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A Return-Risk Analysis of Southern Row Crop Enterprises and the Sod-Based Rotation

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This study examined the expected returns and risks for traditional row crop production systems in comparison to a new experimental sod-based rotation system in the Southeastern Gulf Coast region of Alabama. The sod-based rotation system involved a rotation sequence of two years of Bahiagrass with cattle grazing followed by peanuts then cotton. A Target Minimization of Total Absolute Deviations (MOTAD) model was developed to examine the return-risk relationships of six enterprise alternatives. The results of this study indicated that a sod-based rotation system was more risky and produced less returns than the traditional peanut-cotton rotations in the study region.

Key words: economic analysis, linear programming, production economics, risk, risk-efficient frontier, row crops, sod-based rotation, target MOTAD

In the southeastern United States, peanuts and cotton are major summer agronomic row crops. Farmers are facing great challenges in maintaining sustainable crop yields and profitability (Garcia et al., 2010). Many producers are concerned about lower profit levels resulting from erratic crop yields and price swings. Consequently, producers are extremely interested in examining the factors that affect row-crop enterprise profit and risk levels including the use of irrigation and the integration of alternative crops and livestock.

The development of a sod-based rotation system with beef cattle has been promoted as a production system that will improve yields and reduced production costs when compared with the traditional row-crop enterprises (Brenneman et al., 2003). The sod-based rotation system integrates beef cattle and perennial Bahiagrass into the traditional

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peanut-cotton crop rotation system. Experimental results between 2007-2012 from the established sod-based systems at the Wiregrass Research and Extension Center in Headland, Ala. and the North Florida Research and Education Center in Mariana, Fla. documented that an increase in peanut and cotton yields from the introduction of two years of Bahiagrass along with cattle grazing before planting peanuts followed by cotton (unpublished yield data). The inclusion of Bahiagrass in the rotation has been found to reduce pest and disease pressure in row crop production, build organic matter to aid in soil water holding capacity, and otherwise improve soil properties (Wright et al., 2013). This study seeks to determine whether the sod-based rotation system provides farmers with a system that outperforms the traditional production system with respect to economic returns and risk.

Method of Analysis

This study examines the return-risk relationship of six production alternatives, which included current and experimental rotation systems in the Coastal Plain regions of Alabama and Florida (Prevatt, 2013). They included 1) rain-fed traditional peanut-cotton rotation (TPC-RF), 2) irrigated traditional peanut-cotton rotation (TPC-IRR), 3) irrigated sod-based rotation of peanuts, cotton, and Bahiagrass with a cow-calf enterprise (SBR AL-IRR), 4) rain-fed traditional wheat, soybeans, and corn rotation (TWSC-RF), 5) irrigated land rented out (IRRLNDRT), and 6) rain-fed land rented out (RFLNDRT).

A Target MOTAD model was utilized to evaluate the level of expected returns and risks associated with the production of the rotation systems. The Target MOTAD model presented by Tauer (1983) is a modification of MOTAD that minimizes the negative deviations from the target level of return. Target MOTAD is an extension of the linear programming framework. The returns for the Target MOTAD model are computed as returns over variable costs. The fixed costs associated with production of agricultural products are included in the target level of return (Prevatt et al., 1992). The MOTAD model was chosen because of its ability to consider two-attributes (returns and risk) simultaneously subject to a given target level of return.

The Target MOTAD model was used to identify a farm plan which would maximize the expected returns for a given level of risk and target income. The model was developed on the assumption that decision-makers desire to make choices which maximize expected returns (Enke, 1951).

The mathematical notation of the Target MOTAD model presented by Tauer (1983) may be described as:

$$\text{Max } E(z) = \sum_{j=1}^{n} k_j x_j \qquad \text{(for all } j = 1, \ldots, n) \qquad (1)$$

subject to

$$\sum_{j=1}^{n} a_{kj} x_j \le b_k \qquad \text{(for all } k = 1, \ldots, m) \qquad (2)$$

$$T - \sum_{j=1}^{n} c_{rj} x_j - y_r \le 0 \qquad \text{(for all } r = 1, \ldots, s) \qquad (3)$$

$$\sum_{r=1}^{s} p_r y_r = \lambda = G \qquad G = M \qquad (4)$$

For all $x_j \geq 0$ and $y_r \geq 0$.

