

FIRE ANT-RELATED ECONOMIC LOSSES VERSUS OPERATION SIZE IN CATTLE PRODUCTION: RESULTS OF THE TEXAS CATTLE PRODUCER'S SURVEY

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In 1994, the Texas Agricultural Extension Service with cooperation from the Texas and Southwestern Cattle Raiser's Association (TSCRA), mailed a detailed survey on fire ant-related economic losses to TSCRA members in 72 fire ant-infested counties. The impetus of the survey was to document these losses in order to develop Integrated Pest Management programs for the red imported fire ant. Survey results indicated that fire ant related losses were both widespread and costly, though with substantial variations, even between ranches in the same county. Because of these variations, it is imprudent to make a "one-size-fits-all" management plan. Rather, an operation-by-operation cost analysis is called for in which losses are balanced against treatment costs so that fire ant management can be justified economically.

Nevertheless, survey comments, among other sources, indicate that there is still widespread interest in large-scale fire ant treatment programs. In urban and suburban settings, there is rarely an economic component involved in making treatment decision, other than out-of-pocket costs. In agricultural situations, however, the cost of treating large areas must be balanced by the economic benefits of reducing fire ant damage. Consequently, the need exists for some way to estimate or predict losses without going through detailed cost analyses of every property involved.

Choosing a Predictor

To develop an accurate method of estimation, it is necessary to have an accurate independent variable, or predictor, on which to base the estimates. A ranch must have two things to be called a ranch - cattle and land on which to raise them. Though there are ant-related losses associated directly with cattle, the number of head varies on almost a weekly basis for many operations and is dependent on constantly fluctuating weather and economic factors. Acreage, however, has many advantages for this purpose. Despite land sales, leases and changes in production status, the amount of land on which cattle and hay are raised is relatively constant. Most fire ant-related costs are at least indirectly associated with the amount of land in production. Acreage in agricultural production is publicly accessible information, whether in the form of county tax records or state and national census figures. Finally, acreage in production was provided by nearly all respondents to the Cattle Producer's Survey from which the economic information was extracted.

Frequency of Fire Ant Damage

There are two components to predicting fire ant-related losses - frequency and the loss per-

respondent amount. This report will deal primarily with loss amount since it is a much more complicated subject. However, any loss on a per operation basis **must** be tempered by the fact that not every operation suffers every type of loss. In fact, most operations suffer just a few types of loss on a regular basis.

Of the 4,521 surveys mailed to TSCRA members, 1,540 were returned, or 34%. Of these, 1,090 (70.8%) included some dollar figure for economic loss due to fire ants. Perhaps more importantly, this means that nearly 30% of respondents within the fire ant-infested portion of the state reported no fire ant damage. It was necessary to group the detailed areas of loss into categories for meaningful analysis in this report. Surprisingly, only 309 respondents (28.3% of those reporting losses) reported a loss in every broad category. Further examination revealed that only 65 *respondents* (5.9%) reported a loss in every area of the survey excluding personal injury, losses to other animals, and hunting. Losses in hay production were not included in this figure since they were analyzed separately.

It is important to note that all dollar figures reported here are on a per respondent basis *only for those responding in each category*. "Zero" responses are not included since it is inappropriate to predict losses where losses do not occur.

Analysis Method Development

With 1,090 surveys to analyze, the total number of economic responses in the included categories came to almost 13,000. Therefore, it was necessary to examine these data in both graph form and through the use of statistics in order to comprehend them. This brought about its own set of problems. Reported acreage ranged from 1 to 70,000 acres and loss values ranged from \$10 to nearly \$70,000 per year. To further complicate matters, response numbers were heavily weighted towards the lower end of the acreage range. Over one-third of respondents had operations of less than 300 acres with over two-thirds less than 1,000 acres. This meant that graphs over the entire range of values crowded the great majority of responses into one little corner, obscuring important details.

To help resolve this situation, the data set was narrowed using the following criteria. To be included in this analysis a survey must have: included a dollar value in one of the chosen categories, included a positive acreage figure, and fallen within two standard deviations of the mean for total losses and acreage. Despite this seemingly stringent set of conditions, 957 respondents were included in the data set with acreages ranging up to 11,000 and losses to about \$7,300 annually.

