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Continuous improvement from farm trials

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There is a significant cost associated with opportunities lost from using less than optimal feeds, feeding techniques

Farm trials require a significant commitment of resources, but can yield valuable data that lead to higher profits.

Continuous improvement – or “kaizen,” as it is referenced by the Japanese – is a critical strategy required for the success and sustainability of any business, including shrimp farming. Faced with changing ingredient costs and availability, feed manufactures must adjust formulations on an ongoing basis. Accordingly, facing high feed costs, those farms that regularly conduct experimental field trials to identify the most profitable feeds and optimize feeding programs are often the most successful.

Farm trials

Much of the research on aquaculture nutrition is conducted in well-equipped laboratories using appropriate scientific techniques. These trials are normally of a small scale and often use small animals. Frequently, the data obtained, although useful, may not be representative of what happens at a commercial scale on the farm.

Some farmers occasionally conduct farm-based feed trials, and a few even have designated research ponds and protocols. Regardless of the operation, all feed trials require a commitment of resources and represent significant financial investments. Yet, too often, these trials do not realize their potential because of limitations in planning, execution and/or analysis. This results in an inefficient use of resources and, perhaps more importantly, incorrect conclusions and missed opportunities to improve profitability.

Therefore, it is proposed that shrimp farm managers develop routine programs for on-farm feed trials that incorporate best practices, which in turn will contribute to better decision making and a faster rate of continuous improvement.

Experimental design

Planning is critical. First, identify and prioritize what information is needed to have the most positive effect on the business. Next, design an experiment that has a high probability of providing the required information. Since so many variables affect pond results at shrimp farms, it is suggested that trial planning and protocol development include scientific and technical review by a qualified individual.

A properly designed experiment attempts to minimize the effects of background variability, which can mask the differences due to treatment. The following represent important design criteria.

Ponds

Five or more replicate ponds per treatment are necessary to provide confidence that differences among treatments are consistent and not just due to chance allocations of better or poorer producing ponds. If only 4 replicates/treatment are used, repeat the experiment and average the results. For 3 replicates/treatment, repeat the experiment three times and average all results.

The physical characteristics, including shape, size, depth, soil conditions and water hydraulics, should be the same or highly similar across culture units. If all ponds are similar, treatments should be allocated at random. If the ponds are not similar, a “pair pond” method can be used by selecting five sets of similar ponds and allocating the treatments at random to each pond in a set.

Postlarvae stocking

Stock healthy, feeding animals with the same genetics and weight with little size variation. Target a coefficient of variation of less than 30 percent. Verify consistent stocking density across ponds. Stock all ponds on the same date, or if this is not possible, stock an equal number of ponds for each treatment on the same day using the pair pond method.

Pond management protocols

Protocols should be carefully defined and vetted before stocking so that changes in management are minimized. Standard farm management protocols should emphasize best management practices to meet predetermined targeted standards for shrimp growth, survival and feed conversion. Use the most experienced, qualified and unbiased personnel. Feed treatments must be coded by color or other means, with their identity kept confidential until the trial ends. If any ponds require special treatment, it is recommended that all experimental ponds receive the same treatment.

Harvesting

It is very important that the culture period is identical for all ponds. This is especially important if the experiment is conducted during periods of increasing or decreasing temperatures. If harvesting of all experimental ponds can not be performed in one day, an equal number of ponds from each treatment should be harvested on the same day, using the pair pond method to maintain equal days of culture for all ponds harvested on that date.

Experimental data

The story of a feed trial is revealed through the careful analysis of the experimental data collected. Therefore, the quality of the conclusions drawn is first and foremost dependent on the quality of data collected and its accuracy. This is determined from the quality of the scientific methods used and the skill of the individuals collecting and recording the data.

The following data, as available, is recorded and reported on the day of stocking and at seven-day intervals thereafter for each pond until the crop is harvested:
• date
• days of culture
• average weekly water temperature, both day and night
• average weekly salinity
• animal density
• average animal weight
• average weekly weight gain
• average weekly feeding rate (g feed/animal/day)
• survival
• animal biomass
• weekly average feed-conversion ratio
• feed-conversion ratio for the cycle
• number of days oxygen levels were below 2 ppm
• number of days oxygen levels were below 3 ppm
• daily water exchange
• feed identity/formula, including particle size
• production productivity index (PPI) – kg biomass/ha/day/units of 10 postlarvae/m2 stocked.

For single-harvest crops, the metric PPI has been found to be a good predictor of profitability. Note that the feed cost per unit of gain has been omitted from the above list, as it is an unreliable predictor of profitability. Nevertheless, unit feed cost is a very important factor in determining profitability that is used as part of economic modeling's predictions of profitability.

Economic performance or profitability at harvest is usually reported as a separate final live items or report. This includes the following data:
• actual survival rates
• feed cost
• other variable and fixed costs, reported on a per-pond basis
• crop value
• shrimp condition at harvest and shrimp quality metrics from the processing plant
• economic performance index – profit/ha/day/units of 10 postlarvae/m2 stocked (may only be available after harvest).

Summary, analysis

All data from the weekly and harvest reports should be provided on spreadsheets linked to a summary spreadsheet that reports data as pond averages for each treatment. The summary sheet should be organized with one line for each week in chronological order for proper interpretation.

The ability to understand the true story from a feed trial is greatly increased by carefully studying the data and their interactions over time. It is much like reading a book. One can learn about the story by just reading the last chapter, but a lot is lost by not reading all the chapters in the appropriate context. All too frequently, the only data carefully studied are the harvest data. This significantly limits the ability to come to important, high-value conclusions.

Fig. 1 presents a graphic example in which the performance of two feeds is compared over time. In this example, if the focus is just on harvest data collected at the end of the crop cycle, the appropriate conclusion would be that the two feeds perform the same. However, examining the data over time clearly shows that animals given one feed grew significantly faster than those that received the other,

but its performance in the latter phase of the crop was compromised. It produced a higher biomass earlier, which was unsustainable, because the pond conditions necessary to maintain this biomass were significantly exceeded.

Fig. 1: Performance comparison of shrimp given different experimental feed products.

In all cases, it is preferred that experiments are designed so that the data can be subjected to statistical analysis, which can then be used to reach more reliable conclusions. If this is not possible, experience suggests that treatment means that differ by more than 10 to 15 percent suggest meaningful treatment differences for properly designed experiments.

Making a difference

The purpose of farm feed trials is to improve a farm's success, yet without proper trial planning and careful evaluation of the results, even the best intentions can have the opposite outcome. Although not all inclusive, the above recommendations can materially improve experimental field trials and associated data. This will lead to more informed management decisions targeting improved profitability.

Although farm trials are costly and represent a serious commitment of appropriate human resources, there is a significant cost associated with opportunities lost from using less than optimal feeds and feeding techniques. Doing the "right things" in the "right way" will produce a faster return on investment.

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