Cost of Aflatoxin to the Farmer, Buying Point, and Sheller Segments of the Southeast United States Peanut Industry

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ABSTRACT

Aflatoxin in peanut imposes considerable economic cost to the southeast U.S. peanut industry. A federal marketing agreement administered by the Peanut Administrative Committee ensures the consumer that only edible quality peanuts are allowed entry into edible markets. The 1993-1996 crop years were analyzed to estimate the net cost due to aflatoxin to the farmer, buying point, and sheller segments of the southeast peanut industry. Farmer stock peanuts are examined for visible *Aspergillus flavus*, the mold primarily responsible for aflatoxin contamination in peanut. Detected lots with aflatoxin (Segregation III) are removed from edible channels because the lot is presumed to be at high risk for aflatoxin contamination and the value of farmer stock peanuts is reduced. The farmer segment net cost due to Segregation III lots averaged $2,595,937 per year. Segregation III lots are generally placed under loan in the Commodity Credit Corporation (CCC). Buying points are paid to handle peanuts for CCC, but at a lower rate per ton than commercial commissions; thus, a loss is incurred to the buying point segment. Buying point losses from handling Segregation III lots average $532,585 annually. The southeast peanut sheller segment incurred the highest cost associated with aflatoxin. The majority of the cost was due to the purchase of Segregation I farmer stock that required further processing due to the aflatoxin contamination found via chemical testing. The average net annual cost to the southeast sheller segment over the 4-yr period was $22,697,737. Segregation III lots and aflatoxin cost the farmer, buying point, and sheller segments of the southeast U.S. peanut industry $25,825,259 annually. On a total Segregation I farmer stock basis, aflatoxin cost the southeast peanut industry an average of $25.53/Mg and an average $69.34/ha.

Key Words: *Arachis hypogaea* L., Peanut Administrative Committee, Segregation III.

The potential for aflatoxin contamination in peanuts (*Arachis hypogaea* L.) imposes considerable economic cost annually to the U.S. peanut industry. Aflatoxin refers to four naturally occurring metabolites designated B_1, B_2, G_1, and G_2 of *Aspergillus flavus* (Link) and *A. parasiticus* (Speare). Aflatoxin B_1, a metabolite of *A. flavus*, is considered to be the most important because it is the most toxic and has been classified as a probable human carcinogen. *Aspergillus flavus* and *A. parasiticus* are distributed in soil and air and, under certain environmental conditions, can produce aflatoxin in several agricultural commodities, including peanut (Cole *et al.*, 1995). Research on aflatoxin in feed and food products was heightened in the early 1960s after the 'turkey X disease' syndrome. A federal marketing agreement, administered by the Peanut Administrative Committee, was established in 1965 to provide "The Incoming Quality Regulations" and "The Outgoing Quality Regulations" of domestically produced peanuts. The Incoming Quality Regulations dictate the grade and quality of farmer stock peanuts which may be acquired by handlers for commercial shelling or cleaning. The Outgoing Quality Regulations cover the grades and specifications of shelled and cleaned inshell peanuts which a handler may dispose of for human consumption (Peanut Administrative Committee, 1996). The marketing agreement divides incoming farmer stock peanuts into Segregation I, II, or III on the basis of damage and the visual detection of *A. flavus*. Segregation I lots have less than 2.50% damage and visible *A. flavus* is not detected. Segregation I lots are intended for edible consumption in either domestic or export markets. Segregation II peanuts have 2.50% or greater damage and visible *A. flavus* is not detected. Segregation II peanuts are generally crushed for oil unless market shortages allow them to enter domestic edible markets. Peanut lots are termed Segregation III if any amount of visible *A. flavus* is detected during farmer stock grading. Segregation III lots are not allowed to enter edible markets and must be crushed for oil unless they are retained for use as seed peanuts (Sands, 1982). However, retention of Segregation III lots is not recommended or commonly practiced because the seed quality is generally substandard.

