MINIMIZING COST OF PRODUCTION PER POUND: THE LAW OF DIMINISHING RETURNS AND PRICE

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Abstract

The law of diminishing returns is both a biological and economic law. The production response curve has three components. Stage 1 shows that each additional input of a unit results in a greater output than the previous unit of input. In Stage 2, each additional unit of input results in additional output but a lesser amount than the previous unit of input. Stage 3 results in no additional output for a unit of input or may actually reduce the amount of output. If the nodes on a cotton plant are used as proxies for inputs, we find that at a price of 70 cents per pound at node 18, the output exceeds the cost of a common insecticide application of $14.41. The output at node 19 has a value less than this cost; thus, it would reduce gross returns to make an insect control application at this point. At the price of 50 cents per pound, the last node that is economical to protect is node 17 as the value at node 18 is less than the cost of the unit of input. Given the outlook for prices in the year 2000, this clearly indicates that not only individual inputs must be considered, but the total package of inputs if we are to realize any returns. Regrettably, at expected prices what we may be concerned with is the reduction of loss.

Introduction

It is necessary to begin this presentation by saying that the law of diminishing returns is well understood by economists and biological scientists. This talk, however, is directed towards cotton producers and those working in the agri-business community. This presentation is designed to acquaint cotton producers and industry people with the needs to apply the law of diminishing returns during this era of extremely low prices, not only for cotton, but for other agricultural commodities.

Discussion

The law of diminishing returns states that "If the input of one resource is increased by equal increments per unit of time while the inputs of other resources are held constant, total product output will increase, but beyond some point the resulting output increases will become smaller and smaller." (Leftwich)

Figure 1 depicts a typical production response curve. This supply response curve is derived from plant mapping data developed in the mid-south (Harris, et al).

Figure 2 shows a production response curve by stage. Stage 1 indicates that portion of the curve where with each additional unit of input, in this case node location of the cotton plant, the output is greater than the output resulting from the previous node position or input. Stage 2 indicates that portion of the plant or level of inputs where an additional unit of input continues to increase output but in a lesser rate than a previous unit of input or node. To the far right you will notice a small area of Stage 3. Actually, Stage 3 may continue on but for presentation purpose, only a small portion is presented. In Stage 3, an additional unit of input or node location results in no increase in output from the previous node for unit of input. At some point, added input units may actually result in a decline in total productivity. Figures 1 and 2 are the same production response curve and are derived from plant mapping (Harris, et al) for a typical mid-south cotton plant.

Figure 3 presents that portion of the total productivity contributed by each node. It should be pointed out that the totals for each node are position one age equivalents. If we examine the plant, starting at node 6 and moving up the plant, the percentage of the total output increases between node 6 and node 12. However, at node 13, while output continues to increase, it was less than at node 12 and it continues to diminish from node 13 through node 21. This presentation is concerned with how we determine when to quit adding additional inputs (nodes) so as to maximize returns; or as with the case of the current low price how to minimize losses. For the purpose of this paper, a yield of 850 pounds, slightly higher than the Mississippi Delta average, was used to place a value in terms of weight for each node location.

Figure 4 presents the pounds per acre generated by each node with a yield of 850 pounds. It should be noted at node 12 the yield from that location is 103 pounds. At node 14 the yield is only 96 and diminishes to where at node 21 there are only 2 pounds of lint produced.

Figure 5 shows the value of each node at 70 and 50 cents per pound.

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Figure 6 presents the cumulative lint yield per acre by mainstem node for 850 pounds of lint per acre. This is exactly the same curve presented in Figures 1 and 2.

