TURFGRASS-SOD PRODUCTION in Alabama: *Economics & Marketing*

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TURFGRASS-SOD PRODUCTION IN ALABAMA: ECONOMICS AND MARKETING

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INTRODUCTION

The turfgrass industry has changed significantly over the last twenty years. What once was only a potentially profitable alternative to row cropping has turned into a viable multi-billion dollar industry nationwide, with about $200 million of farm level receipts for Alabama in 2002 *(9)*. With such an emerging fast-paced industry, it is important to continually monitor change and growth. Ten years ago, a customer may have had to wait a month for sod, but today consumers expect fresh sod within 24 hours after ordering. Customer service is not the only aspect of the industry that has changed. Economies of size and scale have provided incentive for farms to become larger to maintain competitiveness and profitability. The popularity and growth of the turfgrass industry can be attributed to many things: need for erosion control; an increase in athletic complexes; more golf courses and parks; desire for instant lawns and landscaping by homeowners, developers, and landscapers; improved technology; and the desire for a profitable use for land by farmers and others.

An analysis of the turfgrass industry can provide insight into the economic relationships that impact producers. In the 1960s, there were an estimated 1,000 sod farms nationally with a total of 105,000 acres and annual revenues at around $100 million *(11)*. In 1995, the turf industry was estimated to include 30 million acres with income being about $45 billion *(9)*. These estimates show the turf industry growing at a rate of more than one billion dollars a year. In Alabama, turfgrass acreage expanded from about 500 acres in 1968 to 3,300 acres in 1979, 15,000 acres in 1988, and 25,000 acres in

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2002. Estimates of producer numbers were 30 for 1979, 85 for 1988, and 89 for 2002. Growth in acreage results from existing producers increasing their acreage and entrance of new producers who often do not have a conventional agricultural background and knowledge of sod production and markets. This study aims to lessen these deficiencies.

There are many considerations in starting a sodgrass operation. One is the extremely high establishment cost associated with production and marketing. High start-up costs can require a very large initial loan that is difficult to cash flow and will take several years to pay off. How quickly the loan can be repaid will be a reflection of production and marketing practices and related revenues generated.

Since the industry is characterized as having relatively high fixed costs, economies of scale are also an important consideration in turfgrass production. Larger farms generally have lower costs and higher returns per acre *(19)*. Thus, many sod farms find it desirable to increase size, improve efficiency, and increase profitability. With lower cost per unit, larger farms have the option of lowering prices and maintaining profit margins, which puts competitive pressure on smaller farms. Many smaller producers find this to be a major problem, one that will continue to evolve as more producers enter this industry and firms get larger.

The objectives of this study are to analyze the costs associated with beginning and operating a turfgrass farm and to provide a comprehensive follow-up to three previous turfgrass-sod studies, which analyzed marketing strategies, production costs and returns, and price sensitivity *(2, 4, 19, 20)*. All start-up costs will be explored, including new equipment, variable and fixed costs, and labor needs and costs. Costs will be analyzed for five different-sized operations to determine the extent of economies of size and scale. Marketing and production practices will also be evaluated based on a producer survey to determine trends in the industry. Turfgrass prices will be related to costs for five alternative-sized operations to define minimal prices at which each size farm can still maintain a positive profit. Prices will also be evaluated to show how quickly a positive net return can be generated under production horizons of three, five, and seven years.

METHODS

The purpose of this work is to analyze the growth, status, and economics of Alabama's turfgrass industry. Methods used in this work include summary of direct surveys of producers, budgeting, and a linear programming analysis of price sensitivity and profitability.

The first segment of the analysis defines the status of the industry in terms of total acreage, acreage by grass species, and number of producers. The second segment evaluates operational and marketing aspects of the industry. The third component provides a detailed economic analysis of alternative-sized farms with related capital outlays, costs, profits, and cash flows. Price sensitivity analysis is conducted to evaluate the relative profitability of grass species.

Surveys

Two different mail surveys and face-to-face interviews were used to discover production and marketing trends in the industry, as well as to obtain information on production techniques and problems. To determine the size of the Alabama turfgrass industry, a brief survey was mailed to existing producers asking about the acreage and species of grasses grown. These farmers were chosen based on a mailing list provided by the Alabama Turfgrass Association (ATA), a previously developed list of turfgrass farmers, and a Yellow Pages Internet search of turfgrass-sod producers in Alabama. Initial surveys were mailed in July of 2001 to 150 addresses. The survey also asked respondents if they were willing to participate in a more detailed survey at a later date.

After the first mailing, 31 usable surveys were returned. An additional three respondents indicated they no longer produced sod. Wrong addresses accounted for another 24 surveys. Efforts were made to correct these addresses. A follow-up survey was sent in October to the non-respondents, yielding another 15 usable surveys. Phone calls to non-respondents in the late fall of 2001 resulted in an additional eight usable surveys for a total of 54 usable surveys.

A second, more detailed survey was sent to the 36 respondents from the original survey who indicated a willingness to provide additional data. This survey was mailed in January of 2002, with a follow-up survey mailed in February of 2002. A total of 22 usable surveys were returned, a 63-percent response rate.

The purpose of the second survey was to analyze the growth of the Alabama turfgrass industry and also to gather information on operational and marketing techniques used by existing producers. Respondents were asked questions about their cultural practices, prices received, promotion and advertising techniques, acreage trends, delivery practices, sales trends, and legal organization. Respondents also provided information on problems they faced in marketing and sales.

To gain information about specific production practices, equipment complements, and costs, five farm visits were conducted in the late fall of

2001 and early winter of 2002. Producers with operations of different sizes indicated their willingness to be surveyed in depth on the farm. The information they provided was used to determine machinery complements associated with the varying size operations. Information from the personal interviews was used primarily to develop asset sheets and budgets for alternative-sized sod enterprises. However, during the visits, some producers expressed opinions on issues that were also explored in the surveys.

Budgets

The sod operators who participated in the personal interviews provided information that was used to develop budgets for farms of different sizes: 100 acres, 250 acres, 550 acres, 850 acres, and 1,200 acres. A 100-acre farm was chosen as a beginning farm size. Two hundred and fifty acres was the smallest size chosen to represent a more profitable and sustainable beginning size. A 550-acre farm was analyzed because it appeared to be the size between a one-manager owner-operator farm and a more corporate structured operation. Eight hundred and fifty acres and 1,200 acres were analyzed to determine the leveling-out point of the average total cost curve.

Capital investment cost outlays were determined for these alternative-sized farms by obtaining asset complements and related prices for the different equipment items and facilities used by turfgrass producers. Prices were obtained from various equipment dealers. Variable and fixed costs were estimated using data from selected representative producers, who provided per-acre estimates from their operations, and previous publications *(19, 13, 1)*.

Linear Programming (LP) and Sensitivity Analysis

The cost estimates provided were used to construct LP models using Microsoft Excel Solver. Linear programming provides a "technique, which decisionmakers can use to develop optimal values of the decision variables considering various constraints" *(14)*. Microsoft Excel was used because it is commonly available and user friendly. This program contains a linear programming solver that can be used directly from the spreadsheet. Target cells or solution cells are chosen along with constraints to provide the optimal solution—profit maximization in this case *(12)*.

Capital investments, variable and fixed costs, and borrowing levels were used in the determination of yearly cost in these models. Models were constructed to determine the most profitable mix of grass species and breakeven square yard prices for all three grass species evaluated: bermuda, zoysia, and centipede. Fifteen models were used for the five alternative-sized

farms and for three different planning horizons (three, five, and seven years). The three-year alternative was analyzed to show how a greater price would have to be received to be able to pay off all debt within that time period. Five years was used because it is the amount of time most businesses can generally expect to begin returning a positive profit. Seven years was evaluated because most operating equipment is fully depreciated over this time frame, with exceptions being irrigation, office equipment, and buildings. These models were generated by using the costs outlined above, and also charging a 9 percent interest rate on borrowed money. A 4 percent interest rate was paid on any profit generated and returned from the prior year.

Variable costs were determined differently for each of the three grass species based on producer estimates of the time period between establishment and reestablishment and harvest. Bermuda was assumed to be harvested twice per year, thus receiving two times the amount of variable costs. Zoysia was considered an 18-month crop with 1.5 times the amount of variable cost, and centipede needed a 15-month production cycle, with 1.25 of variable costs.

Revenue was also calculated in a similar manner by multiplying the average price by the percentage of grass to be sold from each acre times the number of acres. Farmers who responded to the marketing survey also detailed their wholesale and retail prices per square yard. Average wholesale grass prices were used in these models: $1.05 per square yard of bermuda, $2.37 per square yard of zoysia, and $1.41 per square yard of centipede.

All acres of the different-sized farms were assumed to be used for production; additional acres may be owned but were not in production. For example, a 100-acre farm has exactly 100 acres of turf. Buildings, roads, irrigation ponds, and any other non-cultivated areas were not included in the 100 acres. Bermuda was assumed to be available for sale on 80 percent of the total acreage, twice a year. Both zoysia and centipede were assumed to be available for sale on 67 percent of the remaining acreage each year because of their longer establishment and reestablishment production cycles. This figure also takes into account both loss due to disease or death and the turnover for all of the different grass species. However, in the first year, only 25 percent of one harvest of bermuda was assumed to be available for sale, and no zoysia or centipede could be produced and sold in the first year of production. These figures were used in the LP model to determine the optimal combination of grasses for maximum profit, and were also used to determine breakeven prices and the sensitivity prices needed for the other grasses to be considered more feasible than the grass in the initial optimal solution.

RESULTS

While the number of growers remained fairly constant between 1988 and 2001 (85 and 89, respectively), acreage increased by 51.7 percent, from 15,062 to 22,844 acres (Table 1). Baldwin County dominated county totals with 9,033 acres or almost 40 percent of the Alabama's total acreage. Totals for Lowndes (1,342) and Calhoun (1,232) counties were next largest. No production was identified for 20 Alabama counties in 2001 and the number of producers by county declined between 1988 and 2001 for 20 counties. The average size per operation increased by 45 percent between 1988 and 2001, from 177 to 256 acres.

The most frequently grown turfgrass species were bermuda and centipede with 8,546 and 7,985 acres, or 39 percent and 36.5 percent of the total, respectively. The most commonly grown bermudagrass cultivar among respondents was Tifway (419) with 53 producers noting production of 7,629 acres, about 35 percent of the identified acreage or 89 percent of the bermuda total (Table 2). Zoysia was grown by 66 producers on 3,305 acres. Meyer and Emerald were the two most popular cultivars of zoysia, with 1,635 and 1,501 acres, respectively. Results also showed that growers are evaluating a variety of newer cultivars, which may be produced to meet specialty needs or to allow producers to gain access to specific market segments.

For the 22 producers responding to the more detailed survey, total acreage per farm ranged from 20 to 2,000 acres, and average size was 315 acres (Table 3). Thirty six percent of these producers reported growing less than 100 acres of sod. The second largest group of respondents, 32 percent, reported growing between 251 and 350 acres. Three of these growers had more than 850 acres.

Average longevity in the sod business for these growers was about 15 years, with a range from three to 30 years (Table 4). The amount of time a farmer had been in business did not seem to be highly related to the size of the farm. However, of the newest farmers (five years or less), only one farmer had less than 250 acres.

Producers were asked if they had off-farm employment and, if so, what percentage of their total household income came from the sod operation. Ninety-one percent of respondents reported no off-farm employment. Of the 19 producers who reported the portion of income coming from the sod operation, the farmers who had no off-farm employment reported an average of 64.85 percent of their family income coming from sod production. Ten of the responding producers reported that 80 percent or more of total household income came from the sod operation. The two producers who did report off-

TABLE 1. ESTIMATED NUMBER OF TURFGRASS-SOD GROWERS AND ACRES OF SOD CULTIVATED BY COUNTY, ALABAMA, 1978, 1988, 2001

	No. of growers			Acres cultivated			Percent of total ac.		
Cultivar	1978	1988	2001	1978	1988	2001	1978	1988	2001
Baldwin	2	4	14	250	4,200	9,033	8.71	27.88	39.54
Barbour	1	3	3	100	480	335	3.48	3.19	1.47
Bibb	0	2	0	0	14	0	0.00	0.09	0.00
Bullock	0	3	1	0	300	200	0.00	1.99	0.88
Butler	0	1	0	0	10	0	0.00	0.07	0.00
Calhoun	0	5	2	0	1,550	1,232	0.00	10.29	5.39
Chambers	0	1	0	0	10	0	0.00	0.07	0.00
Cherokee	0	1	1	0	100	350	0.00	0.66	1.53
Chilton	0	1	3	0	25	78	0.00	0.17	0.34
Cleburne	0	1	0	0	45	0	0.00	0.30	0.00
Coffee	0	1	0	0	25	0	0.00	0.17	0.00
Colbert	2	2	3	60	140	313	2.09	0.93	1.37
Coosa	0	1	0	0	10	0	0.00	0.07	0.00
Covington	3	1	2	320	650	700	11.15	4.32	3.06
Cullman	0	2	2	0	75	100	0.00	0.50	0.44
Dale	0	0	1	0	0	130	0.00	0.00	0.57
Dallas	0	0	1	0	0	300	0.00	0.00	1.31
Escambia	0	0	2	0	0	600	0.00	0.00	2.63
Elmore	2	3	1	55	15	12	1.92	0.10	0.05
Fayette	0	1	1	0	5	35	0.00	0.03	0.15
Franklin	0	2	1	0	34	59	0.00	0.23	0.26
Geneva	0	0	3	0	0	445	0.00	0.00	1.95
Greene	0	1	0	0	6	0	0.00	0.04	0.00
Henry	0	2	1	0	267	685	0.00	1.77	3.00
Houston	1	5	1	40	232	325	1.39	1.54	1.42
Jefferson	1	0	1	20	0	100	0.70	0.00	0.44
Lauderdale	0	1	1	20	9	155	0.70	0.06	0.68
Lawerence	0	1	2	0	10	137	0.00	0.07	0.60
Lee	2	1	4	724	864	215	25.22	5.74	0.94
Limestone	0	3	2	0	60	81	0.00	0.40	0.35
Lowndes	0	1	2	0	140	1,342	0.00	0.93	5.87
Macon	1	2	3	40	330	755	1.39	2.19	3.31
Madison	0	1	6	0	350	694	0.00	2.32	3.04
Marengo	0	1	0	0	150	0	0.00	1.00	0.00
Marion	0	1	0	0	10	0	0.00	0.07	0.00
Marshall	0	1	0	0	25	0	0.00	0.17	0.00
Mobile	2	0	4	32	0	340	1.11	0.00	1.49
Monroe	0	1	0	0	60	0	0.00	0.40	0.00
Montgomery	1	2	2	20	350	528	0.70	2.32	2.31
Morgan	0	2	2	0	50	160	0.00	0.33	0.70
Pickens	1	7	3	40	336	128	1.39	2.23	0.56
Russell	0	0	4	0	0	980	0.00	0.00	4.29
Shelby	4	9	3	455	2,205	408	15.85	14.64	1.79
St.Clair	1	3	2	675	1,450	896	23.51	9.63	3.92
Talledega	0	1	2	0	300	622	0.00	1.99	2.72
Tallapoosa	0	1	0	0	40	0	0.00	0.27	0.00
Tuscaloosa	1	3	3	20	130	371	0.70	0.86	1.62
Total	**26**	**85**	**89**	**2,871**	**15,062**	**22,844**	**100.00**	**100.00**	**100.00**