Where,
$E(z)$ = the expected return of the solution;
k_j = net return from the j^{th} activity;
x_j = the level of the j^{th} activity;
n = number of activities;
a_{kj} = technical coefficient of j^{th} activity for the k^{th} constraint;
b_k = level of resource for the k^{th} constraint;
T = target return;
c_{rj} – return of j^{th} activity for observation r;
y_r – deviation below target return for observation r;
S = the number of states of nature/observation (years in this study);
p_r = probability of occurring of observation r;
G = constant associated with the level of risk (sometimes written as λ and parameterized from zero to unbounded in order to generate a risk efficient set);
M = an arbitrary large number

Utilizing the Target MOTAD framework enables the determination of the optimal enterprise mix to meet a specified target level of return while taking into account the relative risk of each enterprise (Hazell, 1971). Numerous agricultural production and marketing studies have employed the use of this technique such as Novak, Mitchell, and Crews, 1990; Prevatt et al., 1992; and Mckissick, Dykes, and Turner, 1991. The objective of this study was to maximize the expected return from the alternative row-crop production scenarios in the Southeast that are both subject to resource constraints and a given minimum level of risk associated with a specified target level of return.

Each solution from the Target MOTAD model provided a specific expected return and risk measurement. The expected returns and risk (expected negative deviations below a predetermined target level of return) determined a point on the risk-efficient frontier (Prevatt et al., 1992). Additionally, the model results also specify the next higher level of risk for which the optimal solution will change for a higher level of expected returns. By allowing for the successively higher levels of risk in model runs, a complete set of solutions was used to determine a risk-efficient frontier. The risk-efficient frontier traced out a description of the various levels of expected returns and risk.

The first point, point A, of the risk-efficient frontier represents the minimum level of risk (lowest risk solution) and the lowest expected return. The last point of the risk-efficient frontier, point F, represents the maximum level of risk and maximum expected return for the model subject to resource constraints, or the linear programming solution. The interior points on the risk-efficient frontier represent solutions for which the algorithm has changed. Unlike enterprise budgets or linear programming, no single solution is obtained by using a Target MOTAD analysis. Instead, an optimal solution is generated for each level of risk specified (Berbel, 1990). A larger level of expected return and risk were realized for each successive point on the risk-efficient frontier. Thus, individuals with strong risk averse characteristics would select the first point on any given risk-efficient frontier.

The Target MOTAD model in this study included six activities to evaluate the return-risk relationships of traditional row-crop enterprises of the Southeast along with the relatively new irrigated sod-based rotation system. The center pivot irrigation systems used in this study operate over 160 acres. This limits the land resources to 160 acre units for each system. However, actual productive land varies slightly because of the ability of a center pivot irrigation system to reach the corners of square fields. Multiple rotation systems were allowed on a 1,280 acre farm which is typical of the region (Brown, 2013). The irrigated sod-based rotation system with cattle consisted of 32 acres of cotton, 32 acres of peanuts, and 64 acres of Bahiagrass for cattle grazing. The irrigated traditional peanut-cotton rotation consists of 64 acres of cotton and 64 acres of peanuts. The traditional rain-fed peanut-cotton rotation consists of 160 acres which are rotated between 80 acres of cotton and 80 acres of peanuts. The rain-fed wheat, soybeans, and corn rotation consists of 53.33 acres of wheat, 53.33 acres of soybeans, and 53.33 acres of corn. Additionally, the model was allowed to rent out the available irrigated land and rain-fed land. Land rental was included as a revenue option as the land in this study is assumed to be owned and can be utilized as a source of revenue generation. Producers that are risk averse may choose to rent their land out to other farmers.

Table 1. Basic Data for the Target MOTAD Model

Type of Enterprise	Acres	Units	Total Production	Mean Yield	Mean Price $/Unit	Mean Gross Revenue	Mean Variable Costs	Mean Returns Over Var. Costs
SBR Rotation AL- Irrigated								
Peanuts	32 Acres	Pounds	166,347	5198	0.24	$ 40,156.53	$ 30,571.69	$ 9,584.84
Cotton	32 Acres	Pounds	42,880	1340	0.77	$ 33,014.86	$ 34,057.26	$ (1,042.41)
Beef Cattle	64 Acres	Pounds	41,682	651	1.18	$ 49,108.39	$ 36,482.86	$ 12,625.53
Peanuts and Cotton - Irrigated								
Peanuts	64 Acres	Pounds	301,297	4708	0.24	$ 72,734.01	$ 55,367.10	$ 18,687.68
Cotton	64 Acres	Pounds	79,989	1250	0.77	$ 61,586.67	$ 59,100.12	$ 3,391.72
Peanuts and Cotton - Rainfed								
Peanuts	80 Acres	Pounds	358,587	4482	0.24	$ 86,563.77	$ 56,943.80	$ 30,602.05
Cotton	80 Acres	Pounds	77,253	966	0.77	$ 59,480.13	$ 65,635.21	$ (6,862.52)
Wheat, Soybeans, Corn - Rainfed								
Wheat	53.3 Acres	Bushels	3,469	65	6.07	$ 21,041.97	$ 24,491.88	$ (4,939.44)
Soybeans	53.3 Acres	Bushels	1,954	37	11.69	$ 22,852.85	$ 19,293.36	$ 3,864.81
Corn	53.3 Acres	Bushels	6,039	113	5.42	$ 32,741.12	$ 30,573.82	$ (663.94)
Irrigated Land Rented Out	160 Acres				87.50	$ 14,000.00		$ 13,602.50
Rainfed Land Rented Out	160 Acres				47.33	$ 7,573.33		$ 7,354.40