Figure 7 presents the cumulative dollars per acre at each node site if cotton is valued at 70 cents per pound. We continue to add inputs or protect node sites as long as the value of each unit of input is less than the value of the additional output from that unit. Maximum income is generated at the point where for $1.00 of additional input we receive $1.01 of added revenue. The cumulative value of output is maximized at this point. Revenues are reduced at the next point above where the cost of an additional unit of input, or the cost of protecting the next node, exceeds the value of that unit or node. Let us examine the value of nodes 17, 18 and 19 first when cotton lint is worth 70 cents per pound. A study by Harris, et al conducted to determine when insect control should be terminated indicates that over time the cost of insect control increases and by late season rises to an average of $14.62 per acre. The law of diminishing returns tells us that we should continue to add inputs, in this case insecticide applications, as long as the increased value of cotton is greater than the cost. When we arrive at the point where the value of increased yield equals the cost of the input, insect control, returns are maximized. As we look at Figure 7, node 18 at 70 cents, we see the value of the cotton produced at that location is $16.66. If we make an application at node 19, the value of the lint produced at this site is only $11.90. A $14.62 insecticide application would result in lost revenue at node 19, and this application should not be made.

Now, let us examine Figure 8, which shows returns with the same output at each node but with cotton price at only 50 cents per pound. At node 18 the value of output at 50 cents is only $11.90 per acre and at node 17 is $18.23. Beneficial returns would be obtained in this case from an application at node 17 and not node 18. The value of the output at any given node and in total is significantly different when cotton is 70 cents per pound than it is at 50 cents per pound.

It should be pointed out that there are a total of 20 additional pounds of cotton to be found on nodes 19, 20 and 21. At 70 cents per pound, this cotton is worth $14.41. At 50 cents per pound, this cotton is worth $7.33. To some extent, these sites are protected by the application made to protect node 18. However, the degree of protection from the application at node 18 is not well known and quite often some of these sites are not harvestable due to failure to open or being too small for the picker to extract the cotton. If an additional application at $14.62 is required to protect these nodes, it is very clear that this would be a bad economic decision at either price. The insect termination rule is driven by two pieces of data-- the physiological stage of development of the plant, that is node above white flower 5, and heat units. If, in addition, we had an understanding of insect damage, information for termination would be as near perfect as possible.

Let us look at Figure 9 and we see that the cumulative value of output at node 18 and 70 cents per pound is $580.55 per acre. If cotton is only 50 cents per pound, the cumulative value of node 18 is only $402.78. The 50-cent price when compared with the 70-cent price results in a reduction of gross receipts of $177.77.

This reduction in total receipts tells us that we must do something not only about the amount of expenditures in insect control, but in all inputs. Unfortunately, weather and interactions of the sum total of inputs do not allow us to precisely measure that point at which inputs should be terminated. However, it does tell us that to minimize losses some reduction in total inputs must be made. Yet, these reductions in inputs must be approached cautiously. No input should be reduced to the point where it becomes a limiting factor in yield. That is, any given input or package of inputs must move us from Stage 1 of the production response curve into Stage 2 of the production response curve. Regrettably, it is difficult, if not impossible, to advise producers as to how much of what inputs to reduce. A conscious effort must be made to reduce inputs in such a manner as to have a real impact on the total cost of inputs.

Summary

In conclusion, we must say when faced with prices of 50 cents for cotton, we cannot continue to survive using the level of inputs that have been typical for the last ten years. The whole purpose of this presentation is to make producers aware that significant adjustments must be made for the 2,000 crop if they are to survive economically. These adjustments may take the form of scaling back on many of the total inputs used in production while continuing to produce cotton in the usual manner. Cut-backs may also occur from the benefits associated with new and relatively untried production systems such as ultra narrow row cotton, no-till cotton, and reduced tillage cotton. Thank you.

References

Leftwich, Richard H. *The Price System and Resource Allocation*. 1955. Rhinehart & Company, Inc., New York.1955. P. 102.

Harris, F. Aubrey, Fred T. Cooke, Jr., Gordon L. Andrews, and Randle E. Furr, Jr. *Monitoring Node Above White Flower as Basis for Cotton Insecticide Treatment Termination*. MAFES, MSU Bulletin 1068, June 1997.