Figure 1 shows a scatterplot of the data for total losses vs acreage with a line drawn for a simple linear regression. Note that the regression line is highly significant with almost no probability of it being the result of chance. Also notice that with an R^2 of 0.02 it is a very, very poor fit, meaning that it does a poor job of describing the data. Since the whole object of this analysis is predictive, accurately describing the data is paramount. After many attempts at various regression analysis methods, it was found that a moving average, the second line in Figure 1, gave the best and most

easily understood representation of the data.

A moving average is simply taking a point and averaging the values of a set number of points on either side of it, a "window", then plotting that value against the original point. The "window" then moves to the next data point and the process is repeated. The advantage of a moving average is that it smooths out "noisy" data by diluting unusually high and low values with more common values closer to the mean. It is also a simple mathematical procedure that is easy to understand compared to regression methods. Its main disadvantage is that it inherently "lowers the peaks and raises the valleys." Those peaks and valleys that remain also tend to shift slightly along the X-axis as the window width is adjusted. Therefore, actual values found from a graph of a moving average must be used with caution. What a moving average does is give a better graphical representation of the data.

Graphing Loss Categories

Figure 2 shows the major loss categories across the entire acreage range. Note that the lines are virtually flat after about 2,000 acres. This is due to relatively few respondents above that acreage and the wildly scattered degree of losses they suffered. **Figure 3** includes only those respondents with less than 2,000 acres of land. As mentioned earlier, the dollar amounts associated with the various categories are less important than the shape of the lines.

Pesticide use, the very bottom line, is almost flat across its entire length. Analysis of the individual pesticide use data explains this phenomenon. The majority of fire ant pesticides are used around the home. Whether a ranch is one acre or 1,000 acres, there is usually just one homesite and it only takes so much pesticide to treat that relatively small area.

Note how cattle injury and death rises at a steeper slope than the other lines. Since the number of cattle in an operation is perhaps most closely tied to the number of acres than any other category, its proportional rise is to be expected. The leveling out of the line as acreage increases is probably due to two factors. The first is that there are more large ranches in the western and southern parts of the state where there are fewer fire ant problems. The second is probably one of perceptions. A rancher with a few dozen cattle is more likely to notice fire ant-related losses than a rancher with several hundred. These losses are no more or less real, they are just more likely to be noticed and reported.

The next item of interest is the intriguing "bump" in the material and equipment damage total on the very low end of the acreage scale. **Figure 4** includes only these categories. Note that the range of values on the Y-axis is less than half that of Figures 2 and 3 so the line appears much more jagged despite the increase in size of the moving average "window" from 200 to 300 data points. At this resolution, the "bump" around 200 acres is readily apparent for both electrical damage and shredder damage. There is no such bump for hay and feed losses.

It was first thought that this might be a mathematical anomaly due to a few extreme damage reports and/or greatly varying numbers of respondents between the four categories. However,

electrical damage was reported by 637 respondents (63%), the highest incidence of any category in the entire survey except pesticide use. Shredder damage was reported by only 304 respondents (27.9%), the lowest of the four categories. Ruined feed and hay had 359 and 416 responses respectively. Examination of the data also shows that most of the extreme responses were in feed and hay. Consequently, it can only be assumed that the "bump" is a real phenomenon. But why?

The answer lies in the nature of the ranches, and ranchers, of this size range. Two-hundred acres in any part of Texas is not a full-time ranch, particularly with today's cattle prices. Therefore, it can be safely assumed that the operators of these ranches must also have off-farm jobs or other sources of income. Under most circumstances, that 200 acres will, in fact, provide very little income - to the point that the ranch becomes a "weekend place" rather than a serious money making enterprise. However, it is large enough to require a significant amount of attention. This size operation has its own set of fire ant-related problems versus larger and smaller ranches.

This point can be illustrated by an all-too-real example. Suppose the owner arrives at his ranch for the weekend and finds that fire ants have hit him in all four of the categories shown in Figure 4. He removes the infested feed bags and hay bales from the storage shed, dumps them outside, and lets the ants have them - end of story. He has no desire to spend his weekend without water since the ants have shorted out his well switch, nor does he have the desire to mess with fixing it and get himself electrocuted. So, he calls an electrician and pays \$50 an hour plus parts. While waiting for the electrician, he climbs on his tractor to shred an overgrown pasture. After a time, he hits the inevitable fire ant mound, strips a gearbox and bends a blade which tears the housing. Not having the time, equipment, desire, or, possibly, expertise to fix it himself, he loads the broken shredder onto a trailer and hauls it into town where he pays \$40 an hour shop time plus parts and picks it up the next weekend. Someone who lived on his ranch and operated it as more of a business would have the tools, the welder, and the expertise, and would make time during the week to fix everything to avoid paying those labor costs that cut so deeply into the pocketbook.