To ensure the quality of U.S. peanuts, development of integrated management systems and equipment designed to segregate and remove high risk peanuts from edible lots evolved resulting in large capital investments (Davidson *et al.*, 1981, Cole *et al.*, 1991, 1995). Such investments seemed to have paid off when The Council for Agricultural Science and Technology reported in 1989 that aflatoxin posed no threat to humans at exposure levels found in the U.S. (CAST, 1989). As technological advances in testing, removal, and segregation improve further capital investments were required to maintain competitiveness.

The objective of this report is to quantify the net economic cost of aflatoxin in peanuts to the farmer, buying point, and sheller segments of the southeast U.S. peanut industry during crop years 1993 through 1996. It is important to note that the cost estimates are on a net basis because safety nets such as disaster transfers, PAC indemnification, and insurance are designed to minimize the downside risk associated with substandard quality peanuts. These will be discussed in the following sections where applicable.

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Materials and Methods

Data for this analysis came from several sources for the different segments of the peanut industry. The discussion following will be separated accordingly.

Peanut Producer Level. Data on the tonnage of Segregation III lots in southeast farmer stock peanuts are available from CCC loan association tonnage reports. Segregation III lots retained for on-farm use as seed peanuts are excluded because seed peanuts are deducted from farm quota poundage and are thus valued as a quota marketing. Data on the disaster transfers on Segregation III lots also are available. Prior to 1996, disaster transfers were paid based on a $27.55/Mg deduction from the quota support price with no limitations on tonnage up to the farm's quota. In 1996 through 2002 crop years, disaster transfers are paid at 70% of the quota support on 25% of the farm's quota. Disaster transfers in excess of 25% of the farm's quota are paid at the lower additional support price. When the disaster transfer option is utilized by growers, the poundage transferred is deducted from the farm's quota. Utilization of crop insurance coverage is not deducted from the farm's quota and thus allows growers to conduct a fall transfer on unfilled quota for a particular farm (provided that the farm in compliance with USDA-FSA regulations). The presence of Segregation III lots also reduces the tonnage that a producer could market in additional markets. Thus, from the total Segregation III tonnage net of seed, disaster transfers are subtracted first and the remaining tonnage is valued at contract additional prices.

Buying Point Level. Data from the CCC loan association tonnage reports were utilized to estimate the impact of Segregation III lots on southeast buying points. Peanuts found to be Segregation III are not allowed to enter edible channels. Segregation III lots can be used as seed which is a quota deduction but primarily they are placed under CCC loan. This is a loss to the buying point segment of the industry because CCC loan payments to buying points are lower than commissioned rates paid by shellers. Southeast commissioned buying points receive approximately $41.88/Mg for commercial purchases while receiving about $16.53/Mg for loan purchases.

Sheller Level. A confidential survey of southeast peanut shellers was conducted to gather information on the cost of aflatoxin in shelled stock peanuts. Two shellers having buying points in Alabama, Georgia, and Florida completed the questionnaire. The questionnaire required data over the 1993-1996 crop years including all buying point aflatoxin testing cost, farmer stock purchases, shelled stock outturn and sales, shelled stock aflatoxin testing cost, equipment, and the cost allocation based on removal of aflatoxin, number of lots successfully and unsuccessfully remilled and/or blanched due to aflatoxin and the associated cost, and PAC premiums and indemnifications. During the 1993-1995 crops years, the PAC provided indemnification to peanut shellers for remilling and/or blanching of lots rejected due to aflatoxin. A set indemnification rate was established for remilling and/or blanching. If the sheller's cost exceeded the PAC set rate, the sheller was responsible for the difference. Further, indemnification was limited to the per-unit cost of remilling and/or blanching and the associated rejects. The indemnification did not apply to shrinkage of product during these processes which can account for approximately 8% of product loss (Lamb *et al.*, 1993). Thus, lots requiring further processing can significantly increase cost to peanut shellers even though the sheller is fully indemnified by PAC. The Peanut Administrative Committee eliminated indemnification effective in the 1996 crop year. Shellers then had to purchase coverage from private insurance companies in order to obtain similar protection provided by the PAC in previous years.