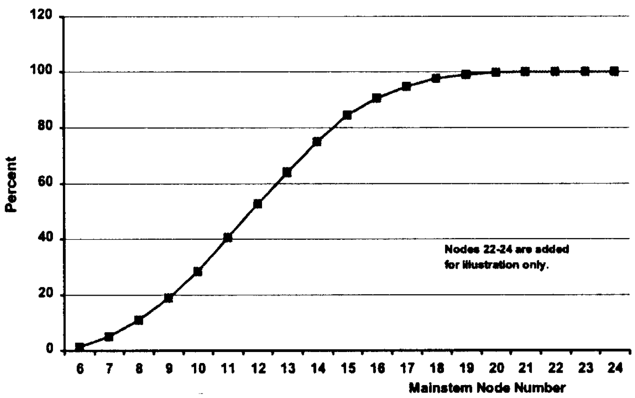

Figure 1. Supply Response Curve.

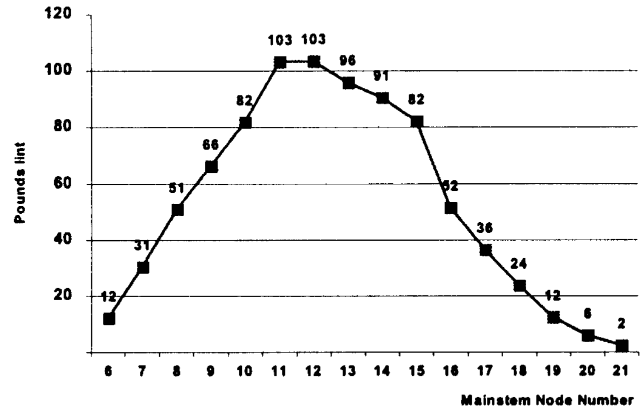

Figure 4. Lint weight per mainstem node.

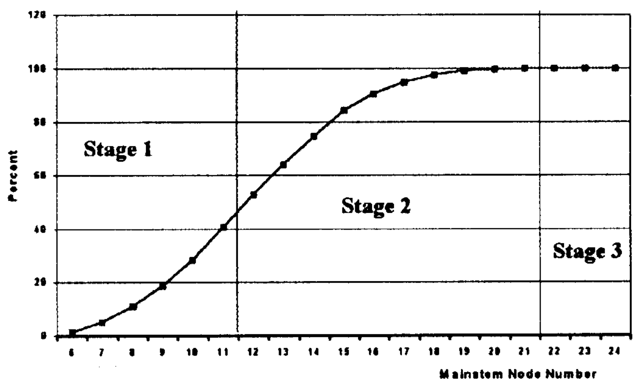

Figure 2. Supply Response Curve by Stage.

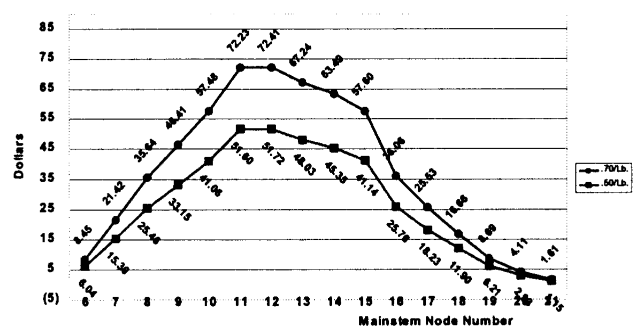

Figure 5. Value of lint per mainstem node at $0.70 and $0.50 per pound lint.

