SPATIAL BREAK-EVEN ANALYSIS OF VARIABLE RATE POTASSIUM APPLICATION TECHNOLOGY ON COTTON: AN APPLICATION ON A SOYBEAN-COTTON FIELD IN WESTERN TENNESSEE

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Abstract

Answering the question, "will adopting new input application technology benefit the producer?" requires spatial analysis of a producer's farm, and should incorporate a comparison between current practices of the producer to the technology under consideration for adoption. In addition, it makes sense to use a mapping system to indicate areas of each field where a producer will benefit from adopting variable rate application technology. From this comparison, either information on additional profit, or information on how much a farmer can afford to spend on the technology can be visually as well as numerically presented.

In this analysis, a field previously in soybeans was tested for potassium. These data were geo-referenced and placed in AGRIS, mapping software. Using hypothetical information on yields and the actual information on nutrient availability, crop management zones were established. Yield response curves for each of the regions were developed from information presented article by a Roberts, et al. on folier K application. Yield potential was assumed to be at a maximum at approximately 1100, 840, and 550 pounds per acre for the good, average, and poor crop management zones, respectively.

Three different fertilizer application methods were examined. The producer was to use a uniform application method with the amount to apply dependant on a single soil sample taken either over the entire field and hence is an average (AVE) or on the best responding soil (MAX)[1]. The results of these two applications on the field given the aforementioned soil samples were calculated. These results were then compared to the estimates that occurred when variable rate application technology was used. Given the response functions, soil test information, a $0.627/pound price for lint, and a $0.05/pound for K_2O, amounts of potash estimated to be optimally applied for each soil test sample with in each crop management zones. K_2O was assumed to be applied as indicated on the K_2O applied contour map.

Given the information provided, the producer in this case should adopt variable rate application technology. In this example, increased yields and decreased K_2O application costs provided the producer an increased net return ranging from $0 to $130/ acre. The largest returns from adopting variable rate application technology occurred in that crop management zone having the largest response to potash. The average per acre benefits from adopting variable rate application technology was $11.53/acre when compared to uniform average application rates and $5.65/acre when compared to uniform maximum application rates. [2] Current cost estimates for the purchase of services capable of providing this technology is $4.50 per acre per year once a complete soil sampling of the field had been conducted.

By examining the maps, the producer might benefit more by applying different application technologies to different portions of the field. For instance, from the data, it appears from the maps that the benefits from using variable rate technology decline on the average and poor responding crop management zones. On these zones, it might be better off to use uniform rate application. The economic impacts of applying variable rate application technology to the high responding areas would be an important tissue to address. GIS mapping of the fields should incorporate costs and returns so that the producer can have additional spatial information on the profitability of their fields and crop management zones.

[1] While discussing previous work, a question as to farmer's decision on fertilizer application seems to surface. Do farmers apply an average amount? Or do they apply to reduce stress from the input on their best lands.

[2] The response functions used in the analysis are quadratic plateau functions. Thus, there is no penalty for over fertilization.

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