TABLE 2. ACRES OF TURFGRASS GROWN BY SPECIES AND CULTIVAR TYPE, ALABAMA, 2001

Species and cultivar		Number of growers	Total acres	Percent of identified acres
Bermuda	Tifgreen (328)	11	405	1.85%
	Tifway (419)	53	7,629	34.82%
	TifwayII	6	255	1.16%
	Tifsport	2	197	0.90%
	Tifdwarf	1	5	0.02%
	TifEagle	0	0	0.00%
	Other	1	45	0.21%
	Common	1	10	0.05%
Subtotal		75	8,546	
Zoysia	Meyer	25	1,635	7.46%
	Matrella	1	35	0.16%
	Emerald	29	1,501	6.85%
	Zenith	1	6	0.03%
	Empire	4	73	0.33%
	Empress	3	40	0.18%
	Marion	1	10	0.05%
	Serene	1	4	0.02%
	Belair	1	1	0.00%
Subtotal		66	3,305	
St. Augustine	Raleigh	5	157	0.72%
	Woerner Classic	1	700	3.20%
	Bitter Blue	1	500	2.28%
	Palmetto	4	240	1.10%
	Common	2	80	0.37%
Subtotal		13	1,677	
Centipede		41	7,985	36.45%
Fescue	Rebel	11	186	0.85%
	Transition	1	10	0.05%
Subtotal		12	196	
Bahai		1	200	0.91%
Total acreage identified by cultivar type			**21,934**	**100%**

TABLE 3. DISTRIBUTION OF RESPONDING UNITS, TURFGRASS-SOD FARMS BY SIZE, ALABAMA, 2001

Size range	Percentage of producers	Number of respondents
<100 acres	36	8
101-250	18	4
251-350	32	7
351-850	0	0
>850	13	3

TABLE 4. DISTRIBUTION OF RESPONDING TURFGRASS-SOD FARMS BY YEARS OF EXPERIENCE IN TURFGRASS BUSINESS, ALABAMA, 2001

Years farming turfgrass	Percent	No. of resp.	——Size—— average	range	Percent employed off-farm
3-6	32	7	350	130-900	100
7-15	32	7	166	35-300	86
16-25	18	4	100	20-250	100
26 and greater	18	4	589	20-2,000	75

TABLE 5. LEGAL FORMS CHOSEN BY ALABAMA TURFGRASS-SOD FARMS, ALABAMA, 2001

Legal form	Percentage of producers	Number of respondents
Sole proprietorship	36	8
Partnership	14	3
Corporation	32	7
Limited liability company	18	4

farm employment (9 percent of respondents) received most of their household income (more than 90 percent) from sources other than sod.

A sod operation is considered a business, and operates under some form of legal identity. The sole proprietorship was the most popular legal form (36 percent) and the partnership was least common (14 percent) (Table 5). Corporations accounted for 32 percent of the responding operations and limited liability companies (LLCs) accounted for the remaining 18 percent of the responding farms.

Sod farms may require more land than is available to either a beginning farmer or a producer wishing to expand. Thus, renting land is usually a feasible way to expand without the added capital outlay and pressure of finding or buying more land. Accordingly, producers were asked to report the number of leased acres they operated and the terms of the lease. Six (27 percent) of the sod growers reported renting some land. Two hundred and fifty-two acres was the most acreage rented, and 10 acres was the smallest amount. The average amount of rented acreage was 144 acres. Producers leased an average of 50 percent of their acreage with a low of 0.02 percent and two producers leased 100 percent of their acreage. Duration of the lease varied among sod farms, with 20 years being the longest reported lease duration and one year being the shortest. Three farmers had a five-year lease and the remaining farmer had a three-year lease. The most common lease rate was around $100 per acre, with the average being $78 and the lowest amount being $20.

Producers were asked to identify changes in their sod acreage over the last three years. If acreage had changed, they were also asked to report by how much (Table 6). About half (48 percent) of the growers indicated that their

acreage had remained constant over the past three years. One farmer reduced his acreage, the rest of the respondents (48 percent) increased acreage. The average increase reported by these 10 farmers was 123 acres. The maximum expansion was 450 acres and the smallest increase was 20 acres.

Farmers were asked to describe many of their cultural practices, including initial establishment practices, regeneration, and postharvesting practices. Although sod can be established for much of the year, the season of establishment is important. The later in the year the grass is harvested, the longer it may take for the grass to reestablish. If a producer hopes to maintain the grass without the extra cost of reestablishment in the spring, harvest dates may need to be closely monitored.

Producers were asked the latest month in which they could harvest and expect reestablishment without field renovation. The latest reported month was November. However, four farmers could not harvest any later than August, and two stated they could not harvest any later than October 15. One farmer reported that he never expected reestablishment the same growing season. Four farmers reported the ability to harvest year-round and expect the turf to reestablish.

The length of time needed to grow each grass species, its production cycle, is very important to the profitability of the sod farm. Table 7 gives the average times farmers noted for the different grass species to reach maturity from initial planting, and also from regeneration after harvest. When a time period was given, the midpoint of that time period was used in the averages. The regeneration time is longer for centipede than the establishment period because fewer farmers regenerated their centipede. Most farmers opted for reseeding of centipede after each harvest. Five of the six farmers who did regenerate their centipede also had initial establishment periods above the survey average.

To more effectively utilize the land resource, producers may try to decrease the length of time grass is left in the field. Netting is one of the most common practices used to increase the turnover of a sod field. Netting is used to give the sod a more stable root system, so the farmer can harvest when the root system may not be sufficiently developed. Only 30 percent of the farmers surveyed reported using netting to promote an earlier harvesting and marketing of their sodgrass. Two of these farmers said they used it on fescue, and only one farmer used it on 419 bermuda.

During the farm visits, meant to develop budgets, some producers expressed strong opinions about netting, with one farmer “hating” it because deer and other wildlife would get caught in it at night and destroy the netting, causing a disaster. However, another farmer loved to use the netting and found it to be very profitable, and had no problem with wildlife.

TABLE 6. ACREAGE CHANGES FROM 1999-2001, TURFGRASS-SOD PRODUCERS, ALABAMA, 2001

Response type	Number of responses	——Acreage amount—— average	range
Increase in acreage	10	123	5-325 acres
Decrease in acreage	1	1,000	
No change in acreage	10		

TABLE 7. GRASS SPECIES ESTABLISHMENT AND REGENERATION PERIODS (MONTHS), RESPONDING TURFGRASS-SOD PRODUCERS, ALABAMA, 2001

Grass species	Initial establishment (months)	Regeneration (months)
Bermuda	9.0	6.80
Centipede	14.6	17.0
Zoysia	18.5	14.4
St. Augustine	9.5	7.0
Fescue	3.5	NA

TABLE 8. ESTABLISHMENT PRACTICES USED AND NUMBER OF RESPONSES BY TURFGRASS-SOD PRODUCERS FOR VARIOUS SPECIES, ALABAMA, 2001

Species	Plugs	Sprigs	Seed	Contract planter
	% (no.)			
Bermuda	6% (1)	88% (15)	0% (0)	6% (1)
Zoysia	63% (5)	38% (3)	0% (0)	0% (0)
Centipede	0% (0)	0% (0)	100% (8)	0% (0)
St. Augustine	100% (1)	0% (0)	0% (0)	0% (0)

Turfgrass can be established in many different ways. Sprigging is a common method that uses a small section of grass with many nodes for propagation. The farmer can either till these roots into the soil or press them in using a roller; some fields may require both. Plugs are also used; these are larger pieces of sod, from about half an inch to several inches in size. Producers were asked to specify the method of establishment used on their operation (Table 8). Some farmers noted that plugs would establish more quickly than sprigs; however, the cost can be higher. Seeding is yet another method of establishment, used mainly on centipede and fescue *(17)*.

Turf can also be reestablished in different ways, depending on the species grown. Ribbons, small strips of grass left as part of harvest, can be left to either till up or to fill in together. A field can also be completely reestablished by utilizing fresh sprigs or plugs. Centipede is often reseeded after harvest. Ribbons were used by 100 percent of the growers when reestablishing zoysia (Table 9). Bermuda was reestablished by ribbons or just roots/rhi-

TABLE 9. REESTABLISHMENT PRACTICES AND NUMBER OF RESPONSES USED FOR DIFFERENT SPECIES BY TURFGRASS-SOD FARMERS, ALABAMA 2001

	Reestablishment practices					
Species	Plugs	Ribbons	Roots	Sprigs	Field renovation	Seed
	% (no.)					
Bermuda	6% (1)	28% (5)	44% (8)	11% (2)	11% (2)	0% (0)
Zoysia	0% (0)	100% (4)	0% (0)	0% (0)	0% (0)	0% (0)
Centipede	0% (0)	57% (4)	0% (0)	0% (0)	0% (0)	43% (3)
St.Augustine	0% (0)	100% (3)	0% (0)	0% (0)	0% (0)	0% (0)

zomes growing back 72 percent of the time. More detailed answers were given by some farmers and included such practices as fertilizing the ribbons, disking the roots, and disking and re-leveling the field to prepare the land for the next harvest.

Producers were asked about their method of sprig distribution, which determines the type of equipment that is used and the size of the propagation material. When sprigs are planted, a separate machine is needed to harvest the sprigs to be used and another is needed to distribute the sprigs. When sprigs or plugs are used, newer machinery is available that will take a pallet of sod and cut each square yard into pieces to be used as springs or plugs, depending on the machinery. Sprigs can be planted by two methods. The first is plug planting, or placing the propagation material directly in the soil. The other is broadcast planting, which involves distributing the propagation material over the field and either rolling or lightly tilling it into the soil. The most common method was the broadcast application method, used by 20 respondents (50 percent). Sprigs were plug planted 30 percent of the time, and both the plug planting and broadcast methods were used by the remaining 20 percent. (The use of both the plug and the broadcast methods is most likely due to using one method for different species.)

Field Renovations

Field renovation can be very important to the success of a turf crop. If the same grass is left for a long time without being renovated, it can take longer to grow back and not provide an aesthetically pleasing product. Producers were, therefore, asked to report the frequency of field renovation, with 20 of 22 farmers responding. After each harvest and every three years were the most frequent answers, with each reported 15 percent of the time. When needed, never, every two years, and every three to four years had an occurrence of 10 percent each. The remaining responses varied, with the shortest time period being every year or every second harvest, and the longest

being five years. Two farmers said they had never renovated and reestablished their fields.

When fields are reestablished, fumigants are sometimes used. Normally, the producer will contract out another company for this procedure, which is usually only used on small acreages or new fields. Use of soil fumigation as a normal procedure in reestablishment was reported by 24 percent of the 21 farmers responding to this question. Of this 24 percent, four indicated they used fumigation on a small area, and another producer used it only on a new field. Two farmers reported the number of acres treated, with one farmer noting treatment of 16 acres and another producer reporting 40 acres in one year and 200 acres in the previous year being treated.

The costs for this service varied, with three farmers reporting that they paid $1,500 per acre, one farmer reporting a cost of $1,700 per acre, and another farmer reporting $500 per acre. Opinions on the results of fumigation were mixed with two of the five respondents saying they had fair results, and one respondent each reporting poor, good, and excellent results.

Harvesting

The time of harvest is important to the sod farmer. The sod is normally dormant November through February in Central and North Alabama and this can lead to a dip in cash flow if little sod is being sold. It may be important to the beginning sod farmer to note the slower times of the year, and plan for this in yearly budgeting and cash flows. Another effect of the decline in sales in the winter is that there may be little work for employees in these months. Some farmers find additional activities for laborers during the slow season. One sod farm sells firewood all winter. The respondent commented on the lack of profitability of firewood sales, but the income did allow him to pay his employees through the year. Another farm also had a small nursery operation, which may be another way to keep workers occupied. One farmer reported that he laid off employees at this time and that they enjoyed the time off. Another farmer offered hunting privileges on the farm as an employment benefit. These few examples illustrate some of the creative ways employees can be occupied during the winter.

Thirteen farmers provided information about the percentages of their sales that occurred in each month (Table 10). Four other producers provided general answers, without specific percentages. One producer reported that sales varied by month. Another said that 90 percent of sales took place from February to September. A third producer reported making 80 percent of his sales from April to October. Finally, one producer reported little change in sales from month to month.

Producers were also asked if the sales pattern varied across grass species, other than fescue. Of the 13 farmers who answered this question, 46 percent (six producers) responded that there were some differences across species. Only one producer provided more specific information; he indicated that zoysia was a species that had a different sales pattern from the other grasses he produced. This could possibly indicate this farmer has a stable demand for bermudagrass year round; however, zoysia may only be demanded in early spring and summer and not sold when dormant.

TABLE 10. AVERAGE ACREAGE AND PERCENTAGE OF TOTAL ACREAGE CUT EACH MONTH, TURFGRASS-SOD PRODUCERS, ALABAMA, 2001

Month	Average number of acres cut	Percent of total
January	15.15	5%
February	18.17	5%
March	24.07	7%
April	41.92	12%
May	23.27	7%
June	51.45	15%
July	37.64	11%
August	28.50	8%
September	29.03	9%
October	28.59	8%
November	24.88	7%
December	18.66	6%

Marketing

Producers were asked to supply information on the prices they received for the different grass species. The question was written in such a way as to allow producers to record different prices for the grass species, depending on the season of sales, with seasons defined as early (March-June), middle (July-August), and late (September-February). Only three farmers indicated that the prices did, in fact, vary at different times of the year. The rest reported only one price. One farmer noted he used a 10-percent winter discount, and another farmer had a quantity discount on zoysia.

Of the three farmers who charged different prices for the three different seasons, one charged the most in the middle season. The other two farmers charged the most in the earliest part of the season. One respondent reported that the bermuda price varied by 5¢ to 90¢ in the early season and 85¢ in the middle and late seasons. The other two producers reported charging different prices for zoysia. One reported a price of $2.40 in the early season and $2.20 in the middle and late seasons. The other farmer charged $2.25 in the early and late season but $2.50 in the middle season. If the farmers stated they charged varying prices in different seasons for turfgrass, the highest reported price was used in computing the averages of each grass. If a grower charged different prices for hybrids of the same species (such as different prices for Emerald and Matrella), both prices were used in the averages.

Average wholesale prices were $1.05, $2.37, $1.41, $1.93, and $1.30 per square yard for bermuda, zoysia, centipede, St. Augustine, and fescue,

respectively (Table 11). Average retail prices were higher at $1.15, $2.47, $1.50, $2.20, and $1.44, respectively.

Of the 13 farmers who indicated selling some sod at retail, 46 percent (six producers) charged a higher price for retail sales. Six producers (46 percent) sold their sod for the same price in wholesale and retail markets. One producer only sold at a retail price. The remaining seven growers only sold at wholesale for the wholesale market. Other answers included one farmer who sold bermuda sod to golf courses for $1.80 per square yard. One producer reported selling certified St. Augustine for $1.80 per square yard wholesale, and one reported selling certified bermuda for $1.35 per square yard.

How selling price was determined was an open-ended question posed to each producer. Numerous answers were provided. Most of the answers were related to economic issues concerning market demand. Eighteen of 22 farmers answered this question. Ten producers (57 percent of those responding) indicated they used the market or competition in determining their turfgrass price. Two producers (11 percent of those answering this question) said that they surveyed other growers before they set their price. The remaining answers were given by one farmer each and included the following: whatever customer will pay, cost of land, expenses plus profit, age of sod, cost of production, and availability of sod in the area. In all, about three-quarters of the responses dealt with market concerns of some sort, while less than 10 percent of the answers dealt with the cost of producing the product.

Producers were also asked to explain how they determined the price differential between wholesale and retail, if they had such a differential in their prices. As discussed previously, six producers indicated that they did have a differential. Three respondents indicated that the differential was based on volume. The remaining three farmers noted competition, nature of the market, and a 1¢ to 2¢ increase from wholesale to retail price. However, in the latter case, no reason was given for the price differential.