The survey data were compiled and the net cost of aflatoxin to the cooperating peanut shellers was estimated in total and on a farmer stock tonnage basis. Based on the ratio of the shellers farmer stock purchases to the actual southeast production, the data were extrapolated to obtain an estimate of the cost to the shelling industry in the Southeast. To ensure anonymity of the survey participants, only the extrapolated data will be presented for the southeast peanut shelling industry.

Results and Discussion

Segregation III tonnage in Alabama, Florida, and Georgia from 1976 through 1996 is illustrated in Fig. 1. Alabama generally had the highest percentage of Segregation III lots per tonnage followed by Georgia and Florida. Over the 1976-1996 period, the average percentage of Segregation III lots for Alabama, Florida, Georgia, and the Southeast were 4.83, 1.36, 2.07, and 2.74, respectively (Fig. 1). However, Georgia was highest on a total Segregation III tonnage basis followed by Alabama and Florida because of its large acreage. The Southeast recorded an annual average of 23,285 Segregation III farmer stock Mg with a minimum of 1917 [crop year (cy) 1994] and a maximum of 170,774 (cy 1990).

Peanut Producer Level. In this analysis only the 1993-1996 crop years will be addressed. The Segregation III tonnage in the Southeast averaged 17,781 farmer stock Mgs with a minimum of 1917 (cy 1994) and a maximum of 38,599 farmer stock Mg (cy 1995). The estimated cost of Segregation III lots in the Southeast during the 1993-1996 crop years averaged $2.595 mil/yr (Table 1). The costs in each state and the Southeast are consistent with the total Segregation III tonnage in each state (Fig. 1). The net cost of Segregation III lots in the Southeast was 0.42% of the total southeast crop value, ranging from 0.02% in crop year 1994 and 0.80% in crop year 1995.

Table 1. Estimated southeast farm sector net cost of Segregation III lots for Alabama, Florida, Georgia and the Southeast during crop years 1993-1996.

Year	Alabama	Florida	Georgia	Southeast
	$	$	$	$
1993	1,049,241	174,904	3,829,231	5,053,376
1994	68,461	9,780	39,718	117,959
1995	1,829,908	191,392	2,838,985	4,860,285
1996	104,154	34,573	208,309	347,037
Average	762,941	102,662	1,729,061	2,594,664