Prediction Equations

As useful as the above mentioned graphs are for "seeing" what is going on, they still do not serve very well as a predictor. What is still needed is an equation, or equations, into which one can plug acreage and get an estimated dollar loss. After many attempts, the best way found to do this was by manually fitting linear regression lines across acreage ranges so that their endpoints matched as closely as possible. The result is shown in **Table**

1 with **Figure 5** illustrating the equations graphically for comparison to the moving regression line. Due to the difficulty of fitting these lines, only the relationship between total losses and acreage was determined. Note that Figure 5 only goes up to 2,000 acres and that the line past 950 acres is not statistically significant. This is due to relatively few responses and the high degree of loss variability among these

Table 1. Loss prediction equations.

<u>Acreage range</u>	<u>Equation</u>
1 - 100	loss = \$7.71(ac) + \$337
100 - 950	loss = \$0.84(ac) + \$1,009
>950	loss = \$0.02(ac) + \$1,790 ¹

respondents. A simple average calculated for these responses was almost identical to the regression line over this range.

An Area-wide Economic Treatment Justification Example

What the statistically significant linear regression equations provide is a way of estimating total losses for groups of ranches. This is best illustrated through a hypothetical example as shown in **Table 2**. The important thing to note is that the number of acres to be treated stays the same: 10,000. How these acres are divided is what makes the area-wide treatment program economically feasible or not. Clearly, Scenario 2 is the only practical one economically. Why the huge difference?

Table 2. Hypothetical area-wide treatment scenarios.

	<u>Scenario 1</u>	<u>Scenario 2</u>
Total Acreage	10,000	10,000
Average Ranch Size	500	80
Number of Ranches	20	125
Estimated loss/ranch/yr ¹	1,429	983.80
Cost per acre to treat	\$10	\$10
Total treatment cost	\$100,000	\$100,000
Total Losses/yr	<u>\$28,580</u>	<u>\$122,975</u>
Net Gain/Loss	-\$71,420	+\$22,975

¹ Calculated using regression equations.

As demonstrated earlier, most factors contributing to fire ant damage have little or no proportional relationship to acreage. The relationship is either non-proportional or incremental. For instance, almost every ranch needs at least one water well and its electrical equipment is susceptible to fire ant damage. In fact, a ranch may only need one water well up to a certain size. Beyond that, it may need two. The same holds true for electrical breaker boxes, feed barns, shredders, or anything else. The point is that every ranch needs at least one of these things and that "one thing" is susceptible to damage. Therefore, it is not so much the size of the ranch as it is the very existence of the ranch. The economic feasibility, indeed profit, in Scenario 2 comes from the fact that there are 125 ranches instead of 20 ranches on that 10,000 acres.

But what about the 20 ranchers in Scenario 1? Must they just live with over \$1,400 in losses each year? No. Those items causing the most loss to virtually every rancher are located on very small amounts of land. It is quite likely that the owners of those 500-acre ranches are suffering almost all their losses on less than 100 acres. If they were each to treat only 100 acres, their total treatment costs would drop from \$100,000 to \$20,000, they would realize a profit of over \$8,000 between them, and solve the majority of their problems.

Conclusions

- Individual ranchers are strongly encouraged to do their own cost/benefit analysis regarding fire ant losses before initiating any type of treatment program.
- The frequency of fire ant-related damage must be given equal weight to per-operation losses when making loss estimates for multiple ranches.
- All dollar amounts listed in this report must be treated as estimates. There is tremendous variability depending on numerous factors including geography, topography, weather, climate, and ranch management practices.
- Generally speaking, it is not feasible for ranchers with over 200 acres to treat their entire property.
- Any group or governmental organization planning a large-scale fire ant treatment program should look at the character of the agricultural industry in that area, not just total acreage to be treated, in order to economically justify treatment.
- Areas with high concentrations of small ranches, such as are found around many cities in Texas, are more likely to benefit economically from large-scale fire ant treatments.