Farmers were asked what percentage of their sales was wholesale in 2001, rather than retail (Table 12). Eight producers (47 percent) sold 90 percent or more sod at the wholesale price, while four growers (24 percent) had

TABLE 11. AVERAGE WHOLESALE AND RETAIL PRICES CHARGED FOR SELECTED TURFGRASS SPECIES, ALABAMA, 2001

	Wholesale average per sq. yd.	Number of responses	Retail average per sq. yd.	Number of responses
Bermuda	1.05	18	1.15	13
Zoysia	2.37	16	2.47	11
Centipede	1.41	13	1.50	10
St.Augustine	1.93	3	2.20	1
Fescue	1.30	2	1.44	1

10 percent or less of their sod sold at a wholesale price. Other answers, each given by only one farmer, included 80, 75, 70, 50, and 20 percent. An important observation is that 75 percent of the farmers had 50 percent or more of their sod sold at wholesale.

Producers were asked their expectations relative to sales in each of the next three years. Twenty producers responded. Six respondents expected their sales to stay the same, ten respondents expected an increase in sales, and one respondent expected a decline in sales. The remaining three respondents reported different expectations for different years.

For respondents who did not expect to change their sales over the next three years, answers to an open-ended question about the reason for their expectations regarding future sales included the following: market conditions, limited current farm acreage, customer loyalty, competition, and no desire to increase in size. Producers who expected an increase in sales listed customer demand, increased development in urban areas, starting new sod acreage, purchasing more land, entering new markets, increasing number of clients, more advertising, and a "master plan" for further expansion. The farmers who expected a decrease had different views, which included oversupply due to number of growers, downturn in new housing, the economy, and low stock and CD returns, which limit discretionary income for customers.

TABLE 12. PERCENTAGE OF TURFGRASS-SOD SOLD AT THE WHOLESALE MARKET LEVEL, ALABAMA, 2001

Percentage	Responses
100%	6
90-99%	2
80-89%	1
70-75%	2
50%	1
20%	1
0-10%	1
0%	3
Total	17

TABLE 13. AVERAGE STATED ACREAGE CHANGES OVER THE NEXT THREE YEARS AND NUMBER OF PRODUCERS RESPONDING BY GRASS SPECIES, ALABAMA, 2001

Grass species	Increase acreage average	Decrease acreage average
Bermuda	18.25 (4)	25 (2)
Zoysia	31.00 (5)	
Centipede	29.17 (6)	500 (1)
Fescue	10.00 (1)	
St. Augustine	14.00 (2)	
Total	441.00 (18)	550 (3)

Farmers who stated their sales would change were also asked which grass species were expected to change and by how much. Table 13 provides a summary of their responses. Some producers gave multiple responses, since they produced more than one type of grass.

Advertising is an important consideration for sod farmers. Many farmers will advertise not only in their local Yellow Pages, but also in locations

where they are willing to deliver. For maximum benefit from advertising dollars, target markets should be determined before an advertising outlet is chosen. Farmers were asked if they advertised, where they advertised, and what percentage of their sales revenue was devoted to advertising. Seventy-four percent of the respondents said they used some form of advertising. The average percent of total sales used for advertising was 1.51 percent. This level is consistent with the 1 to 2 percent of total sales commonly allotted for advertising by "farm oriented businesses" *(8)*. Four producers provided their advertising budget in a dollar amount, with the average being $4,375.

Table 14 provides a summary of the places where producers indicated they advertised. Producers could list more than one place so the total adds up to a higher number than the number of respondents to the survey.

Advertising in the Yellow Pages was the most popular response, with 13 of 14 producers noting use. Professional magazines were less popular, with only four producers indicating they advertised in this medium. Six producers indicated using the local papers to advertise. Two farmers, listed in the "other" category, stated that a local service station and community publications were places in which they advertised. Although this answer was not given in the survey, one producer is now using billboards as part of his advertising program.

Producers were asked to describe their customer base. Of the 18 producers answering this question, all reported that they marketed at least part, if not all, to a landscaper (Table 15). The second most frequent outlet was to the homeowner. Three producers responded with a yes or no answer instead of a percentage; their farm acreage was divided evenly among the chosen categories. For producers who did not answer this question, acreage was added to the non-designated category.

Producers were also asked to identify the primary geographic area in which they marketed their sod. The primary market areas were diverse, with 29 percent of the 21 responses claiming Birmingham as their major market area. Huntsville and Atlanta were primary market areas with 9.5 percent of the producers marketing to each. The remaining areas were more general and

TABLE 14. ADVERTISING MEDIA USED BY TURFGRASS-SOD PRODUCERS, ALABAMA, 2001

Place of advertisement	Number of producers	Percentage of responding producers
Yellow Pages	13	93%
Professional magazine	4	29%
Local paper	6	43%
Other	3	22%

all different than the others: southwest Georgia, southeast Alabama, north Florida, west Georgia, Huntsville, Alabama, Mississippi, Florida, Fayette County, Tuscaloosa, and central Alabama.

The survey also asked what percentage of each farmer's volume was marketed out of state (Table 16). Eighteen of the 22 farmers answered this question, and 44 percent (eight producers) claimed they marketed little or no sod out of state. Those who did market out of state reported that an average of 35 percent of their sales were out of state. There were only three farmers who marketed more than 50 percent of their sod out of state. One grower reported 85 percent of sales to out-of-state markets.

Of the 6,465 total acres identified in the market survey, 2,642.8 acres were marketed out of state. Georgia provided the largest out-of-state market, which was also true 10 years earlier. One farmer reported sales in Louisiana. However, no farmers in the earlier surveys reported selling to Louisiana outlets *(19)*.

Producers were asked to list their three most serious marketing problems. Nineteen producers responded, listing 40 different problems. Not all producers listed three problems, and some of the listed problems were the

TABLE 15. MARKET OUTLETS USED BY TURFGRASS-SOD PRODUCERS, ALABAMA, 2001

Buyer	Total acres	Percentage of total acres	Number of responses	Total sq. yds.
Garden centers	493.75	8%	5	1,580,000
Landscapers	3,743.20	58%	18	11,978,240
Golf courses	295.75	5%	5	946,400
Other growers for resale	90.00	1%	1	288,000
Home owners	957.30	15%	14	3,063,360
Institutional markets	299.00	5%	6	956,800
Retailers, other than garden centers	126.00	2%	1	403,200
Not designated	460.00	7%	5	1,472,000
Total	**6,465**			**20,688,000**

TABLE 16. ACRES OF TURFGRASS-SOD SOLD OUT OF STATE, ALABAMA, 2001

State	Out-of-state acres	Percentage of total out-of-state acres	Number of respondents
Georgia	1,681	64%	6
Florida	351	13%	4
Louisiana	134	5%	1
Mississippi	473	18%	4
Tennessee	4	0%	2
Total	**2,643**	**100%**	

same for various producers. Price was the most frequent response, given 23 percent (nine producers) of the time. However, there were varying problems associated with price. Three farmers stated price-cutting by other growers was a problem, and four farmers stated problems with corporate farm sod prices.

Labor was another noted problem with 15 percent stating they either had a problem with labor, truck drivers, or no sales person. Transportation problems were the third most noted (15 percent), with specific problems identified by some producers, such as delivery demands being difficult to meet, trucking distance, and being in a remote location. Other farmers stated they had transportation problems but did not provide details of the type of problem.

Other problems identified by more than one farmer were weather (7.5 percent), too many new producers (5 percent), and too many producers in general (5 percent). Many of the other problems were more varied and general such as insurance, oversupply, customer awareness of their business, collecting for sales, growing quality turf, growing the many varieties, too small of an operation, demand met soon, uninformed customers, marketing, and grass from local area has a bad reputation.

Producers were also asked (1) if they had ever purchased sod from other growers for any reason, and (2) if they had been able to supply all the sod their customers wanted. These questions were asked because a farmer may use other farmers to meet his customers' demands if his sod is not yet ready to be harvested, or if he has already sold out of his sod, and has unfilled orders. Producers may also purchase sod from other growers for propagation. Buying from other producers is a beneficial practice because it not only keeps the sod business reputation high (customers' demands can be satisfied), but also allows farmers who may not have as many customers to sell more of their grass.

Fourteen (74 percent) of the 19 farmers who answered this question said they had bought sod from other producers in the last three years. Fifty-five percent of the stated reasons were related to resale. Three producers said they bought when they were sold out, and one reported reselling because he did not grow that species of grass. About a third of those who had bought sod from other producers said they bought it to plant, and one grower said he would buy extra for his landscaping company to install.

To get a better understanding of the sod farmers' ability to meet the customer demand over the past three years, producers were asked if they had been able to supply all the sod that customers wanted. Half of the 20 producers who answered this question said they had been able to meet the demand; however, some of those who said they could meet demand reported that they had sometimes resorted to reselling or they had limited their customer base in

some way, indicating that, in reality, they were having difficulty meeting demand from their own production. One producer stated he had run low on his inventory, another stated the only way he had been able to met demand was to buy extra, one producer limited his market, and another producer stated he was only able to meet the demand for bermuda.

The other half reported that they had not been able to meet demand. The most common reason given (reported by four producers) was related to increased demand. Three other farmers had problems with either not growing or running out of a specific grass species. One reported he sold out of bermuda. Another producer reported limiting zoysia sales. Another did not grow fescue, which was in demand. One producer said he turned down large orders. Only one producer indicated that the reason he could not meet demand was weather-related; he reported that dry weather reduced his output.

When producers were asked if they delivered their sod to the point of sale, all but one of the 19 respondents said yes. Growers were also asked to indicate the maximum distance they would travel. Five respondents (29 percent) indicated that 150 miles was the limit. The second most common answer was 200 miles with a response of 18 percent (three producers). Other responses given by only one farmer each included the following: 30, 35, 50 to 75, 75, 100, and 500 miles. One farmer stated he had no limit to the distance he would deliver.

Turfgrass producers were asked to categorize their transportation fee as an amount per mile, a flat fee, or some other method. Seven producers used the per-mile system with the average cost being $1.61 per loaded mile, although answers ranged from $1.00 to $2.20. Six producers charged a flat fee. Two of these six did not provide information on the fee they charged. The four other producers gave their fees as $75 to $100, $45 to $110, $50 to $300, and $125. The difference in these prices could depend on distance, time of year, fuel prices, or the amount of grass that was sold. One farmer stated he did not charge for delivery; however, he would only deliver within a 30-mile radius of the farm. Three farmers who charged by the square yard had an average deliver charge of 17¢ per square yard. The remaining farmer charged by mileage and by the load.

Farmers were also asked if they allowed field pick-up, and if so, the price charged. Seventeen of the 19 farmers (89 percent) who answered this question allowed for pick-up in the field, and 13 producers provided a price. The average price charged was $1.03 per square yard with the range being from $0.90 to $1.17 per square yard. Three farmers charged their usual wholesale price, while three others charged their normal retail price, thus not giving any discount for field pick-up (except for delivery charge). Three other

producers listed they only sold by the pallet with an average price of $47 a pallet or $0.94 per square yard.

Farmers were asked to indicate what percentage of their grass was sold for field pick-up in 2001. Two (12 percent) of 16 responding producers sold more than 70 percent this way. The remaining 14 producers (88 percent) sold 20 percent or less of their grass this way. This observation notes the importance delivery now plays in the sod grass industry. One sod farmer stated, "Ten years ago an order needed to be placed a month in advance, now if you can't guarantee it out there before lunch the next day the guy down the road can." However, irrespective of the increased competition among the individual farmers, none of the farmers who responded to the survey employed a salesperson other than himself.

Many sod farmers are asked to install the sod, and the survey inquired as to how many of the farmers would install the sod they sell. Of the 20 growers who responded to the marketing survey, 65 percent provided no installation services. The balance of the producers provided this service, but there were specific guidelines, such as only rolls, if time permits, only athletic fields or golf courses, only local large jobs, and only if they had to.

Installation services could place an extra burden on a beginning sod operation because it would take another crew, and possibly another manager to oversee the crew to install the sod. This activity could be beneficial if there is some downtime in production, but it does not appear to be a popular practice. Some producers have specific landscape companies they will suggest to people who need sod installed, and these referrals can create good relationships between the producers and the landscapers. (As discussed previously, 19 producers, or 86 percent of the sample, said they sold to landscapers.) The general lack of interest in providing installation services was probably also related to the difficulty of consistently providing this service, while maintaining the production operation.

Producers were next asked whether they pre-established contracts with landscapers, builders, or others. Twelve of the 22 producers responded to this question and five producers (42 percent) indicated they had such agreements. Three of these farmers gave some criteria they followed for these business ventures including pre-establishing prices, bidding for all the business of the builder or landscaper, or bidding for large jobs. This practice can generate more consistent cash flow and provide some stability in income. The grass may be sold at a cheaper price but the producer will feel more confident when he knows he will be able to sell more or move his production in a timely manner.

Another aspect of growing turfgrass relates to production of certified sod. There are several criteria for certification, but the resulting product can

generally be sold for a greater price if there is a market that needs it. Thirty eight percent of 21 responding farmers grew certified sod. Producers were asked to comment on the different criteria for certification. There were several answers, which included using guidelines from the International Sod Producers Association, fumigating then purchasing (possibly referring to certified propagation material), fumigating then having the field inspected, and using the Southern Seed Association criteria. The criteria for certified sod production can be found in the "Standards and Regulations for Certified Turfgrass Production in Alabama and Florida" published by the Southern Seed Certification Association located in Auburn, Alabama.

Because turfgrass production is increasingly becoming a customer service industry, farmers were asked about their return policy on sod. Beginning farmers need to realize that if they accept returned sod, it is likely damaged for some reason, and they can expect to lose the entire cost of that sod. However, accepting returned sod can be very good for customer relations. Only 47 percent of the sod growers would accept returned sod for any reason. However, several farmers qualified their response by listing different conditions that must be met before they would consider accepting returned sod. Many of these farmers also contradicted themselves in the comments they provided, by saying that they would not accept the sod for "any reason." Some of the responses included they would supply additional sod, or would refund its value or replace it. Another producer said he had no policy but the return had to be on the same day. Another said he would accept returned sod from a regular customer. Another response was that return would depend on the condition of the sod and the reason for return. Two farmers would accept returns if the reason was that the grass was poor quality.

Eight producers responded to a question relating to the amount of time in which sod would still be accepted. Three said they would take it within 24 hours, one said within 36 hours, and one producer stated the return must be the same day. Two farmers said they would accept returned sod at any time, but one of these producers clarified that the return must be from a regular customer.

INVESTMENT OUTLAYS, PRODUCTION COSTS, AND RETURNS

Production costs described summarize information obtained from six producers on a case-study basis. Five producers were visited at their places of business, where they were asked to provide an equipment list, production costs, amount of acreage in sod, type of irrigation system, and number and

size of all buildings used in the business. They were also asked questions about labor needs and availability. A sixth producer was contacted by telephone and he provided this information by fax.

Producers chosen for these in-depth cost analyses were selected from the list of producers who answered the initial survey. They were telephoned and asked if they would allow a farm visit for the purpose of developing detailed budget information on sod production. Producers were selected for these follow-up contacts primarily based on the size of their operation. Operations of various sizes were needed for development of information about economies of size and scale.

