Average DMI Calculation	Simple Average - Including Regressed Data	Simple Average - Including Regressed Data
	Weigh Day Feed Intakes	Kept ⁸	Kept ⁸
	Pen Check Failure Intakes	Deleted – Regressed Back In	Deleted – Regressed Back In
	Individual Animal Missed Days ⁹	Deleted – Regressed Back In	Deleted – Regressed Back In
	Unaccounted Feed Supply	< 15%	< 15%
	Unaccounted Feed Disappearance	< 10%	< 10%
	Low Intake Threshold	< 25% of Animal Average	< 25% of Animal Average

¹IPW = In-Pen Weighing Positions; ²Benfield, D.B. 2015; Benfield, D.B. et al. 2016; ³Animals should start the trial adapted to the system and to the final diet and must be tagged with new HDX RFID tags that are ICAR compliant; ⁴The first 5 consecutive days and the last 5 consecutive days of the trial must each contain less than 5 failed days; ⁵Vytelle standards are 2 consecutive Days, but chute weights can also be measured in 14d intervals; the Vytelle Analytics team must be advised on which method is being used; ⁶Trials with new breeds or new customers, it is required to have a total of 500 chute weights over 5 separate weighing days; ⁷Start Weight: Animals should be in the pen, with an EID tag for approx. 7 days before the start chute weight is taken. End Weight: Animals must go back into the pen for at least 1 day after the final chute weight is taken; ⁸Data is always verified whether to be kept, by the Vytelle Analytics team; ⁹Individual Animal Missed Days could be for example tag changes, animal escaping pen, and others.

DATA COLLECTION

Animal weight, gain and feed intake patterns vary over time. To obtain values representative of the long-term performance for an individual animal, data must be collected both accurately and over an appropriate timeframe. The highly accurate daily feed intake data provided via Feed Intake Nodes lowers the variation in individual feed intake trends, while In-Pen Weighing Positions are able to capture ADG in a shorter period of time and with greater accuracy.

Collection of accurate weight measurements, which are applied to RFI calculations, are somewhat more challenging using conventional chute weighing techniques. Animals' weights fluctuate over time due to several factors, including rumen fill, water consumption, feeding patterns, etc. An analysis of over 40,000 live weight measurements collected using chute scales found that the standard deviation of the difference in weights on consecutive days was 19.5 lb which makes accurate calculation of ADG challenging. Therefore, Vytelle

recommends collecting weight measurements using In-Pen Weighing Positions. Our technology collects several partial body weights daily which increases the accuracy of ADG calculations and shortens the overall trial period.

Previous work done on efficiency measurement trials using chute weighing suggested minimum durations for RFI calculation (Wang et al., 2006; Culbertson et al., 2015). The limiting factor to RFI calculation in these cases was measuring consistent ADG values. The assurance of ADG measurements provided by the In-Pen Weighing Positions can reduce the necessary duration of an efficiency measurement trial. Analysis of 27 RFI trials (1,874 animals) weighed using In-Pen Weighing Positions determined that a 49-day trial duration, plus approximately 10-14 days of system adaptation, was adequate to measure RFI and ADG accurately (Benfield et al. 2016).

CONTEMPORARY GROUP SELECTION

As RFI is a relative parameter, the composition of the group of animals evaluated affects all RFI values calculated. To isolate differences in efficiency from other effects, a contemporary group should be made up of animals which are similar in terms of sex, breed, age and size. At the start of the trial, animals should be between 8 months (after weaning) and 18 months of age (post weaning to mature weight they are highly dependent on the feeding regime), with a maximum range of 90 days between animals, to ensure that composition of gain is consistent and issues due to feeding dominance are minimized. Contemporary groups must have a minimum of 4 valid animals at the end of trial, in order to calculate RFI. Animals should each be tagged with a new half-duplex (HDX) radio frequency identification (RFID) transponder that are ICAR compliant and allowed to acclimatize to the functioning data acquisition system for at least 10 days prior to trial data collection. This allows the adaptation period to the system to be monitored.

All animals in a contemporary group should be treated equally and have ad libitum access to feed at all times during the trial. Trial days where

animals were unable to access feed at all times should be noted and removed from the average feed intake calculation. Similarly, any technical issues with feed intake calculation on an individual or pen basis should be grounds for exclusion of data. Animals with other anomalous patterns in intake or gain (due to sickness, poor adaptation or other factors) should also be excluded from the contemporary group. To accurately identify these patterns, there must be at least one day of valid feed intake data within five consecutive days at the start and end of the trial.

CONTEMPORARY GROUP SELECTION SUMMARY

1. Breed: Similar breed
2. Sex: Cattle should be of the same sex
3. Age: Post weaning to mature weight is highly dependent on the feeding regime, with a range of no more than 90 days
4. Group: Minimum of four valid animals at the end of trial, to run RFI

DATA REQUIRED FROM CUSTOMER

To conduct proper feed intake trials, it is important for Vytelle to receive the correct data from its customers. Without data from customers, RFI cannot be calculated accurately. Pre-trial data required from customers includes:

- Visual tags
- Date of birth
- Breed
- Origin
- Three generations or more of pedigree information for EPD calculation, with the animal registry

Detailed information is linked to the EID numbers of animals in trial. This allows trends to be established for logical groups of animals.

IN-TRIAL DATA REQUIRED FROM CUSTOMER INCLUDES:

- Ration sheet, including percentage of each ingredient plus the total ration dry matter content

- Chute weights and date the weights were taken
- Dry matter content is necessary to accurately calculate RFI.

EXPECTED PROGENY DIFFERENCE CALCULATION

Vytelle has curated records of more than 262,000 animals into a multi-breed database to determine expected progeny differences (EPDs) based on RFI (and other) phenotypes. Inputs for this database are measured phenotypes, three generations (or more) of pedigree information on the animals tested, and additional information on relevant environmental conditions (location, weather, environment, etc.). Critical to this analysis are three main factors:

1. Consistent data collection and phenotype measurement;
2. Adequate volume of data;
3. Accurate linkage between measured phenotypes and animal pedigree information.

Outputs for this database are efficiency EPDs relevant for making breeding decisions. The RFI EPDs generated are produced using feed intake and weight data collected simultaneously. The significance of simultaneous acquisition is that measured feed intake and weight change are coupled together, reducing loss of RFI phenotype accuracy due to short-term variation.

VYTELLE RFI RESULTS VS. RFI EPDS

RFI EPDs are not the same as off-test RFI results. RFI test results are dependent on the contemporary group, and therefore can only be compared within the contemporary group. Changing the composition

of a contemporary group by adding or removing animals will affect the RFI results for each animal within the group. Vytelle's RFI EPDs, however, can be compared across different trials and contemporary groups. Keep in mind, an animal's RFI can differ drastically from its RFI EPD, simply due to the influence of related animals.

LITERATURE CITED

- Benfield, D.B., Garossino, K., Kerley, M, Sainz, R.D. and Huisma, C. (2016), [internal study], "Measurement of Feed Efficiency Traits and Reduction of Test Duration Periods in Beef Cattle using High-Frequency Partial Body Weights. In preparation".
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