The application of a Target MOTAD model requires the use of enterprise budgets to estimate the returns and the cost of production for each enterprise (Prevatt et al., 1992). A typical mixed enterprise farm located in the Coastal Plain region of the Southern United States was used for this study. The farm is assumed to possess average quality land, improvements to land (fencing, barn, etc.), and the needed machinery and equipment that is associated with row-crop production. This analysis assumes proper row-crop and cattle management practices.

The acres, units, mean total production, mean yield, mean price, mean gross revenue, mean variable costs, and mean returns over variable costs are shown in Table 1.

The yield data for this study were collected from both experimental plots and farms in the Coastal Plain region of Alabama for the years 2007-2012 (unpublished research data, and Brown, 2013). Though a longer time is desirable, it is assumed that a six-year period is long enough to capture some degree of price and yield variability.

In addition to land, other resource constraints in the model are operator labor, operating capital, allowed risk, and target income. The resource constraints ensure that the use of any given resource does not exceed its availability. As indicated, a farm with 1,280 acres was assumed for this analysis. The land constraints that were placed on the model included rain-fed land and irrigated land. Each type of land is allowed an equal amount of acreage to compete. Rain-fed land was constrained to 640 acres and irrigated land was constrained to 640 acres (512 productive irrigated acres), respectively. Only the rain-fed method fully utilizes the available acreage to produce crops. The irrigation systems leave dry corners, utilizing only 80% of the available acreage to produce crops. Labor and management are assumed to be provided by the owner-operator and not to exceed 1,920 hours annually (48 wk/yr * 40 hr/wk). Additional labor was assumed to be hired as necessary (unconstrained). The operating capital requirements for various levels of risks were measured, as well. The operating capital row was included as an unconstrained resource. Operating capital was assumed to be unconstrained due to the lower level of indebtedness. Producers were assumed to be able to effectively implement the latest production technologies.

The variable costs of each row-crop enterprise include the costs associated with growing, overhead (utilities, equipment maintenance, etc.), harvesting, and marketing (hauling, commission fees, warehouse fees, etc.). In the sod-based rotation system the establishment cost of Bahiagrass was equally allocated to peanuts, cotton, and cattle. Thus, the returns from the Bahiagrass sod are seen through the yield improvements in peanuts and cotton, as well as through the sale of cattle. The market price data and variable cost data for the six-year period are in real dollars using the consumer price index (CPI, 2011=100). The returns for each enterprise were reduced by the variable costs of the enterprise crop to obtain returns above variable costs. The returns over variable costs for the six years (2007-2012) were used to calculate the expected return for each enterprise. The expected return estimates were the objective function values used for each activity in the Target MOTAD model.

The target level of return was composed of the operator's wage, debt payment, and the opportunity cost of owned assets. The operator's wage reflects the opportunity costs associated with the operator's labor and management skills. The operator's wage was assumed to be $50,000, which is about the average U.S. salary in 2011 (U.S. Department of Labor, 2012). Machinery and equipment investment costs used in this analysis were discussed with Alabama Ag Credit. The annual debt payment was based on the investment cost for machinery and equipment of $500,000 for row-crop production. The level of debt was set at 30% of the investment cost with the remaining 70% being owned assets. The debt serviced is financed over 10 years which is generally the maximum period of time allowed for loan repayment. The annual interest rate used for the financed debt was 6%. All of these factors are dependent on individual farmers and their lenders. The annual debt payment for the fixed costs of machinery and equipment was $20,380. The opportunity cost associated with the owned assets (land and machinery/equipment) was based on the market value of these assets times an opportunity cost of 2% (current rate of a certificate of deposit). The opportunity cost associated with these owned assets was $37,000 which was calculated based on 70% of the machinery and equipment investment cost and 100% of the owned land asset value multiplied by the alternative investment earnings of 2% earnings. The target level of return sums to a total of $107,380 ($20,380 + $37,000 + $50,000). The target return estimate in this study was rounded to $100,000.