Capital Investments

Capital investment represents equipment or building purchases, which usually require a large financial outlay. These investments are bought to increase either productivity, efficiency, or size (such as equipment to reduce labor or more land to increase size). For the purposes of establishing a turf farm, capital outlay and production costs are defined for five farm sizes: less than 100 acres, 101 to 300 acres, 301 to 600 acres, 601to 900 acres, and more than 900 acres. To calculate per acre investment requirements, a "typical" value for farm sizes within each range was used. These values were 100, 250, 550, 850, and 1,200 acres, respectively.

Although previous turfgrass-sod economics-oriented studies and related publications were based on the assumption that sod was being added to an existing row crop farm *(19, 2,3,5,6)*, this study assumed that turfgrass production is a start-up enterprise, requiring the purchase of all new equipment. The assumption was changed to reflect the development of a specialized turfgrass industry since previous studies on this subject. Equipment prices were obtained from many sources, including recent Cooperative Extension System budget publications, equipment dealers, and specialty turfgrass equipment builders and marketers. (These specialty builders are sometimes current turfgrass producers or have previous experience in turfgrass production. These builders often first made equipment for themselves to meet a specialized need on their own farm and then realized that other producers had similar needs. Thus, they built and marketed the item.)

Capital investments for each size farm (Table 17) have been separated into groupings for buildings and equipment. Equipment was subdivided by function: harvesting, maintenance and establishment, irrigation, and delivery. Table 18 presents the information in Table 17 on a per-acre basis.

Total capital outlays for starting a sod farm range from about $0.5 million for a 100-acre farm ($5,121 per acre) to $3.61 million for a 1,200-acre farm ($3,000 per acre) (Figure 1).This dramatic jump in outlay is due to the

TABLE 17. CAPITAL INVESTMENT AND PERCENT OF TOTAL OUTLAY FOR ALTERNATIVE-SIZED TURFGRASS-SOD FARMS, ALABAMA, 2001

Size-acres				
100	250	550	850	1,200
$ (%)	$ (%)	$ (%)	$ (%)	$ (%)
Buildings and office equipment				
21,000 (4%)	39,000 (3%)	58,000 (3%)	79,000 (3%)	97,000 (3%)
Equipment (harvesting)				
116,900 (23%)	191,800 (16%)	206,800 (11%)	272,600 (10%)	371,600 (10%)
Maintenance and establishment				
201,764 (39%)	378,514 (31%)	701,614 (38%)	1,139,428 (41%)	1,437,928 (40%)
Maintenance and establishment: irrigation				
85,000 (17%)	205,000 (17%)	415,000 (23%)	670,000 (24%)	790,000 (22%)
Maintenance and establishment: delivery				
87,500 (17%)	392,500 (33%)	457,500 (25%)	610,000 (22%)	915,000 (25%)
Total investment				
$512,164	**$1,206,814**	**$1,838,914**	**$2,771,028**	**$3,611,528**

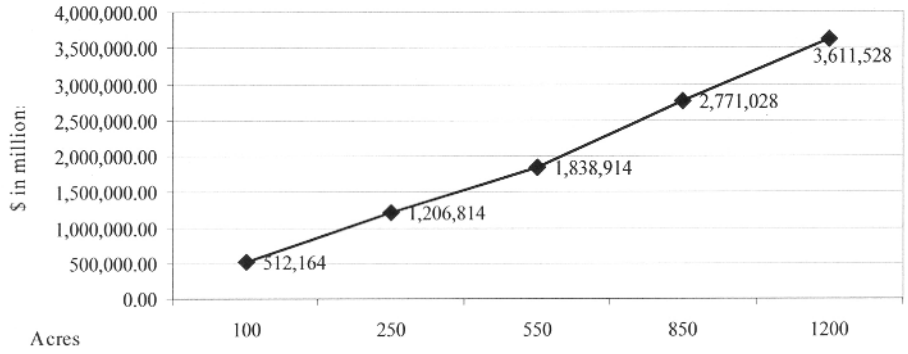
TABLE 18. CAPITAL INVESTMENT PER ACRE FOR ALTERNATIVE-SIZED TURFGRASS-SOD FARMS, ALABAMA, 2001

Size-acres				
100	250	550	850	1,200
Buildings and office equipment				
210.00	156.00	105.45	92.94	80.83
Equipment (harvesting)				
1,169,.00	767.20	376.00	320.71	309.67
Maintenance and establishment				
2,017.64	1,514.06	1,275.66	1,340.50	1,198.27
Maintenance and establishment: irrigation				
850.00	820.00	754.55	788.24	658.33
Maintenance and establishment: delivery				
875.00	1570.00	831.82	717.65	762.50
Total investment per acre				
$5,121.64	**$4,827.26**	**$3,343.48**	**$3,260.03**	**$3,009.61**

larger amount of equipment needed for the larger farm. As operation size increases, and more sod is produced, more tractors, harvesters, and mowers are needed. However, due to the efficient use of these items, costs per acre decline.

Building investment is based on an average construction cost per square foot, with square footage for "typical" buildings derived from the information provided by the participating farmers (for estimated square footage amounts, see Appendixes A.1-A.5). Some farmers used existing barns or built their own service buildings to lessen expenditures. Beginning farmers usually chose to use existing facilities or build smaller buildings until sufficient cash flow is

Figure 1. Capital investment for alternative-sized turfgrass-sod farms, Alabama 2001.



generated. Some farmers had a sales office, while others only had a barn with a room that was used as an office. No matter what the size of the operation, the capital investments for buildings comprised only 3 to 4 percent of the total capital investment outlay.

Equipment required a large outlay for operating sod farms. The amounts of equipment listed in Appendixes A.1-A.5 were based on on-site interviews with sod producers. Farmers were asked to identify specific equipment they had and the quantities of each. Many farmers also commented on equipment they wanted, or equipment that was only for their specific use that other farmers may not need. One farmer sometimes would work land that stayed wetter and swampier, so he purchased a track-hoe (a $100,000 investment). One farmer said he would rent a track-hoe when needed because the cost was difficult to justify, while another large operation (more than 1,000 acres) would rotate a track-hoe from operation to operation. Almost every responding farmer had one or more pieces of equipment that he had built himself to meet a specific need or to save on the cost of buying a new piece of equipment. One farmer built his first harvester. Another producer built a specialty granular fertilizer spreader, because he could not find one to meet his specific needs.

Maintenance and establishment investment was consistently the largest outlay item, ranging from 31 to 41 percent of the total (Table 17). Harvesting equipment was a major investment component for 100-acre operations (23 percent) but this category claimed only about 10 percent of the total for the larger operations. Irrigation and delivery equipment claimed 22 to 25 percent of the total for 500- to 1,200-acre operations. Delivery equipment was the major investment item for the 250-acre operation (33 percent).

The size and specialization of the industry was obvious when obtaining equipment prices to calculate total investment. In the early years of this indus-

try, many farmers used equipment that was made for traditional agriculture and had been adapted to turfgrass-sod use. Other farmers could find no equivalent to the equipment they needed, and so instead built their own. Some producers now sell their inventions on a large scale to other sod growers. One builder of specialty netting equipment discussed how he could never get sod netting to stay down in a way that pleased him. He built his own netting machine, and now markets it to other sod growers. A surveyed farmer said when he used this particular piece of equipment, he was able to go from using every employee to place netting to just two or three workers.

The purchase price of harvesters accounted for the entire capital expenditures for harvesting. These percentages of capital outlays decrease as the operation size increases because the 1,200-acre size operation was the only size that had more than four harvesters. Operators of larger farms usually had more employees, and had these employees work longer hours to meet the sales demand in the peak sales months of summer.

The maintenance and establishment category included all essential equipment to establish the turfgrass and maintain it until time to harvest. This equipment includes tractors, mowers, sprayers, and other such items. For all farm sizes, other than the 250-acre farm, maintenance and establishment equipment accounted for the highest percentage of capital investment among all capital investment categories. For the 250-acre farm, transportation equipment was the largest single category of capital investment. Farms of this size had as many trucks as the farms in the next size category (550-acre farms), so that they could compete effectively for customers. If farmers are unable to meet the timely and prompt delivery demands, they can lose valuable customers.

Irrigation equipment outlays were based on a per-acre average cost of purchasing the irrigation equipment, derived from a publication from the North Carolina Cooperative Extension Service, and the cost of diesel pumps. Electric pumps are cheaper to buy, but electricity must be present to operate them.

Expenditures for delivery equipment are based on the cost of semi-trucks and trailers, and delivery forklifts that are carried with each truck to the delivery site. Delivery equipment accounted for 17 to 33 percent of capital expenditures for all five farm sizes. As mentioned before, the 250-acre farm had the highest percentage outlay for delivery equipment. Most sod farms had at least three semi-trucks, with some smaller farms (250 acres or less) purchasing smaller flatbed straight trucks. These trucks were useful for smaller deliveries and a Commercial Drivers License (CDL) is not required to drive them. (This can reduce cost by not hiring a licensed truck driver.) Some very large sod operations (more than 850 acres) used contract trucking to save on

the total dollars invested in trucking, but this can result in higher operating costs for the rentals and leases. Many farmers discussed the need for "extra equipment" because delivery forklifts may need to remain on the site after delivery for specific jobs, while the truck may be scheduled to deliver to more than just one site on a particular day. Also, equipment may break down unexpectedly, and availability of extra equipment is imperative to ensure timely and efficient operation and delivery.

Figure 2 illustrates the economies of size and scale that exist for turf farmers. As the sod farm increases in size, total investment per acre decreases. This is important, because there is more than a $2,000 decrease in investment outlays per acre from the 100-acre operation to the 1,200-acre operation. A flattening out of the capital outlay curve is starting to develop from the 550- to the 1,200-acre operations, where there is only a $82 difference per acre between the 550- and the 850-acre operations and a $251 difference per acre in capital investment costs between the 850- and the 1,200-acre operations.

Fixed Costs

Fixed costs are those costs that must be paid no matter how much turfgrass-sod is produced and sold. These costs may also be considered the cost of being in operation. Fixed costs levels were determined using information derived from on-site interviews, equipment dealers, and previous publications *(19,13,1).* Table 19 provides a list of fixed costs by farm size.

Land Rent

Land rent was specified as $100 per acre. This level was the highest price that any surveyed farmer paid. Many individuals who are entering this enterprise may not possess the traditional agrarian background, and do not

Figure 2. Investments per acre for alternative-sized turfgrass-sod farms, Alabama, 2001.

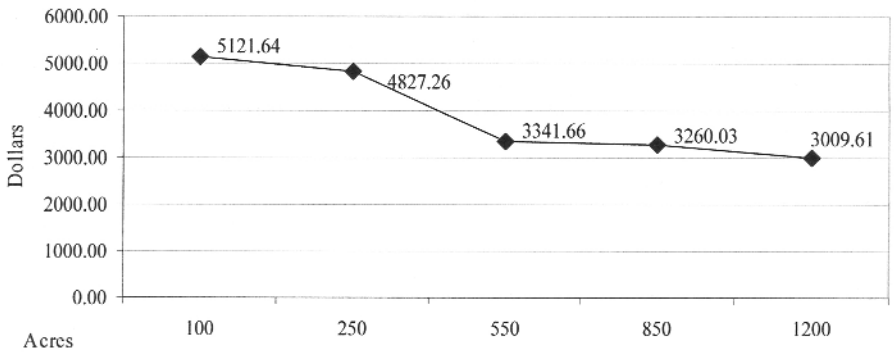


TABLE 19. FIXED COSTS PER ACRE FOR ALTERNATIVE-SIZED TURFGRASS-SOD FARMS, ALABAMA, 2001

	Size-acres				
Fixed costs	100	250	550	850	1,200
Land rent	100	100	100	100	100
Insurance	41	39	27	26	24
Depreciation	670	602	418	408	380
Interest on fixed capital (@ 10%)	256	241	167	163	150
Operator labor management	400	160	145	235	233
Miscellaneous	100	100	100	80	80
Fixed costs per acre	**1,567**	**1,242**	**957**	**1,012**	**967**

already own large acreages of land. Buying large holdings of land may be impractical in some areas where land prices are high, or in cases in which the business's credit limit may already be reached by purchasing necessary equipment. Thus, renting land can become a more feasible option for many new producers. Production acreage can be owned or leased. Previous studies have assumed that growers owned their land. This analysis assumes land rental because it is a more common practice in the industry today.

Insurance

Insurance is paid to protect equipment against loss, theft, or damage. Insurance is also used to protect the entire operation against liability claims. Insurance costs were estimated at 0.8 percent of total new equipment value (Appendixes A.1-A.5). This estimate is based on the Alabama budget generator, and a 0.02 percent additional allowance for perceived increases in risk for the current economic environment.

Depreciation and Interest

Depreciation is used to spread the cost of a capital investment over each item's useful life. In developing included budgets, straight-line depreciation is preferred because it gives an equal depreciation cost to each year and does not necessarily distort annual costs. (However, for tax purposes, producers usually prefer accelerated depreciation methods.) The depreciation costs in Table 19 reflect straight-line depreciation over seven years for all equipment except irrigation, which had a 15-year life; all buildings, which had a 30-year life; and office equipment, which had a three-year useful life due to constant changes in technology. All equipment and buildings were assumed to have a zero salvage value. No salvage values were used because none of the surveyed farmers commented on selling used equipment. Most farmers discussed repairing and using old equipment until the machine was good only for parts.

Depreciation was the largest estimated fixed cost (Table 19), encompassing roughly 40 percent of estimated fixed cost per acre for all farm sizes. Economies of size and scale are evident for depreciation. The 100-acre farm had $670 in depreciation cost per acre while the 1,200-acre farm's depreciation cost was estimated at $380 dollars per acre. Purchasing used equipment, or building one's own equipment can dramatically reduce the capital outlay and this cost item.

Interest on the equipment was calculated based on the average value of the equipment over its useful life. The average value was found by adding the new price to the salvage value (0) and dividing by two. An annual interest rate of 10 percent was charged.

Operator Labor and Management

Salaried employees constitute another source of fixed costs (Table 20). Good management is essential to the success of the sod farm operation. It is imperative that managers have a well-rounded knowledge, not only of turfgrass production, but equipment maintenance and repair, employee management, and business skills. Smaller sod farms usually only had one manager and this was typically the owner. As the farm increased in size, more managers and drivers were needed for the farm. Smaller farms and some medium-sized farms (500 acres or less) usually had only one or two managers.

One of the most important types of laborers a turf farm needs is a mechanic. Many of the interviewed sod farmers had skills in this area, which allowed them to reduce the cost of the repair and maintenance of equipment. Also, repairing old equipment can be considerably cheaper than buying new equipment. A new dump truck costs $100,000, but a used truck that is still in fairly good condition might cost only $30,000. The larger-sized operations had full-time mechanics with their own garage area to constantly repair equipment.

The 550-acre farm had one to two managers, usually the owner-operator and one other person. When the size of the farm increased to 850 acres, as

TABLE 20. LABOR REQUIREMENTS FOR ALTERNATIVE-SIZED TURFGRASS-SOD FARMS, ALABAMA, 2001

	Size-acres				
Item	100	250	550	850	1,200
Hourly employees	3	10	22	32	40
Management [1]	1	1	2	5	7
Total labor cost	$88,000	$200,000	$432,000	$712,000	$420,000
Per-acre labor cost	$880	$800	$785	$4,838	$767

[1] Owners were considered managers and pay was still allocated in fixed costs.

many as five supervisory persons may be needed to address the operational demands and complexity. The smaller operations had one person doing many tasks (such as managing, delivering, marketing and sales, production supervising, and mechanic work). On many smaller farms, the owner-operator's spouse sometimes answered the phone and took orders. One or two people cannot address the many and varied tasks that evolve as acreage increases. The larger-sized operations had receptionists/secretaries in office buildings, along with managers in charge of separate tasks. One producer discussed how the business had a manager over harvesting, another for mowing, and a third for orders, as well as a mechanic, a general farm manager, and an assistant farm manager. These employees may all receive different salaries. The owner of a large farm said that an average salary for turfgrass-sod managers was around $40,000 a year, and this figure was used in Table 19.