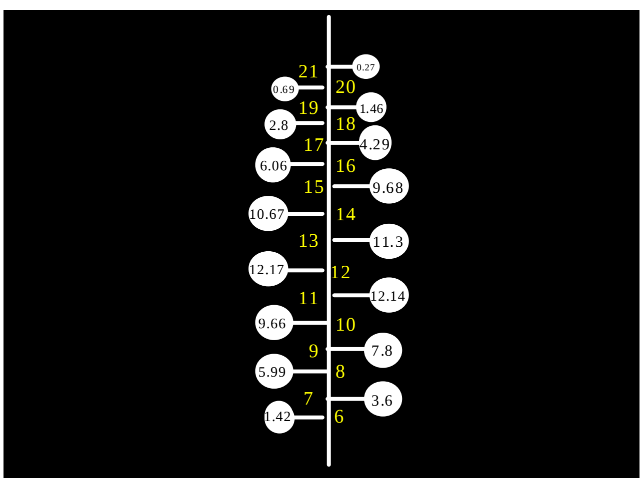

Figure 3. Percent of total yield by mainstem node.

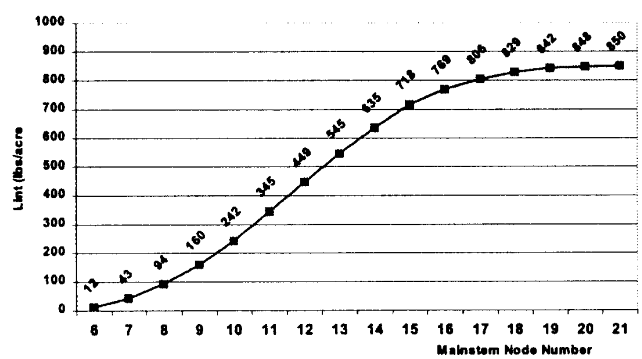

Figure 6. Cumulative lint yield per acre by mainstem node: 850 pounds per acre.

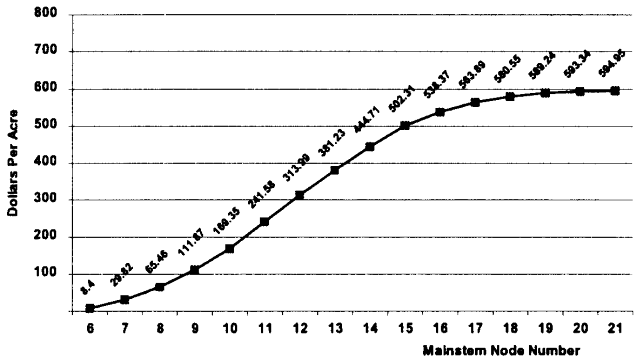

Figure 7. Cululative dollars per acre by mainstem node at $0.70 per pound of lint.

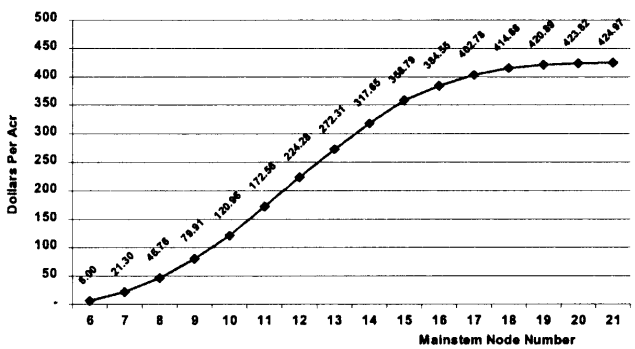

Figure 8. Cumulative dollars per acre by mainstem node at $0.50 per pound of lint.

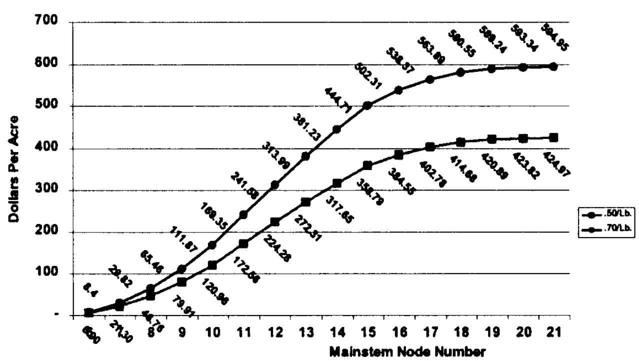

Figure 9. Cumulative dollars per acre by mainstem node.