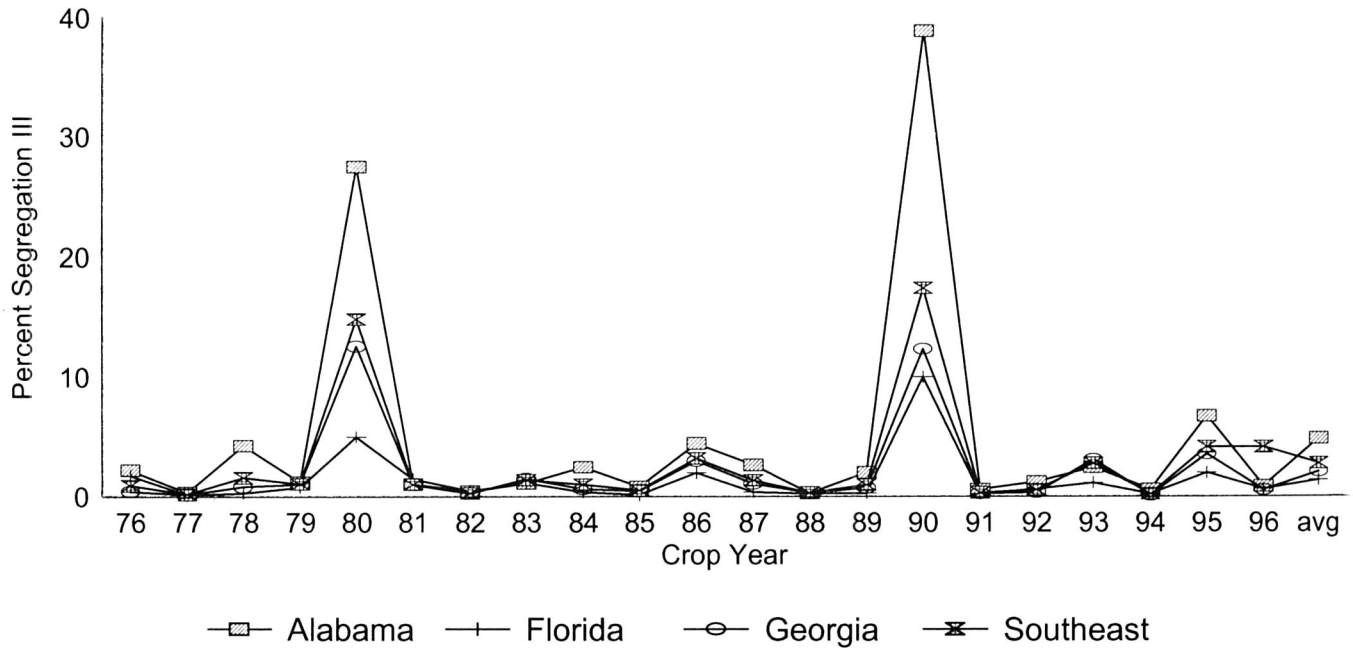

Fig. 1. Percentage of Segregation III tonnage in Alabama, Florida, and Georgia during the 1976 through 1996 crop years.

Alabama peanut producers averaged $762,941 annual losses due to Segregation III lots which represented 0.54% of their total crop value during the 1993-1996 crop years. The percentage for Alabama ranged from 0.05 to 1.31% in crop years 1994 and 1995, respectively. Florida was least affected by Segregation III lots on both total cost and percentage basis. Florida's net losses averaged $108,662, or 0.18% of total crop value during the 1993-1996 period, ranging from 0.02% (cy 1994) to 0.36% (cy 1995). The net losses in Georgia averaged $1,729,061 or 0.32% of the total crop value.

While the total cost of Segregation III lots is important data in emphasizing the need to eliminate, or better manage, Segregation III lots, it is also important to break down these cost to a per-Mg and per-ha basis for better analysis on the feasibility of control methods. Dividing the estimated cost by the total production and harvested hectares in the respective years and states provides the per unit cost of Segregation III lots (Table 2). As technology emerges designed to minimize aflatoxin in Segregation III lots, data on the cost to the farm sector are required. Segregation III lots cost southeast farmers an average of $7.36/ha, with ranges from $0.52 (cy 1994) to $15.17 (cy 1995) (Table 2). The southeast cost per farmer stock Mg averaged $3.06 over the 1993-1996 period. Alabama farmers averaged the highest cost per Mg and per hectare at $3.52 and $8.36, respectively. In crop year 1995, Alabama farmers netted the highest losses at $8.42/Mg and $21.32/ha (Table 2). Florida was least affected by Segregation III lots with an average of $1.30/Mg and $2.90/ha. Contaminated Segregation III lots cost Georgia farmers an average $2.75/Mg and $6.69/ha. Note that the per-hectare results in Table 2 are estimated on total state and southeast hectare basis. However, preharvest aflatoxin contamination in peanut can be greatly reduced with proper irrigation, and the per-hectare cost of Segregation III lots also should be provided on a per-nonirrigated hectare basis (Dorner *et al.*, 1989; Cole *et al.*, 1995). Dividing the state and southeast estimated cost by the nonirrigated peanut hectares in Alabama, Florida, Georgia, and the Southeast results in per-hectare nonirrigated cost of $34.17, $7.26, $13.27, and $20.34, respectively. Thus, the cost of Segregation III lots obviously is higher for nonirrigated peanut farmers. However, if the current disaster transfer provisions were effective in the 1993-1995 crop years, the estimated total cost of southeast Segregation III lots is $3.41 million, and costs to farmers would average $9.71/ha and increase up to $22.26/ha in drought years.

Table 2. Estimated southeast farm sector net cost of Segregation III lots (per-Mg and per-harvested-hectare basis) for Alabama, Florida, Georgia, and the Southeast during crop years 1993-1996.