Truck drivers who possess the proper licenses (CDL) to drive the 18-wheelers are also needed. Some farmers discussed problems with drivers, such as promised adequate hours or salaries to maintain employment at the farm. The larger farms often possessed the volume to contract out their delivery to trucking companies, or other contracted truck drivers. Thus, these firms did not have to make the large capital outlay for a fleet of 18-wheelers and the employees to drive them. Use of contract trucking has become more common in the industry and transportation cost entries have somewhat shifted from the fixed to the variable category. Contracting for this service was reported by growers to cost from $1.30 to $1.60 per loaded mile.

Variable Costs

Variable costs are estimated for each of the five sod farm sizes based on information provided by participating farmers and previous publications *(19,13,1)*. Most farmers stressed the difficulty of estimating variable costs because these costs can differ depending on such factors as weather conditions, age of equipment, the species of grass grown, water availability, soil, insects, and technology used. Table 21 presents information on variable costs, by size of operation, and type of variable cost. These variable costs are estimated for one year for zoysia and centipede. Because these grasses take longer than a year to mature, these variable costs were adjusted upward to match the production cycle. For bermuda, these variable costs would be accurate if the grass is only harvested once per year. If it is harvested twice, these costs need to be doubled to account for reestablishment charges and the additional harvesting and cultural practices associated with rapidly growing grass.

TABLE 21. VARIABLE COSTS FOR ALTERNATIVE-SIZED TURFGRASS-SOD FARMS, ALABAMA, 2001

	Size-acres				
Variable costs	100	250	550	850	1,200
Herbicides	50	50	50	45	45
Insecticides and fungicides	25	25	25	20	20
Fertilizer and lime	135	135	135	121	121
Fuel and lubrication	140	140	140	140	140
Pallets	360	360	360	324	324
Irrigation	39	39	39	39	39
Repairs	342	242	168	161	148
Hired labor	480	640	640	602	533
Int. on var. capital (@ 9%)	147	148	146	133	130
Other variable costs	250	250	250	250	250
Total variable costs	**1,968**	**2,029**	**1,953**	**1,836**	**1,751**

Pesticides

Pesticide (herbicides, insecticides, and fungicides) costs may change for an operation depending on the severity of the weed problem and number of insects present, which in turn may vary with weather patterns and time of year. As more effort is spent on reducing weed populations and/or eradicating weed problem areas, a reduction in herbicide costs may result in the future. Irrigation water can be a source of weed seed along with non-cultivated bordering fields. Smaller farms tended to do more spot spraying because it was easier to manage a few acres this way. Large farms often contracted out spraying to other companies due to increased productivity and lower cost. Contracting also potentially reduced liability for the farmer and pesticide exposure to employees. Contracting companies would tend to have larger, more efficient equipment and could possibly do all of the spraying much faster and more cheaply per unit than the sod grower. Lower levels for some variable costs were due to the discounts that larger farms may be able to receive by buying in large quantities. Insecticide costs also varied with conditions, but these costs were much lower than herbicide costs. Insect infestations do not appear to be as significant a problem for turf producers as weed infestations.

Pallets

Pallets accounted for 18 to19 percent of variable costs and were the second most expensive variable cost item for sod growers, behind hired labor. An average cost of $4.50 was used per pallet. The cost of pallets can vary based on the quality of the product and the quantity ordered. Many smaller farms reused old pallets and offered to return a deposit if the pallets were returned

after sod installation. Some farms also built their own pallets in the winter months to occupy downtime for employees, and save on costs.

Irrigation Repair

Irrigation repair accounted for 2 percent of variable costs. The cost for irrigation repair was derived from a 2001 irrigation publication from Illinois Extension *(10)*. Irrigation selection is usually situation dependent. For each field, there will be an optimal type of irrigation that could be used. Factors affecting selection include the following: size and shape of the field; presence or absence of a well; use or lack of use of a pond, stream, or river; and amount of starting capital available. The grower may be able to reduce the cost of irrigation per acre by using a soft hose or a movable system. A movable system may entail more labor than a permanent system, but if land is leased on a short-term contract, a movable system may prove more economical for that producer.

Field Labor

The cost of hourly or field labor employees is a significant outlay for turfgrass producers. Hourly wages are the single greatest variable cost per acre for all sizes of turfgrass-sod farms. Hired labor accounts for at least 33 percent of variable costs for all sizes of turfgrass-sod farms, except for the smallest (100 acre) farm where it was 24 percent. On the 100-acre farm, the owner-operator performs a variety of field labor tasks that reduce the labor cost per acre. As the sod farm increases in size, hourly employees must handle more of these tasks.

Hourly labor accounts for such a high percentage of costs because of the nature of sod production. To harvest sod, for example, three workers are needed just to run the equipment. One employee drives the tractor, and two employees put the sod pieces on a pallet. A fourth employee will sometimes drive the forklift and put the pallet on the delivery truck; however, this may not always be feasible. Many farms use only Hispanic migratory labor. Some farms, which had greater competition from other local industries for hourly laborers, employed local residents. To reduce turnover, these farms also offered more benefits to their employees, such as health insurance and hunting trips. Some producers emphasized they would hire any laborer they could find and who was dependable.

The number of hourly workers who are needed per acre was determined from the producers interviewed on site (Table 20). Producers reported that one hourly worker was needed for every 25 to 50 acres of sod, depending on grower preferences. One farmer gave the estimate of one worker for every 100 acres. Most farms paid around $8 an hour, or roughly $16,000 a year.

This $8-per-hour figure was used to develop variable cost estimates in this study, using the number of workers reported in Table 20.

Other Variable Costs

Other variable costs account for 13 to 14 percent of variable costs. Employee taxes and other charges are included in this category. The number also includes an allowance for contract trucking at the average $1.30 to $1.60 per loaded mile.

Total Costs

Variable costs account for around 60 percent of total costs per acre, while fixed costs account for 40 percent. Economies of size and scale are most apparent in turfgrass-sod production when discussing total cost of production per acre (Figure 3). As the size of the operation increases, there is an increased ability to buy in large quantities, and to have more specialized managers and workers to increase efficiency and generally spread fixed costs over more acreage. There is also the ability to hire contracting companies to reduce capital investment costs and laborers needed for specific tasks. Despite these economies, maintaining a large operation may not be feasible for a new producer. Many employees will be needed along with more managers who bear greater responsibility. In addition, a new producer may not be able to meet the capital investment and operating capital requirements for a large farm.

Estimated Returns

Net returns were estimated by combining the total cost estimates discussed previously with average market prices per square yard and yields. Estimated returns are reported for both the first year (Table 22) and the fifth year (Table 23) of operation. Because of the high capital costs, establishment difficulties, and the relatively long production cycles for zoysia and centipede, returns in the first year are generally considerably lower than in later years.

Figure 3. Fixed and variable costs for alternative-sized turfgrass-sod farms, Alabama, 2001.

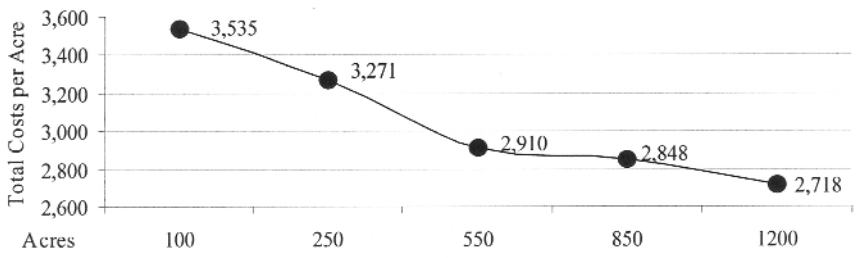


TABLE 22. ESTIMATED RETURN TO MANAGEMENT PER ACRE, YEAR 1, FOR ALTERNATIVE-SIZED TURFGRASS-SOD FARMS, ALABAMA, 2001

	Size-acres				
Item	100	250	550	850	1,200
Gross receipts	735	735	735	735	735
Variable costs	1,968	2,029	1,953	1,836	1,751
Income above variable costs	-1,233	-1,294	-1,218	-1,101	-1,016
Fixed costs	1,567	1,242	957	1,012	967
Return to management	-2,800	-2,536	-2,175	-2,113	-1,983

TABLE 23. ESTIMATED RETURN TO MANAGEMENT PER ACRE, YEAR 5, FOR ALTERNATIVE-SIZED TURFGRASS-SOD FARMS, ALABAMA, 2001

	Size-acres				
Item	100	250	550	850	1,200
Gross receipts	6,224	6,206	6,226	6,225	6,224
Variable costs	3,567	3,679	3,540	3,328	3,174
Income above variable costs	2,657	2,527	2,686	2,897	3,050
Fixed costs	1,567	1,242	957	1,012	967
Return to management	1,090	1,285	1,729	1,885	2,083

Gross receipts were estimated using producer averages (from the initial mail survey of producers), with roughly 70 percent of total production acres in bermuda, 15 percent in zoysia, and 15 percent in centipede (see Appendixes B.1-B.5 for specific acreage amounts).

In the first year of production, it was assumed that producers on all sizes of farms will get only 25 percent of their bermuda acreage harvested, and that they will not be able to harvest twice *(13)*. Generally, the other grasses cannot be harvested at all in the first year, so there will be no returns for these grasses in the first year of operation.

After the first year, revenue was estimated assuming that 80 percent of bermuda acreage will be harvested during each of two separate harvests. For zoysia and centipede, it was assumed that 67 percent of the acreage was harvested one time per year after the first year. As mentioned previously, to match the production cycles of the various grasses, the annual variable costs as reported in Table 21 need to be adjusted. The annual variable costs reported in Table 21 for zoysia were increased by 1.5 times, because it generally has an 18-month production cycle. Variable costs for centipede were adjusted by 1.25 times because it has a 15-month cycle. The variable costs in Table 21 for bermuda were doubled because it is usually harvested twice per year.

Table 22 provides the estimated gross returns, variable costs, fixed costs, and net returns for the five different-sized farms in the first year. All farms have negative net returns in this year. The amount of borrowing that

will be needed the first year can be estimated from these figures, with the 100-acre farm borrowing $2,800 an acre, and the 1,200-acre farm borrowing less than $2,000 per acre.

By the fifth year of operation, the farms no longer have to borrow to pay off the first year's debt (for a more detailed borrowing plan for all five alternative farm sizes, see Appendixes B.1-B.5). Table 23 provides the estimated gross returns, variable costs, fixed costs, and net returns for the five different-sized farms in the fifth year of operation, a time of generally more stable production and cash flow.

Cash Flow

Proper understanding of cash flow is imperative to the longevity of any business. Cash flows over seven years have been estimated for each alternatively size turf farm. Variable and fixed costs were used as outlined above. Revenues were generated by using the average wholesale prices determined from producer marketing surveys ($1.05 per square yard for bermuda, $2.37 for zoysia, and $1.41 for centipede). Funds were borrowed at 9 percent to cover negative cash flows. Borrowed money was repaid the next year when revenues were available, or more funds were borrowed and repaid in the subsequent year if revenue was still not greater than costs. After a positive profit is generated, cash will accumulate in the cumulative cash section. (Table 24 provides a seven-year cash flow for the 100-acre operations. Cash flow for

TABLE 24. CASH FLOW ESTIMATES OVER SEVEN YEARS FOR A 100-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Receipts [1,2]							
Bermuda	73,500	470,400	470,400	470,400	470,400	470,400	470,400
Zoysia	0	35,550	95,274	95,274	95,274	95,274	95,274
Centipede	0	21,150	56,682	56,682	56,682	56,682	56,682
Total Revenue	73,500	527,100	622,356	622,356	622,356	622,356	22,356
Expenses							
Variable cost	196,800	356,700	356,700	356,700	356,700	356,700	56,700
Fixed cost	156,700	156,700	156,700	156,700	156,700	156,700	56,700
Borrowing paid back from previous year	0	305,200	317,735	227,569	129,288	22,162	0
Interest earned	0	0	0	0	0	0	0
Cumulative Inflow/Outflow	-280,000	-291,500	-208,779	-118,613	-20,332	86,794	108,956
Borrowing needs	-280,000	-291,500	-208,779	-118,613	-20,332	0	0
Compiled yearly cash	0	0	0	0	0	86,794	195,750

[1] Price per square yard is $1.05 for bermuda, $1.41 for centipede, and $2.37 for zoysia.

[2] Production includes 70 acres of bermuda, 15 acres of centipede, and 15 acres of zoysia.

other operation sizes are included in Appendixes B.2-B.5.) Once the cumulative amount is greater than the combined variable and fixed costs, interest is earned on excess funds at 4 percent. These estimates are important to plan financial repayment and can create a horizon to schedule new equipment purchases, land purchases, or other long-term investments.

Regardless of size, all farms were able to pay off incurred debt in five years of operation using the estimates provided. These numbers are very volatile and a slight change in the cost of any variable can drastically affect profit. For example, if the 100-acre farm chose to only grow bermuda, instead of all three species, it could see a positive profit by the fourth, instead of the sixth year. If the 550-acre farm's fixed costs were $200 more per acre than the estimated $957, it would make total fixed costs over $100,000 more for the entire farm. Variable and fixed costs must be closely monitored for a particular operation to retain profitability.

PRICE SENSITIVITY

The cost estimates provided in the personal interviews and producer surveys were used to construct linear programming (LP) models using Microsoft Excel Solver. Linear programming was used because it provides a "technique, which decision makers can use to develop optimal values of the decision variables" *(14)*. Microsoft Excel was used because it is commonly available and user friendly. This program contains a Linear Programming Solver, which can work from the spreadsheet itself. The target cells or solution cells are chosen along with constraints to provide the optimal solution *(12)*.

Capital investments, variable and fixed costs, and borrowing were used in the determination of yearly costs in these models. These models were constructed to determine the most profitable mix of grass species and breakeven square yard prices (price needed to be charged for a profit over and above all costs) for all three species analyzed: bermuda, zoysia, and centipede (see Appendix C for a sample model).

Fifteen models were estimated for the five alternative-sized farms, and over three different time periods: three, five, and seven years (Table 25). Three years was used to show how a greater price would have to be charged to be able to pay off all debt within that time period. Five years is the standard amount of time most businesses can expect to begin returning a positive profit, and seven years was used because most operating equipment is completely depreciated over this time frame, except for irrigation, buildings, and office equipment. These models were evaluated by using the costs outlined above, and also charging a 9-percent interest rate on borrowed money. A 4-

TABLE 25: COMPARABLE PROFIT PRICES FOR ZOYSIA AND CENTIPEDE GRASS PRICES FOR FIVE ALTERNATIVE-SIZED FARMS, BY THREE TIME PERIODS, ALABAMA, 2001

	Size-acres				
	100	250	550	850	1,200
3 Year					
Zoysia	$3.62	$3.60	$3.52	$3.55	$3.57
Centipede	$3.35	$3.22	$3.25	$3.30	$3.32
5 Year					
Zoysia	$2.75	$2.70	$2.73	$2.75	$2.76
Centipede	$2.52	$2.49	$2.51	$2.54	$2.56
7 Year					
Zoysia	$2.54	$2.52	$2.52	$2.54	$2.56
Centipede	$2.33	$2.31	$2.31	$2.35	$2.37

percent interest rate was credited on any profit generated the year before over and above the total of variable and fixed costs for that specific year. Returns were compiled for each year and the total was returned to present value at a 6-percent interest rate.