Results

The results of the Target MOTAD model evaluating the six production scenarios are presented in Table 2. Initially, the model was used to determine the maximum expected return from the selected enterprises for a target level of return of $100,000. Points A through F in Table 2 represent the alternative solutions over the selected risk preference levels. The four enterprises that entered into the optimal solution included a traditional rain-fed peanut-cotton rotation (TPC-RF), irrigated land rented out (IRRLNDRT), rain-fed land rented out (RFLNDRT), and the traditional irrigated peanut-cotton rotation (TPC-IRR). The new sod-based rotation system (SBR AL-IRR) did not enter the solution.

The risk minimum solution shown as point A in Figure 1 included irrigated land rented out (IRRLNDRT), rain-fed land rented out (RFLNDRT), and rain-fed traditional peanut-cotton rotation (TPC-RF) at 4.00, 3.85, and 0.15 units of 160 acres each, respectively. The level of owner-operator labor and hired labor for this solution was 41 and 0 hours, respectively. The level of operating capital used at this solution level was $18,420. The risk level and maximum expected return associated with point A was $14,464 and $86,339, respectively. At point A, the target level of return of $100,000 was not achieved as reflected by the risk level.

Allowing for changes in risk levels the model determined the optimal solutions associated with points B, C, D, E, and F. At points B, C, D, E, and F the optimal solution and the maximum expected return exceeded the target return of $100,000. For the additional increases in the level of risk, the maximum expected return increased. As risk increased, more units of the rain-fed traditional peanut cotton rotation (TPC-RF) came into the solution and replaced rain-fed land rented out (RFLNDRT). As allowed risk increased, the traditional irrigated peanut-cotton rotation (TPC-IRR) came into solution and replaced irrigated land rented out (IRRLNDRT).

The final point of the solution (point F) included the rain-fed traditional peanut-cotton rotation (TPC-RF) and the irrigated traditional peanut-cotton rotation (TPC-IRR) at 4.00 and 4.00 units of 160 acres each, respectively. The level of owner-operator labor and hired labor for this solution was 827 and 1,155 hours, respectively. The level of operating capital used for this point was $929,538. The risk level and maximum expected return associated with point F was $77,635 and $169,411, respectively. At point F, the target level of return of $100,000 was achieved.

Table 2. Target MOTAD Model Solutions and Activity Levels, $100,000 Target Return[a]

Item[a]	Point A	Point B	Point C	Point D	Point E	Point F
			Number of 160 Acre Units			
SBRAL-IRR						
TPC-IRR						4.00
TPC-RF	0.15	1.32	1.96	3.63	4.00	4.00
TWSC-RF						
IRRLNDRT	4.00	4.00	4.00	4.00	4.00	0.00
RFLNDRT	3.85	2.68	2.04	0.37	0.00	0.00
Total[b]	8.00	8.00	8.00	8.00	8.00	8.00
OPRLAB (hr.)	41	354	450	560	584	827
HIRELAB (hr.)	0	0	78	417	493	1,155
Operating Captial ($)	$18,420	$158,141	$235,648	$436,132	$480,682	$929,538
Expected return ($)	$86,339	$105,390	$115,016	$138,385	$143,455	$169,411
Change in expected return ($)		$19,051	$9,626	$23,369	$5,070	$25,956
Risk ($)	$14,464	$19,872	$22,872	$30,632	$32,671	$77,635
Change in risk ($)		$5,408	$3,000	$7,760	$2,039	$44,964
Return-risk ratio[c]		$3.52	$3.21	$3.01	$2.49	$0.58

[a]Abbreviations for enterprise activities and labor include: (SBR-IRR) Sod-Based Rotation Irrigated; (TPC-IRR) Traditional Peanut-Cotton Rotation Irrigated; (TPC-RF) Traditional Peanut-Cotton Rotation Rain-fed; (TWSC-RF) Traditional Wheat-Soybeans-Corn Rotation Rain-fed; (IRRLNDRT) - Irrigated Land Rented Out; (RFLNDRT) Rain-fed Land Rented Out; (OPRLAB) Operator Labor Hours; (HIRELAB) Hired Labor Hours.