Year	Alabama		Florida		Georgia		Southeast	
	$/Mg	$/ha	$/Mg	$/ha	$/Mg	$/ha	$/Mg	$/ha
1993	4.85	10.85	2.25	4.40	6.21	13.57	5.78	12.70
1994	0.34	0.77	0.11	0.27	0.04	0.15	0.22	0.52
1995	8.42	21.32	2.45	5.83	4.42	11.86	5.84	15.17
1996	0.50	0.50	0.37	1.09	0.33	0.96	0.38	1.06
Average	3.52	8.36	1.30	2.90	2.75	6.64	3.06	7.36

Buying Point Level. During the 1993-1996 crop years, handling of Segregation III lots cost buying points in the Southeast an average of $532,858/yr (Table 3). The cost of Segregation III lots to the southeast buying point sector ranged from $54,189 (cy 1994) to $1,161,621 (cy 1995). The Southeast has 301 buying points which indicates that Segregation III lots cost buying points an average of $1769 per buying point with a range of $180 (cy 1994) to $3859 (cy 1995) per buying point. However, many buying points receive peanuts from predominantly nonirrigated fields and often have increased Segregation III lots. Thus, the costs to

Table 3. Estimated southeast buying point sector net cost of Segregation III lots for Alabama, Florida, Georgia and the Southeast during crop years 1993-1996.

Year	Alabama	Florida	Georgia	Southeast
	$	$	$	$
1993	155,271	25,883	566,665	747,819
1994	31,450	4,492	18,246	54,189
1995	437,352	45,743	678,524	1,161,621
1996	50,362	16,717	100,725	167,805
Average	168,609	23,209	341,040	532,858

these buying points are significantly higher. On a per-Mg and per-hectare basis, Alabama buying points averaged the highest cost at $0.79 and $1.91, respectively. Georgia buying points had an average cost of $0.54/Mg and $1.35/ha, while Florida buying points averaged losses of $0.30/Mg and $0.67/ha from Segregation III lots. The cost of Segregation III lots to the southeast buying point sector averaged $0.64/Mg and $1.57/ha (Table 4).

Southeast Peanut Sheller Level. The southeast peanut sheller segment incurred the highest cost associated with aflatoxin. The majority of the cost was due to purchase of Segregation I farmer stock that were not rejected due to excessive aflatoxin, thus requiring further processing. The estimated average and total annual net cost of aflatoxin to the southeast sheller during the 1993-1996 period was $22,697,737/yr (Table 5). The range of cost to shellers was $9,934,705 (cy 1994) to $37,723,520 (cy 1995), which is consistent with both the farmer and buying point sectors previously discussed.

On a total Segregation I farmer stock basis, aflatoxin cost southeast peanut shellers an average of $22.28/Mg, ranging from $7.31/ Mg (cy 1994) to $35.49/Mg (cy 1993) (Table 5). The southeast shellers' cost of aflatoxin on a total southeast per-hectare basis averaged $60.41/ha, ranging from $24.22 (cy 1994) to $105.34 (cy 1995). The shellers net costs were broken down into five categories, including costs associated with aflatoxin detection (testing), capital investment (equipment), removal of aflatoxin from rejected lots (remilling and blanching), and risk management for rejected lots (insurance). Figure 2a illustrates the percentage of the itemized cost to the southeast peanut shelling industry averaged over the 1993 through 1996 crop years. On average, blanching was the highest cost factor at 41% of net cost followed by insurance, testing, remilling, and equipment. However, the percentages vary depending on the quality of the incoming peanut crop. Crop year 1994 had the highest quality peanut crop at all southeast industry levels with respect to aflatoxin during the 1993-1996 crop years. Figure 2b illustrates this point as only 10% of the total net cost was due to blanching. The largest cost factors in crop year 1994 were insurance and testing at 39 and 34%, respectively. Although the actual presence of aflatoxin imposes significant cost to the peanut industry, this indicates that the potential for aflatoxin contamination also imposes considerable economic cost to the peanut industry. Crop year 1994 is contrasted by crop year 1995 where determination of aflatoxin in Segregation III at

Table 4. Estimated southeast buying point sector net cost of Segregation III lots (per-Mg and per-harvested-hectare basis) for Alabama, Florida, Georgia, and the Southeast during crop years 1993-1996.