Variable costs were determined differently for each of the three grass species. Bermuda was given the capability of two harvests a year, thus receiving two times the amount of variable costs. Zoysia was considered an 18-month crop with 1.5 times the annual amount of variable cost per acre, per crop, and centipede was considered a 15-month crop with 1.25 times the annual amount of variable costs per crop. These numbers were determined from a survey question regarding time period between establishment or reestablishment and harvest.

Revenue was calculated in a similar manner by multiplying the average price by the percentage to be sold from each acre multiplied by the number of acres. Farmers who responded to the marketing survey also detailed their wholesale and retail prices per square yard. Average wholesale grass prices from surveys used in these models were $1.05 per square yard of bermuda, $2.37 per square yard of zoysia, and $1.41 per square yard of centipede.

Bermuda was assumed to be harvested for sale on 80 percent of the bermuda acreage, which was 70 percent of the total acreage, twice a year. Both zoysia and centipede were assumed to be available for sale on 67 percent of the remaining acreage annually. Farmers discussed the importance of getting more than one harvest a year out of all bermuda acreage. Some farmers were able to get up to three harvests a year. Centipede and zoysia were figured at 67 percent to account for turnover in 15- and 18-month growing cycles, respectively. If only 67 percent is cut each year, this means there will always be some mature grass to sell, before the harvested grass can grow back

in again. All of the grass may be available to harvest at once, but this could later damage the customer market when there is no grass to sell until the other grass matures. These percentages also consider any loss due to disease or death, or leaving grass ribbons for all of the different grass species. However, in the first year only 25 percent of one harvest of bermuda was assumed to be available for sale, and no zoysia or centipede could be sold. The 25-percent figure was used for bermuda to account for a low beginning market base, and the grass may not be fully mature in May and June when the demand is the highest. Centipede and zoysia are considered to have a production cycle of longer than one year and this would mean no grass would be available to sell. These figures were used in the LP model to determine the optimal combination of grasses for maximum profit and were also used to determine breakeven prices, and the comparable profit prices needed for the other grasses to be considered more profitable than the optimal solution.

Every model chose to allocate all acres to bermuda production, except for 100 acres analyzed over three years. When bermuda is sold for $1.05 per square yard, there is no profit generated over a three-year period on a 100-acre farm (Table 26). The amount of profit that was generated for each model was recorded and used to determine the optimal prices for centipede and zoysia. The prices charged for centipede and zoysia were raised until the amount of profit generated by each model was at least one dollar greater than the profit generated by producing only bermuda. When a shorter time horizon was used to pay back all debt, a greater price must be charged for centipede and zoysia to generate more profit than bermuda.

TABLE 26: BREAKEVEN PRICES FOR BERMUDA, ZOYSIA, AND CENTIPEDE FOR FIVE ALTERNATIVE FARM SIZES, BY THREE TIME PERIODS, ALABAMA, 2001

	Size-acres				
	100	250	550	850	1,200
3 Year					
Bermuda	$1.08	$1.03	$0.94	$0.91	$0.86
Zoysia	$3.62	$3.41	$3.08	$2.99	$3.00
Centipede	$3.35	$3.13	$2.81	$2.74	$2.59
5 Year					
Bermuda	$0.99	$0.95	$0.86	$0.83	$0.80
Zoysia	$2.55	$2.41	$2.18	$2.11	$2.02
Centipede	$2.33	$2.18	$1.95	$1.90	$1.82
7 Year					
Bermuda	$0.95	$0.92	$0.84	$0.81	$0.77
Zoysia	$2.28	$2.15	$1.95	$1.89	$1.80
Centipede	$2.07	$1.93	$1.74	$1.69	$1.62

There are some relationships that can be seen from Table 25. The larger the sod farm, the greater the prices of zoysia and centipede must become to overcome the profitability of bermuda. If all profitability prices for centipede and zoysia were analyzed, none of the answers are lower than the current market average price (Figures 4 and 5). This means a farmer may have to look at a longer time horizon to generate a comparable profit growing cen-

Figure 4. Prices at which zoysia becomes more profitable than bermuda for each alternative turfgrass-sod farm size by three time horizons.

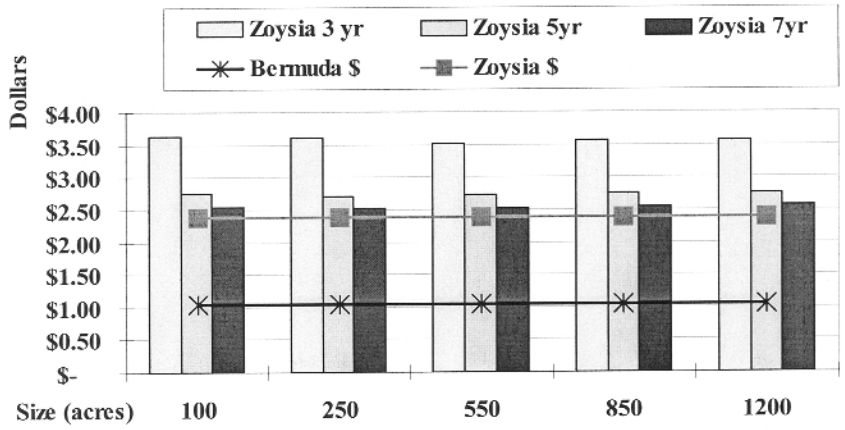
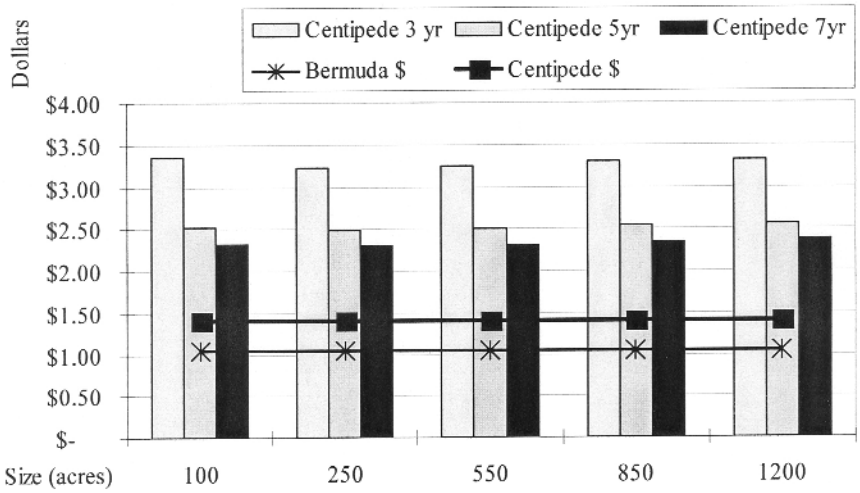


Figure 5. Prices at which centipede becomes more profitable than bermuda for each alternative turfgrass-sod farm size by three time horizons.



tipede and zoysia or to lower production costs in some way to be able to charge a lower price. The pennies' worth of difference in the different prices shown in the proceeding table may seem irrelevant, but if a producer with a 550-acre farm chose to charge $2.51 instead of the model's $2.52 for a square yard of zoysia, $56,020 worth of profit could be lost over a seven-year period when evaluated at present value at a 6-percent interest rate. If the same farmer chose to grow only centipede and charged $2.30 instead of the model's $2.31, $57,461 dollars of profit could be lost over seven years when evaluated at present value at 6 percent.

Figures 4 and 5 show the prices per square yard at which centipede and zoysia become more profitable than bermuda. These graphs are helpful to give a visual representation of the profitability prices' falling as the three time horizons increase. These figures also illustrate the profitability prices in relationship to the current average market prices for these two species, with the average market price of bermuda ($1.05) also added as a reference point. Zoysia prices that result in more profitability than bermuda come closer to current average market prices than centipede. If a producer still wanted to produce either zoysia or centipede and be more profitable than bermuda, it would be necessary either to decrease some area of production or capital investment costs or to decrease the defined production cycle.

Breakeven prices were determined for each of the three grass species using the specified optimization models (Table 26). These were calculated to enforce the commitment that must be made over time to reach a profit and pay off incurred debt. For every model, all acres were put to the production of only one species of grass to determine the breakeven price. The price charged for the grass was raised until the grower had a positive profit for that particular grass species. The answer only had to be greater than one penny to become the optimal solution. This relationship can provide sod farmers some insight into how much lower grass prices can go before they will no longer make a positive profit, when analyzing profit over the different time horizons as presented in Table 26.

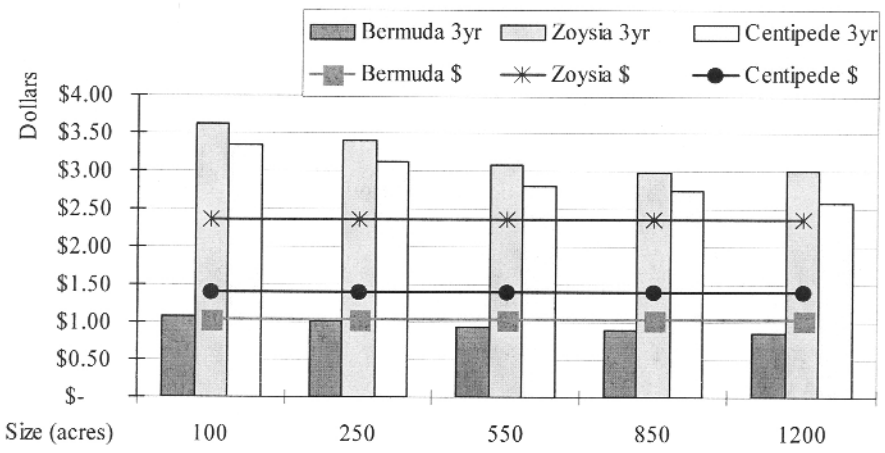
As the table outlines above, the only way to break even, under current market prices, when analyzing a three-year horizon is to grow two harvests of bermuda a year. However, the 100-acre farm does not break even; it must charge $1.08 to break even under current market conditions. The producers will also be able to break even growing zoysia over a five-year horizon if the farmer grows 250 acres or more. The farmer may still be able to break even, but he must either lower production costs from those outlined in the previous chapter or charge a higher-than-market average price. Centipede does not break even over either time frame at current market prices and the current cost structure.

The previous models can illustrate how a change in the price of turfgrass can affect profitability. These prices were determined using the fixed and variable costs outlined in the previous chapter. A farmer can drastically change the breakeven price for his grass by having a slightly different cost structure, or a different production time frame. For example, if a 550-acre producer analyzing a seven-year horizon lowers variable costs by $100 ($1,953 to $1,853) per acre for all seven years and charges the breakeven price of $1.95 per square yard for zoysia, profits will increase from $57,286 to $531,416.

These tables can be further studied in Figures 6 through 11. Figures 6, 7, and 8 show the three different time horizons with breakeven prices for bermuda, zoysia, and centipede with current average market prices for each grass species shown as straight lines. For the three-year time horizon (Figure 6), bermuda is the only species that has a breakeven price below the current market average price. Thus, if a producer has a three-year loan and chooses to grow a species other than bermuda, more than the market average price may have to be charged to meet the loan payment because production is not profitable. Also, this producer may not be able to find a buyer if an above-average market price is being charged. Conversely, if bermuda is grown and market prices begin to fall, the producer may feel more secure because of knowing how low the price can fall and still maintain a positive profit.

Figure 7 shows alternative breakeven prices for the different turfgrasses over a five-year horizon. Bermuda has a breakeven point below the current market average price for all five farm sizes. Zoysia has a breakeven price

Figure 6. Breakeven prices for turfgrass-sod over a three-year horizon by species for alternative-sized farms, current average market prices shown as lines, Alabama 2001.



below the current market average price for the 550-acre farm and greater. Centipede does not have a breakeven price below the current market average price, only above. A farmer must decide if it will be possible to have costs lower than the ones used for these models to feasibly grow centipede under current market prices, and what an option might be if the grass prices continue to fall.

Figure 8 shows breakeven prices below the current market average price for both bermuda and zoysia for a seven-year horizon. Centipede continues to have breakeven prices above the current market price. A beginning farmer should carefully consider all costs and establishment periods before deciding to produce centipede.

Figure 7. Breakeven prices for turfgrass-sod over a five-year horizon by species for alternative-sized farms, current average market prices shown as lines, Alabama 2001.

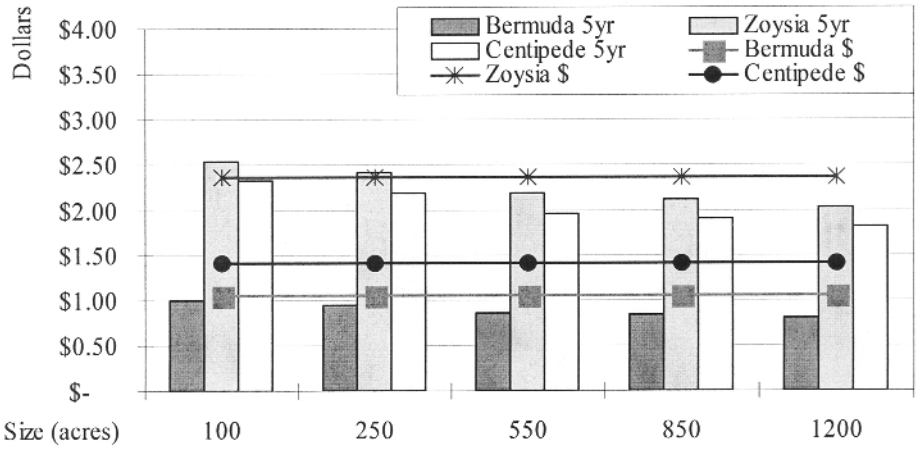
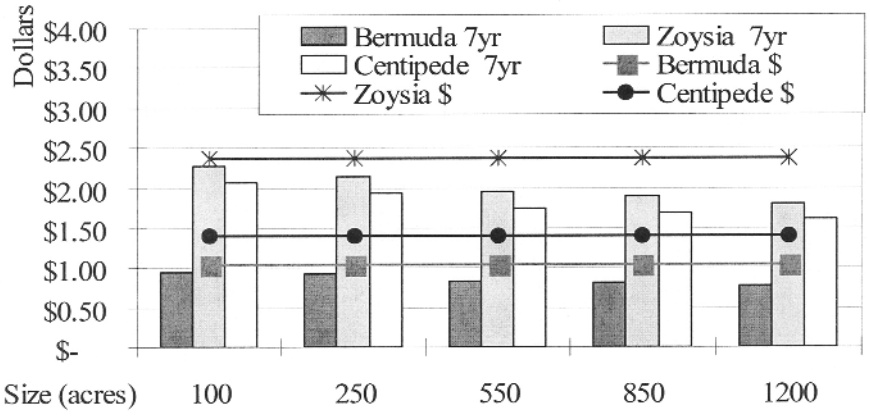


Figure 8. Breakeven prices for turfgrass-sod over a seven-year horizon by species for alternative-sized farms, current average market prices shown as lines, Alabama 2001.



Figures 9, 10, and 11 show the breakeven grass price separately for each species, and the current average market price for that species for each of the three time horizons. As stated previously, bermuda has a breakeven price below the current market average for all time horizons and alternatives sizes, except for a 100-acre farm analyzed over three years (Figure 9). Zoysia (Figure 10) has a breakeven point below the current market price average for none of the alternative farm sizes for a three-year horizon. The five-year horizon has breakeven prices for zoysia below the current market average price for the 550-, 850-, and 1,200-acre farms. All breakeven prices are below current market averages for the seven-year horizon. Centipede (Figure 11) has no breakeven prices below the current market average price for any alternative size over the three time horizons.