[b]Acreage total may not sum exactly due to rounding error. Total acreage may be calculated by multiplying the total unit above by 160 acres.

[c]Return-risk ratio is the dollar value increase in expected return for each additional dollar of risk incurred between the two relevant points.

A return-risk ratio measurement was calculated between each of the points to develop a risk-efficient frontier. Figure 1 described the expected return-risk relationship. The return-risk ratios of $3.52, $3.21, $3.01, $2.49 and $0.58 measures the additional dollars of expected return for each additional dollar of risk incurred between the relevant points. The selection of management plans associated with points B, C, D, and E each contributed more than a dollar of expected return for each additional dollar of risk. Between point E and F the return-risk ratio was less than one, indicating that an increase in expected return of $0.58 was realized for each additional dollar of risk.

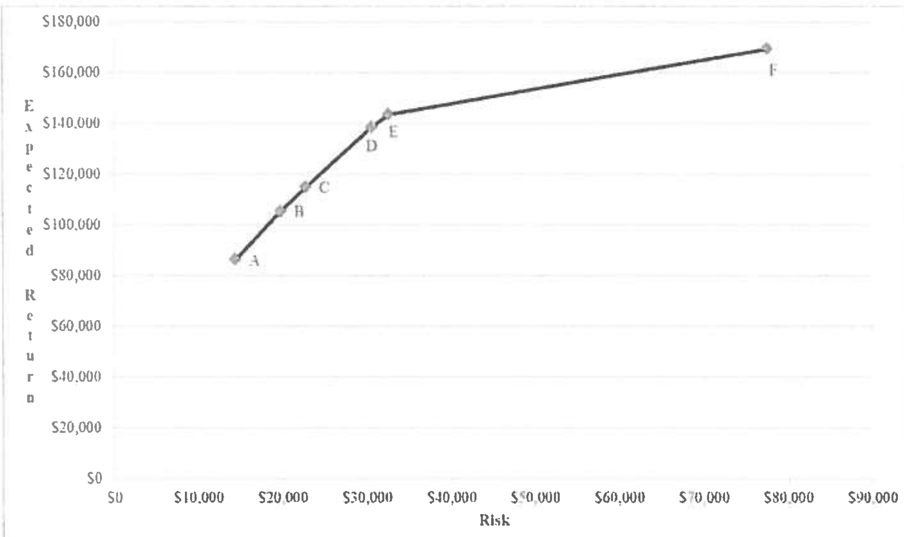

Figure 1. Risk Efficient Frontier, $100,000 Target Return

The operating capital required increased as the model accepted more risk. The level of operating capital dramatically increased between the points (i.e., from $18,420 at point A to $929,538 at point F). In general, the largest level of operating capital was associated with the highest levels of risk and the maximum expected return (last point on the return-risk frontier).

Summary and Conclusions

The Target MOTAD model used in this study helped explain the level of return and risk for row-crop enterprise alternatives in the coastal plain region of Alabama and Florida. Based on the results of the analysis, several conclusions may be drawn regarding the production mix, level of risk, expected returns, target level of return, labor, and operating capital that generally supports what row crop farmers are currently doing in the region.

The enterprises selected as optimal by the model included traditional cropping patterns, which included rain-fed peanut-cotton, irrigated land rented out, rain-fed land rented out, and irrigated peanut-cotton rotations. Irrigated land rented out was initially selected by the model at the minimum level of risk (and profit). Rain-fed traditional peanut-cotton rotation was selected by the model to achieve the higher levels of profit although with increasing levels of risk.

Based on returns over variable costs, it was determined that the sod-based rotation proved to be an economically viable system; however it did not enter into the optimal solutions when compared to more traditional cropping systems in this region. As indicated by the model the sod-based rotation system produced slightly less risk and lower returns than the irrigated traditional peanut-cotton rotation for producers. The traditional rain-fed peanut-cotton rotation produced much greater returns and less risk than the sod-based rotation. The increase in yield of the sod-based rotation was not enough to justify reducing row crop acreage by roughly one-half, which would be required when converting to a sod-based rotation system. An implication of this study is that growers may not adopt this system without other incentives such as reducing costs, subsidies, or continued increases in yields relative to more traditional systems. However, this analysis does not take into considerations the long-term environmental benefits that may be provided to the producer by adopting the sod-based rotation, which is demonstrated to have numerous soil health benefits (Wright et al., 2012).