Figure 1. Total economic loss versus acreage.

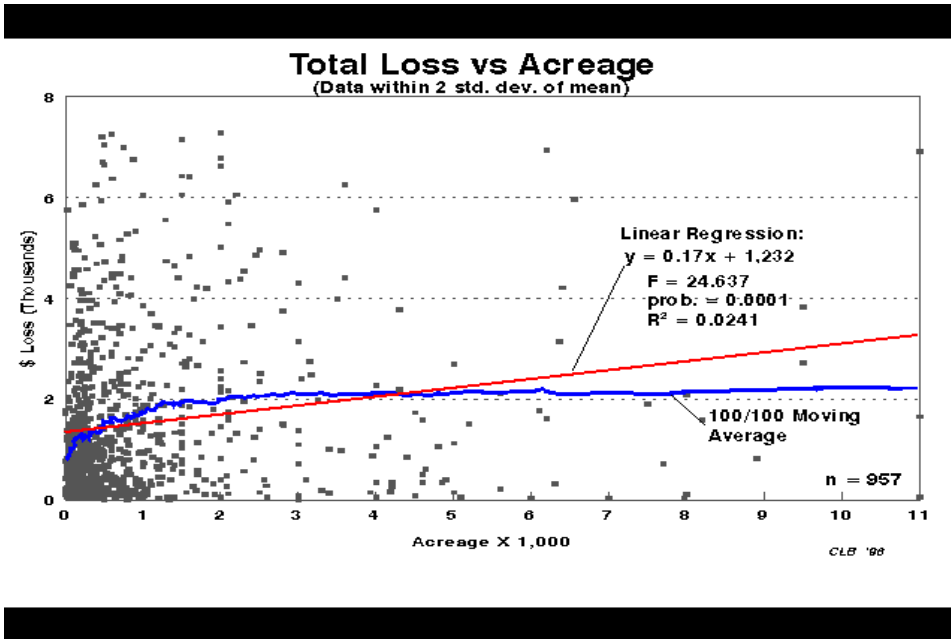


Figure 2. Moving average (100/100) for all loss categories and all acreages.

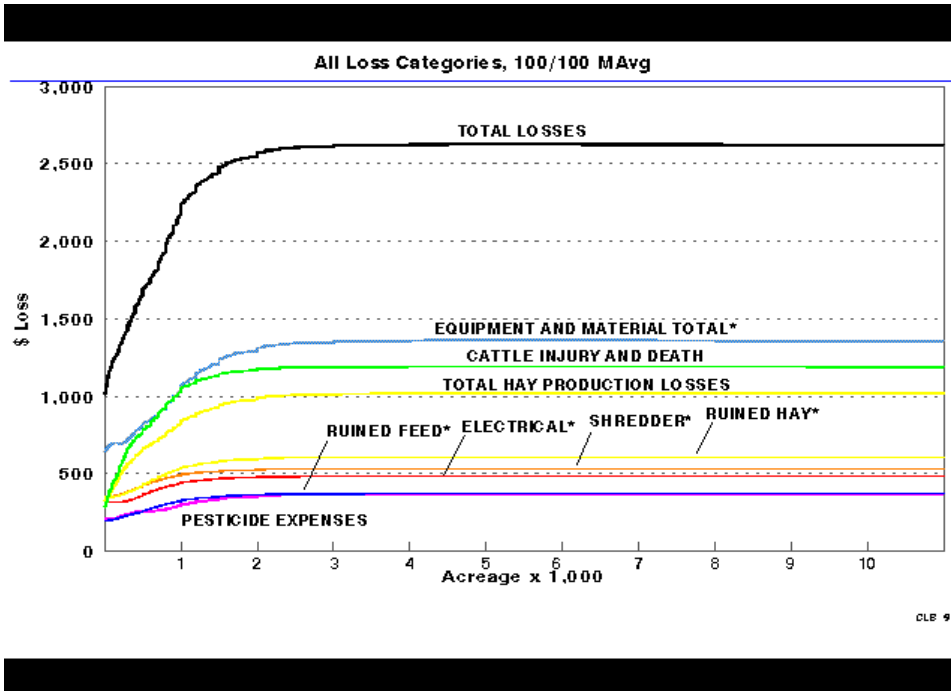


Figure 3. Moving average (100/100) for all loss categories, $\leq 2,000$ acres.