These relationships should be carefully evaluated by beginning turfgrass-sod growers. Beginning growers should determine if they can charge a competitive price and still pay off all debt over the specified loan period. The beginning grower must also take into account the market and any current economic conditions. It is important to monitor the growth of metropolitan areas, the number of new subdivisions being built, individuals' discretionary income, rising costs of pesticides or fuel, and any other situations that can affect producers and their ability to make a profit.

Even though some models show breakeven levels growing and selling zoysia and centipede at current market prices, it is still more profitable to sell bermuda for every model. Some possible indicators suggest that the market for zoysia will be more stable over a longer period of time and the price of zoysia could rise due to increased demand for this species *(13)*. Being aware

Figure 9. Current market price and breakeven turfgrass-sod prices for bermuda over three-, five-, and seven-year horizons.

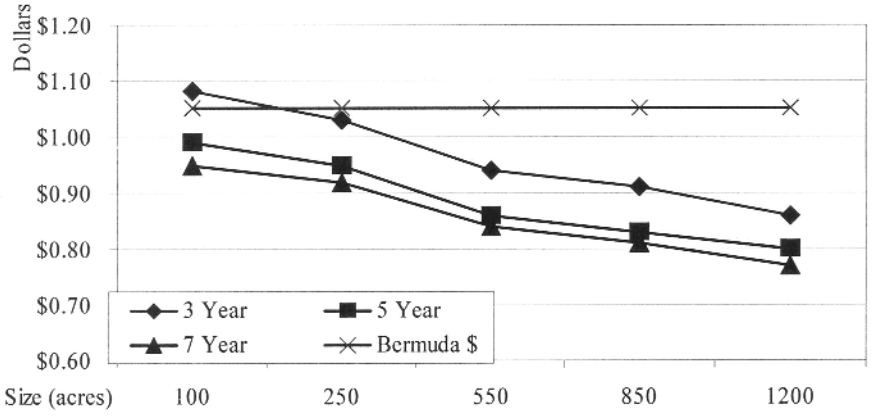


Figure 10. Current market price and breakeven turfgrass-sod prices for zoysia over three-, five-, and seven-year horizons.

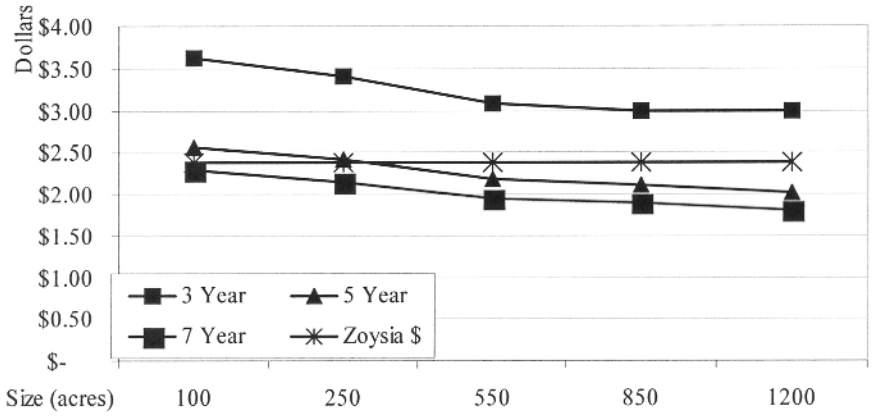
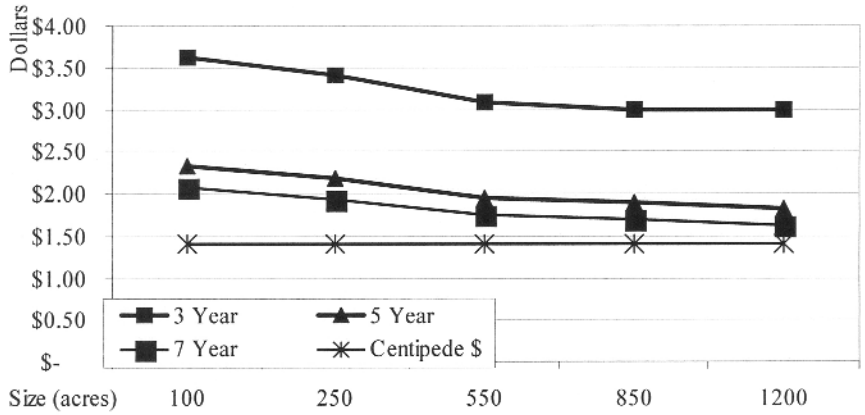


Figure 11. Current market price and breakeven turfgrass-sod prices for centipede over three-, five-, and seven-year horizons.



of customer preference or market orientation could influence growers to produce zoysia over bermuda. Many other considerations other than profit are involved in the decision to produce more acreage or a specific grass species, and these should be analyzed before making production decisions. Even though a 1,200-acre farm makes the greatest profit, and can withstand the largest degree of price-cutting, it requires the greatest amount of management, employees, and capital for establishment and operation. A beginning producer may consider starting small to incur less risk, and later consider increasing acreage thereby increasing profitability. Such a strategy could lower the amount of upfront capital and debt. However, the costs per unit are

higher for smaller operations. Increased efficiency in addition to better production practices and more effective use of fixed factors will benefit farmer's profitability over time. To ensure awareness of business profitability, producers should constantly analyze costs and market prices in order to meet current and future goals and objectives.

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

The primary objectives of this study were to determine (1) the status of Alabama's turfgrass industry including the number of producers, total grass acreage, and acreage by turfgrass species; (2) marketing preferences and activities among turfgrass-sod producers; (3) capital investments and production costs for five different-sized turfgrass-sod farms—100, 250, 550, 850, and 1,200 acres; and (4) price sensitivity for the five different-sized operations for the three primary turfgrass species (bermuda, zoysia, and centipede) over three time frames (three, five, and seven years).

Results were accomplished through two different turfgrass-sod producer surveys and an on-farm case study of selected operations. The first survey asked the type of grass produced and total acreage. Participants in the first survey were also asked if they were willing to participate in a longer, more detailed production/marketing oriented survey. The detailed survey asked more specific questions about advertising, transportation, legal organization, establishment and reestablishment practices, market outlets, and grass species prices. Farm visits and personal interviews were conducted with four farmers to identify complete equipment inventory complements and one farmer responded to this interview by fax.

Data collected in the summer of 2001 through the winter of 2002 indicated there were 22,844 acres of turfgrass-sod being produced in Alabama. Twenty-five varieties of turfgrass were being cultivated with Tifway 419 (34.82 percent) and centipede (36.45 percent) being the most commonly grown grasses. Sod farms averaged 315 acres in size with the largest being 2,000 acres. Bermuda, zoysia, and centipede were the most commonly grown grasses. Tifway (419) was the most common bermuda and Meyer and Emerald were the most commonly grown zoysia. Experience in the industry averaged about 15 years, with one grower having been in operation for 30 years.

Almost all (91 percent) of the responding producers claimed no off-farm employment. The most preferred form of legal organization was a sole proprietorship with eight producers indicating their operation was so organized. Seven producers (32 percent) operated under the corporate form of business.

About half (48 percent) of responding farmers indicated they expected their acreage to increase over the next three years by an average of 123 acres, with the high for any one operation being 325 acres. Another 48 percent expected acreage to stay the same over the next three years, and one farmer expected acreage to decrease by 500 acres.

Primary sales months were April (12 percent) and June (15 percent), with 86 percent of sod being cut and marketed from March to November. Average grass prices charged were $1.05 per square yard for bermuda, $2.37 per square yard for zoysia, and $1.41 per square yard for centipede. In comparison, average wholesale prices per square yard in 1988 were $0.90 for bermuda, $1.13 for centipede, and $1.80 for zoysia. Eight of 17 producers sold 90 percent of more of their turfgrass at the wholesale market, while four producers sold less than 20 percent at the wholesale market.

Advertisement outlays claimed roughly 1.5 percent of sales revenue on average and the Yellow Pages was the most popular form of advertisement. Landscapers were the most popular market outlet, 58 percent of the total. Out-of-state sales accounted for 12 percent of total sales. In 1988, 41 percent of Alabama's sod acreage was sold out of state. Georgia was the largest geographic outlet, with 64 percent of out-of-state acreage.

Capital investment per acre ranged from roughly $5,000 per acre for the 100-acre farm to less than $3,000 per acre for the 1,200-acre farm. Fixed costs varied from $1,567 per acre for the 100-acre farm to $967 per acre for the 1,200-acre farm. Variable costs ranged from $1,968 per acre for the 100-acre farm to $1,751 for the 1,200-acre farm. Returns to management for the fifth year of operation were estimated at $1,090 per acre for the 100-acre farm and $2,083 for the 1,200-acre farm. Cash flow analysis indicated that operations were generally profitable by the sixth year for smaller operations and the third year for larger operations. Over a seven-year cycle, accumulated cash flow was $195,750 for the 100-acre farm and $11,344,809 for the 1,200-acre farm, or $280 versus $1,351 per acre per year, respectively.

Price sensitivity analyses showed that bermuda was the most profitable grass to produce at current average market prices. Zoysia became a feasible option when the price increased to as much as $3.62 for the 100-acre, three-year model to a low of $2.56 for the 1,200-acre, seven-year model. Centipede became feasible at a high of $3.35 for the 100-acre, three-year model and a low of $2.37 for the 1,200-acre, seven-year model.

As the size of the turfgrass farm increased and the planning horizon was lengthened, the breakeven price that could be charged per square yard of turfgrass fell in response to economies of size and scale. The bermuda breakeven price was a high of $1.08 for the 100-acre farm over a three-year planning horizon compared with a low of $0.77 for the 1,200-acre farm over a seven-

year horizon. Zoysia had a breakeven price of $3.62 for the 100-acre farm over a three-year time horizon while the 1,200-acre farm had a breakeven price of $1.80 over a seven-year horizon. Centipede had a similar price structure with a breakeven price of $3.35 for the 100-acre farm over a three-year period and $1.62 for the 1,200-acre farm over a seven-year period. Centipede was the only species that did not have a breakeven price below the current market average price for any size operation over any of the three time frames.

The extent of economies of size and scale identified justifies turf farms continuing to increase in size over time to improve efficiency and competitiveness. This tendency can be confirmed by the small increase in the number of turfgrass producers in the past 10 years, and the substantial increase in total acreage and the size of operations.

Contract growing will become a more feasible alternative for smaller turfgrass sod producers. Larger farms may find it more profitable to purchase grass from smaller growers and save on production costs. Smaller farms will be able to lower marketing costs and transportation costs by growing for a larger operation. Smaller operations may also lower marketing and transportation costs by using contract trucking instead of maintaining fleets of eighteen wheelers and commercially licensed truck drivers.

Contracts with landscapers and builders are expected to increase. Smaller farms may find a feasible way to lock in a market that will ensure selling their acreage and provide a more stable cash flow. Contracts with landscapers and builders can also help to save on marketing costs if a large majority of the operation's acreage is being marketed to a specific contractor or landscaper.

More farms will try to grow more specialized varieties of grass to be able to charge a higher price. They will also use this and other techniques to differentiate their product from other farms by growing more specific varieties or "branded" grasses. Some farms are also beginning to grow trademarked grass with their farm name to further differentiate their turfgrass-sod.

Equipment will continue to become more specialized, focusing on the specific needs of turf producers and increased efficiency. More efficient equipment will be produced and used that reduces the number of laborers who are needed, and thus reduces the cost of production. Producers may find it more profitable to use contract trucking and maintain fewer 18-wheelers and properly licensed drivers. Contract delivery and hauling could be a savings to a beginning turfgrass producer who may have trouble employing drivers and obtaining funds to purchase 18-wheelers.

Turfgrass-sod producers will also begin to analyze and monitor their costs and returns more closely to ensure their business remains profitable. It is important that each dollar be accounted for with constant emphasis on the

best management practices for employees and other resources. As the market continues to become more competitive and the price of grass shows little upward tendency, farmers will find cost restructuring a feasible way to still generate a desirable profit margin.

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APPENDIX A.1. EQUIPMENT INVESTMENT FOR A 100-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

Equipment	Quantity	Unit cost ($)	Total ($)
300 gal. tank sprayer	1	5,500	5,500
Buildings storage/office sq. ft.	2,000	8	16,000
Disk, 8 ft.	1	3,500	3,500
Forklift	1	32,900	32,900.
Forklift delivery truck mounted	1	27,500	27,500
Four-wheeler	1	8,000	8,000
Granular spreader, 14 ft.	1	950	950
Harvesters, 16 in.	2	42,000	84,000
Irrigation (acres)	100	700	70,000
Irrigation pump diesel	1	15,000	15,000
Land plane, 8 ft.	1	475	475
Misc. tools, equipment…etc	1	10,000	10,000
Office equipment (computer, desk…etc.)	1	5,000	5,000
Plugger, 9-row	1	17,900	17,900
Reelmower, 5-gang	1	15,500	15,500
Rotary mower, 22 ft.	1	15,700	15,700
Straight truck	1	60,000	60,000
Subsoiler	1	250	250
Tiller, 8 ft.	1	6,789	6,789
Tractor, 60 hp	1	22,000	22,000
Tractor, 80 hp	1	34,200	34,200
Trucks, pickup	2	20,000	40,000
Vacuum, 8 ft.	1	21,000	21,000
Total cost			**512,164**

APPENDIX A.2. EQUIPMENT INVESTMENT FOR A 250-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

Equipment	Quantity	Unit cost ($)	Total ($)
18 wheelers with trailers	2	125,000	250,000
300 gal. tank sprayer	1	5,500	5,500
Backhoe	1	40,000	40,000
Buildings storage/office sq. ft.	4,000	8	32,000
Disk, 12 ft.	2	6,000	12,000
Forklift	2	32,900	65,800.00
Forklift delivery truck mounted	3	27,500.00	82,500
Four-wheeler	1	8,000	8,000
Granular spreader, 14 ft.	1	950	950
Harvesters, 16-in.	3	42,000	126,000
Irrigation (acres)	250	700	175,000
Irrigation pump diesel	2	15,000	30,000
Land plane, 8 ft.	1	475	475
Misc. tools, equipment…etc	1	20,000	20,000
Mower flail, 10 ft.	1	12,350	12,350
Office equipment (computer, desk…etc.)	1	7,000	7,000
Plugger, 9-row	1	17,900	17,900
Reelmower, 5-gang	1	15,500	15,500
Reelmower, 7-gang	1	19,000	19,000
Roller, 8 ft.	1	3,900	3,900
Rotary mower, 22 ft.	1	15,700	15,700
Straight trucks	1	60,000	60,000
Subsoiler	1	250	250
Tiller, 8 ft.	1	6,789	6,789
Tractor, 120 hp	1	63,000	63,000
Tractor, 60 hp	1	22,000	22,000
Tractor, 80 hp	1	34,200	34,200
Trucks, pickup	3	20,000	60,000
Vacuum, 8 ft.	1	21,000	21,000
Total cost			**1,206,814**

APPENDIX A.3. EQUIPMENT INVESTMENT FOR A 550-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