This study takes into consideration the productive use of an acre in comparing rain-fed and irrigated acres. Farmers utilizing rain-fed land use the entire acreage to produce crops. For this study, 160 of the 160 rain-fed acres are utilized. Farmers utilizing irrigated land use 80% of the entire acreage to produce crops. For this study, only 128 of the 160 irrigated acres are utilized because the dry corners left by the irrigation system were not planted. The comparison between rain-fed land and irrigated land is not a one to one comparison. In this study, the returns to traditional rain-fed peanut-cotton rotation and the traditional irrigated peanut-cotton rotation are both positive. The advantage of rain-fed production has over irrigated production in this study is having more productive row-crop acres.

Resources and production costs are factors that need to be tailored to individual operations. The conclusions drawn from this analysis are enterprise-specific and should not be extended to other agricultural enterprises with differing resources, technology, markets, and debt. Alterations of one or more factors could change the results and conclusions drawn by this analysis. Regional differences in results could also result.

Since risk is inherent in agriculture, farmers are concerned with any additional risk they assume when they make farm planning decisions. The results of this study document the significant levels of risk associated with different farm plans and the tradeoff between income and risk for successive farm plans, which includes a comparison to the new and experimental sod-based rotation system.

References

Alabama Ag Credit. (2013). Online. Available at https://www.alabamaagcredit.com/

Berbel, J. 1990. "A Comparison of Target MOTAD Efficient Sets and the Choice of Target." *Canadian Journal of Agricultural Economics* 38: 149-58.

Brenneman, T.B., P. Timper, N.A. Minton, and A.W. Johnson. 2003. "*Comparison Of Bahiagrass, Corn, And Cotton As Rotational Crops For Peanut.*" Paper presented at the Sod Based Cropping Systems Conference, North Florida Research and Education Center-Quincy, University of Florida, Feb. 20-21.

Brown, S. 2013. "Gulf Coast Farm Analysis Summary, 2007-2012." Alabama Farm Analysis Association. Alabama Cooperative Extension System. Auburn University. 9 pages.

Enke, S. 1951. "On Maximizing Profits: A Distinction Between Chamberlin and Robinson." *The American Economic Review*. 41: 566-578.

Garcia, A., E.J. Belasco, T.O. Knight, K.H. Coble, P.D. Mitchell, R.M. Rejesus, 2010. "The Evolution of Risk Management Education: An Evaluation of Past and Present Demand." 2010 Annual Meeting, July 25-27, 2010, Denver, Colorado. Agricultural and Applied Economics Association.

Hazell, P.B.R. 1971. "A Linear Alternative to Quadratic and Semivariance Programming for Farm Planning under Uncertainty." *American Journal of Agricultural Economics* 53:53-62

Mckissick, J.M., N.S. Dykes, and S.C. Turner. 1991. "Feeder Cattle Price Differentials In Georgia Teleauctions." *Southern Journal of Agricultural Economics* 23:75-84.

Novak, J.L., C.C. Mitchell, Jr., and J.R. Crews. 1990. "Risk and Sustainable Agriculture: A Target-MOTAD analysis of the 92-year Old Rotation." *Southern Journal of Agricultural Economics* 22:145-154.

Prevatt, C. 2013. "A Return-Risk Analysis of Traditional Row-Crop and Sod-Based Rotation Enterprises in the Wiregrass Region of Alabama." Unpublished Master's Thesis, Auburn University, Auburn, Al.

Prevatt, J.W., L.L. Bauer, E.H. Kaiser, and P.J. Rathwell. 1992. "Measuring the Effect of Capital Structure and Seasonality on Expected Returns and Risk: The Fresh Market Vegetable Case." *Southern Journal of Agricultural Economics* 24:171-78.

Tauer, L.W. 1983. "Target MOTAD." *American Journal of Agriculture Economics* 65:606-10.

U.S. Department of Labor. Bureau of Labor Statistics. Available at: http://www.bls.gov/bls/blswage.htm (Accessed July 12, 2012).

Wright, D.L., J.J. Marois, T.W. Katsvairo, and J.R. Rich. Use of Perennial Grasses in Peanut/Cotton Rotations: Effect on Pests. *IFAS Extension*. University of Florida, Pub. No. SS-AGR-125. 2012.

Wright, D.L., B. Tillman, E. Jowers, J. Marois, J.A. Ferrell, T. Katsvairo, and E.B. Whitty. Management and Cultural Practices for Peanuts. *IFAS Extension*. University of Florida, Pub. No. SS-AGR-74. 2013.