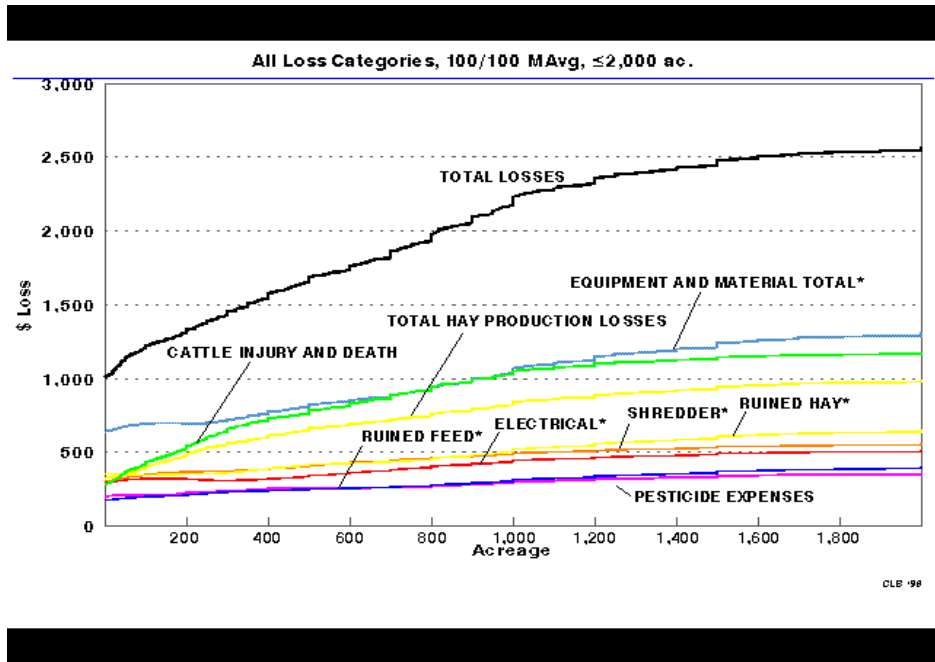


Figure 4. Material and equipment damage, 150/150 moving average, $\leq 2,000$ acres.

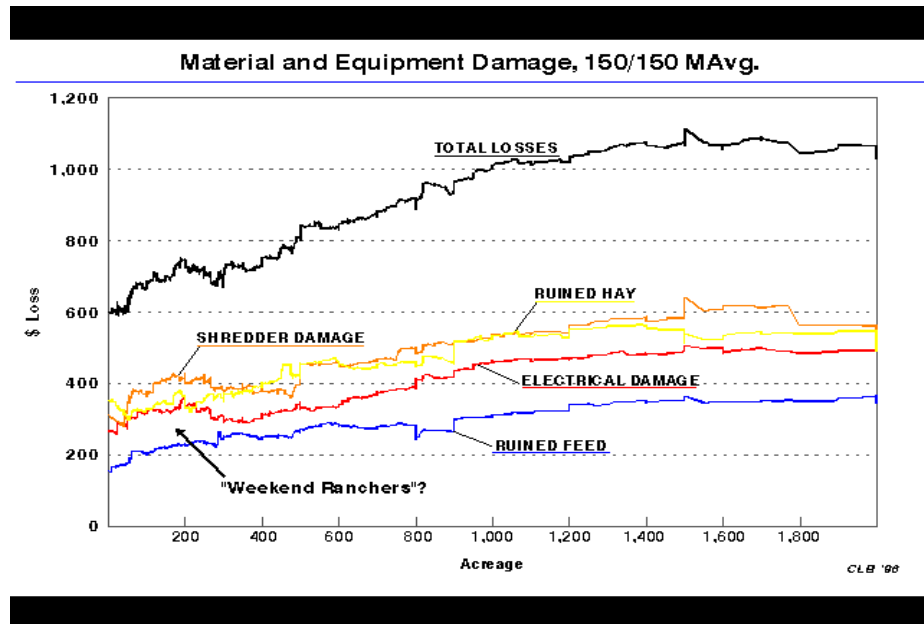


Figure 5. Prediction equations and confidence intervals, $\leq 2,000$ acres