Equipment	Quantity	Unit cost ($)	Total ($)
18 wheelers with trailers	3	125,000	375,000
300 gal. boom sprayer	1	5,500	5,500
Four-wheeler	1	8,000	8,000
Aerator, 10 ft.	1	7,700	7,700
Backhoe	1	40,000	40,000
Buildings storage/office sq. ft.	6,000	8	48,000
Disk, 12 ft.	2	6,000	12,000
Dump truck	1	100,000	100,000
Forklift	2	32,900	65,800
Forklift delivery truck mounted	3	27,500	82,500
Four-wheeler	2	8,000	16,000
Granular spreader, 14 ft.	1	950	950
Harvesters, 16-in.	3	42,000	126,000
Harvester (30-inch roll)	1	15,000	15,000
Irrigation (acres)	550	700	385,000
Irrigation pump diesel	2	15,000	30,000
Land plane, 8 ft.	1	475	475
Misc. tools, equipment…etc	1	30,000	30,000
Mower flail, 10 ft.	1	12,350	12,350
Netting machine	1	12,500	12,500
Office equipment (computer, desk…etc.)	1	10,000	10,000
Plugger, 9-row	1	17,900	17,900
Reelmower, 5-gang	1	15,500	15,500
Reelmower, 7-gang	1	19,000	19,000
Roller, 8 ft.	1	3,900	3,900
Rotary mower, 22 ft.	2	15,700	31,400
Subsoiler	1	250	250
Tiller, 8 ft.	1	6,789	6,789
Tractor, 120 hp	2	63,000	126,000
Tractor, 60 hp	3	22,000	66,000
Tractor, 80 hp	2	34,200	68,400
Truck, pickup	4	20,000	80,000
Vacuum, 8 ft.	1	21,000	21,000
Total cost			**1,838,914**

APPENDIX A.4. EQUIPMENT INVESTMENT FOR A 850-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

Equipment	Quantity	Unit cost ($)	Total ($)
18 wheelers with trailers	4	125,000	500,000
300 gal. boom sprayer	1	5,500	5,500
Aerator, 10 ft.	1	7,700	7,700
Backhoe	1	40,000	40,000
Buildings storage/office sq. ft.	8,000	8	64,000
Dethatcher, 5-gang	1	15,000	15,000
Disk, 12 ft.	2	6,000	12,000
Dump truck	1	100,000	100,000
Forklift	4	32,900	131,600
Forklift delivery truck mounted	4	27,500	110,000
Four-wheeler	3	8,000	24,000
Granular spreader, 14 ft.	1	950	950
Harvesters, 16 in.	3	42,000	126,000
Harvester (30-inch roll)	1	15,000	15,000
Irrigation (acres)	850	700	595,000
Irrigation pump diesel	5	15,000	75,000
Land plane	1	15,500	15,500
Misc. tools, equipment…etc	1	40,000	40,000
Mower flail, 10 ft.	1	12,350	12,350
Netting machine	1	12,500	12,500
Office equipment (computer, desk…etc.)	1	15,000	15,000
Plugger, 9-row	1	17,900	17,900
Reelmower, 5-gang	2	19,000	38,000
Reelmower, 7-gang	4	24,000	96,000
Roller, 8 ft.	2	3,900	7,800
Rotary mower, 22 ft.	3	15,700	47,100
Sprig harvester	1	18,000	18,000
Sprig planter	1	29,000	29,000
Subsoiler	1	250	250
Tiller, 8 ft.	2	6,789	13,578
Tractor, 120 hp	2	63,000	126,000
Tractor, 140 hp	1	82,300	82,300
Tractor, 60 hp	2	22,000	44,000
Tractor, 80 hp	5	34,200	171,000
Truck, pickup	5	20,000	100,000
Vacuum, 8 ft.	3	21,000	63,000
Total cost			**2,771,028**

APPENDIX A.5. EQUIPMENT INVESTMENT FOR A 1,200-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

Equipment	Quantity	Unit cost ($)	Total ($)
18 wheelers with trailers	6	125,000	750,000
300 gal. tank sprayer	1	5,500	5,500
Aerator, 10 ft.	1	7,700	7,700
Backhoe	1	40,000	40,000
Blower	1	3,000	3,000
Buildings storage/office sq. ft.	10,000	8	80,000
Dethatcher, 5-gang	1	15,000	15,000
Disk, 12 ft.	2	6,000	12,000
Dump truck	2	100,000	200,000
Forklift	4	32,900	131,600
Forklift delivery truck mounted	6	27,500	165,000
Four-wheeler	4	8,000	32,000
Granular spreader, 14 ft.	1	950	950
Harvesters, 16 in.	5	42,000	210,000
Harvester (30-inch roll)	2	15,000	30,000
Irrigation (acres)	1,000	700	700,000
Irrigation pump d6	15,000	90,000	
Land plane	2	15,500	31,000
Misc. tools, equipment…etc	1	50,000	50,000
Mower flail, 10 ft.	1	12,350	12,350
Netting machine	1	12,500	12,500
Office equipment (computer, desk…etc.)	1	17,000	17,000
Plugger, 9-row	1	2,500	2,500
Reelmower, 5-gang	2	19,000	38,000
Reelmower, 7-gang	5	15,500	77,500
Roller, 8 ft.	2	3,900	7,800
Rotary mower, 22 ft.	4	15,700	62,800
Sprig harvester	1	18,000	18,000
Sprig planter	1	29,000	29,000
Subsoiler	1	250	250
Tiller, 8 ft.	2	6,789	13,578
Tractor, 120 hp	4	63,000	252,000
Tractor, 140 hp	1	82,300	82,300
Tractor, 60 hp	2	22,000	44,000
Tractor, 80 hp	6	34,200	205,200
Truck, pickup	6	20,000	120,000
Vacuum, 8 ft.	3	21,000	63,000
Total cost			**3,611,528**

APPENDIX B.1: CASH FLOW ANALYSIS OVER SEVEN YEARS FOR A 100-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Receipts [1,2]							
Bermuda	73,500	470,400	470,400	470,400	470,400	470,400	470,400
Zoysia	0	35,550	95,274	95,274	95,274	95,274	95,274
Centipede	0	21,150	56,682	56,682	56,682	56,682	56,682
Total Revenue	73,500	527,100	622,356	622,356	622,356	622,356	622,356
Expenses							
Variable cost	196,800	356,700	356,700	356,700	356,700	356,700	356,700
Fixed cost	156,700	156,700	156,700	156,700	156,700	156,700	156,700
Borrowing paid back from previous year	0	305,200	317,735	227,569	129,288	22,162	0
Interest earned	0	0	0	0	0	0	0
Cumulative Inflow/Outflow	-280,000	-291,500	-208,779	-118,613	-20,332	86,794	108,956
Borrowing needs	-280,000	-291,500	-208,779	-118,613	-20,332	0	0
Compiled yearly cash	0	0	0	0	0	86,794	195,750

[1] Price per square yard is $1.05 for bermuda, $1.41 for centipede, and $2.37 for zoysia.
[2] Production acres include 70 acres of bermuda, 15 acres of centipede, and 15 acres of zoysia.

APPENDIX B.2: CASH FLOW ANALYSIS OVER SEVEN YEARS FOR A 250-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Receipts [1,2]							
Bermuda	183,750	1,176,000	1,176,000	1,176,000	1,176,000	1,176,000	1,176,000
Zoysia		90,060	241,361	37,758	237,758	237,758	237,758
Centipede	0	52,170	139,816	137,729	137,729	137,729	137,729
Total Revenue	183,750	1,318,230	1,557,176	1,551,487	1,551,487	1,551,487	1,551,487
Expenses							
Variable cost	507,250	919,644	919,644	919,644	919,644	919,644	919,644
Fixed cost	310,500	310,500	310,500	310,500	310,500	310,500	310,500
Borrowing paid back from previous year	0	691,060	657,242	359,929	42,058	0	0
Interest earned	0	0	0	0	0	0	0
Cumulative Inflow/Outflow	-634,000	-602,974	-330,210	-38,586	279,285	321,343	321,343
Borrowing needs	-634,000	-602,974	-330,210	-38,586	0	0	0
Compiled yearly cash	0	0	0	0	279,285	600,627	921,970

[1] Price per square yard is $1.05 for bermuda, $1.41 for centipede, and $2.37 for zoysia.
[2] Production acres include 175 acres of bermuda, 37 acres of centipede, and 38 acres of zoysia.

APPENDIX B.3: CASH FLOW ANALYSIS OVER SEVEN YEARS FOR A 550-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Receipts [1,2]							
Bermuda	404,250	2,587,200	2,587,200	2,587,200	2,587,200	2,587,200	2,587,200
Zoysia	0	196,710	527,183	527,183	527,183	527,183	527,183
Centipede	0	115,620	309,862	309,862	309,862	309,862	309,862
Total Revenue	404,250	2,899,530	3,424,244	3,424,244	3,424,244	3,424,244	3,424,244
Expenses							
Variable cost	1,074,150	1,947,141	1,947,141	1,947,141	1,947,141	1,947,141	1,947,141
Fixed cost	526,350	526,350	526,350	526,350	526,350	526,350	526,350
Borrowing paid back from previous year	0	1,303,913	956,882	6,680	0	0	0
Interest earned	0	0	0	0	0	0	14,884
Cumulative Inflow/Outflow	-1,196,250	-877,874	-6,129	944,073	950,753	950,753	950,753
Borrowing needs	-1,196,250	-877,874	-6,129	0	0	0	0
Compiled yearly cash	0	0	0	944,073	1,894,827	2,845,580	3,796,333

[1] Price per square yard is $1.05 for bermuda, $1.41 for centipede, and $2.37 for zoysia.
[2] Production acres include 385 acres of bermuda, 82 acres of centipede, and 83 acres of zoysia.

APPENDIX B.4: CASH FLOW ANALYSIS OVER SEVEN YEARS FOR A 850-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Receipts [1,2]							
Bermuda	624,750	3,998,400	3,998,400	3,998,400	3,998,400	3,998,400	3,998,400
Zoysia	0	303,360	813,005	813,005	813,005	813,005	813,005
Centipede	0	179,070	479,908	479,908	479,908	479,908	479,908
Total Revenue	624,750	4,480,830	5,291,312	5,291,312	5,291,312	5,291,312	5,291,312
Expenses							
Variable cost	1,560,600	2,828,817	2,828,817	2,828,817	2,828,817	2,828,817	2,828,817
Fixed cost	860,200	860,200	860,200	860,200	860,200	860,200	860,200
Borrowing paid back from previous year	0	1,957,695	1,270,811	0	0	0	0
Interest earned	0	0	0	0	0	0	57,974
Cumulative Inflow/Outflow	-1,796,050	-1,165,882	331,485	1,602,295	1,602,295	1,602,295	1,602,295
Borrowing needs	-1,796,050	-1,165,882	0	0	0	0	0
Compiled yearly cash	0	0	331,485	1,933,780	3,536,075	5,138,371	6,740,666

[1] Price per square yard is $1.05 for bermuda, $1.41 for centipede, and $2.37 for zoysia.
[2] Production acres include 595 acres of bermuda, 127acres of centipede, and 128 acres of zoysia.

APPENDIX B.5: CASH FLOW ANALYSIS OVER SEVEN YEARS FOR A 1,200-ACRE TURFGRASS-SOD FARM, ALABAMA, 2001

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Receipts [1,2]							
Bermuda	882,000	5,644,800	5,644,800	5,644,800	5,644,800	5,644,800	5,644,800
Zoysia	0	426,600	1,143,288	1,143,288	1,143,288	1,143,288	1,143,288
Centipede	0	253,800	680,184	680,184	680,184	680,184	680,184
Total Revenue	882,000	6,325,200	7,468,272	7,468,272	7,468,272	7,468,272	7,468,272
Expenses							
Variable cost	2,101,200	3,808,425	3,808,425	3,808,425	3,808,425	3,808,425	3,808,425
Fixed cost	1,160,400	1,160,400	1,160,400	1,160,400	1,160,400	1,160,400	1,160,400
Borrowing paid back from previous year	0	2,593,764	1,348,754	0	0	0	0
Interest earned	0	0	0	0	0	47,230	149,098
Cumulative Inflow/Outflow	-2,379,600	-1,237,389	1,150,693	2,499,447	2,499,447	2,546,677	2,648,545
Borrowing needs	-2,379,600	-1,237,389	0	0	0	0	0
Compiled yearly cash	0	0	1,150,693	3,650,140	6,149,587	8,696,264	11,344,809

[1] Price per square yard is $1.05 for bermuda, $1.41 for centipede, and $2.37 for zoysia.
[2] Production acres include 840 acres of bermuda, 180 acres of centipede, and 180 acres of zoysia.

APPENDIX C: LINEAR PROGRAMMING SAMPLE MODEL FOR 100 ACRES OVER A THREE-YEAR HORIZON

	PRICE	Bermuda	Zoysia	Centipede		COSTS	Variable	Fixed		
		$1.05	$2.37	$1.41			1784.16	1766.33		
	Ber 1	Ber 2	Ber 3	Zoy 1	Zoy 2	Zoy 3	Cent 1	Cent 2	Cent 3	Banking	Constraints
Land 1	1			1			1				100<100
Var cost 1	1,784.16			1,784.16			1,784.16			178,416.00	
Fixed cost 1	1,766.33			1,766.33			1,766.33			176,633.00	
Harvest 1	0.25			0			0				
Revenue	1050.00			0			0			105,000.00	
Income										-250,049.00	
Borrow money										272,553.41	
Earned interest										0	
Land 2		1			1			1			100<100
Var cost 2		3,568.32			2,676.24			2,230.20		356,832.00	
Fixed cost 2		1,766.33			1,766.33			1,766.33		176,633.00	
Harvest 2		1.60			0.25			0.25			
Revenue 2		6720.00			2370.00			1410.00		672,000.00	
Income										-134,018.41	
Borrow money										146,080.07	
Earn interest										0	
Land 3			1			1			1		100<100
Var cost 3			3,568.32			2,676.24			2,230.20	356,832.00	
Fixed cost 3			1,766.33			1,766.33			1,766.33	176,633.00	
Harvest 3			1.60			0.67			0.67		
Revenue 3			6720.00			6351.60			3778.80	672,000.00	
Income										-7,545.07	
Borrow money										8,224.12	
Earn interest										0	
Solution	100	100	100	0	0	0	0	0	0	-6,905.13	

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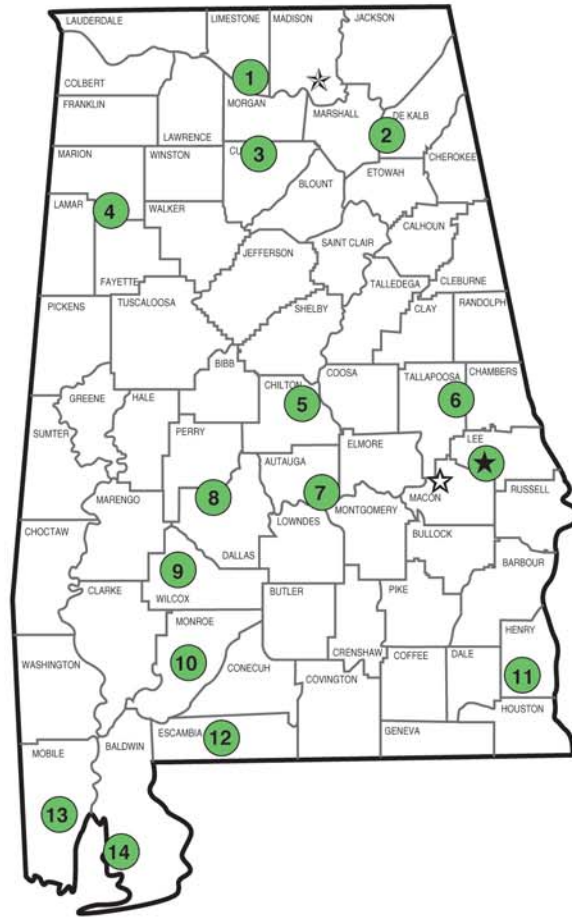

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