Year	Alabama		Florida		Georgia		Southeast	
	$/Mg	$/ha	$/Mg	$/ha	$/Mg	$/ha	$/Mg	$/ha
1993	0.72	1.61	0.36	0.64	0.92	2.00	0.85	1.88
1994	0.16	0.35	0.06	0.12	0.02	0.07	0.10	0.25
1995	2.01	5.09	0.58	1.38	1.05	2.84	1.40	3.63
1996	0.25	0.59	0.18	0.52	0.16	0.47	0.19	0.52
Average	0.79	1.91	0.30	0.67	0.54	1.35	0.64	1.57

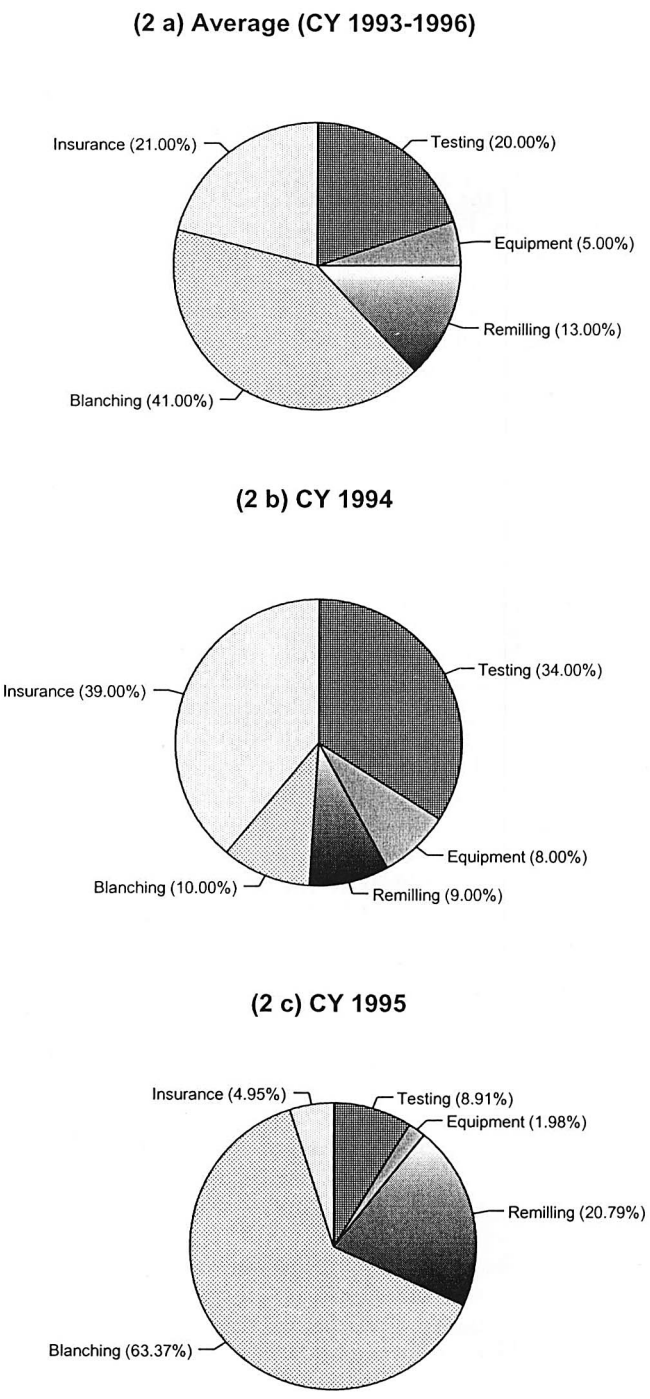

Fig. 2. Average percentage of itemized net cost of aflatoxin to the southeast peanut shelling industry - (a) average of crop years 1993 through 1996; (b) crop year 1994, and (c) crop year 1995.

Table 5. Estimated southeast sheller sector net cost of aflatoxin (total, per-Mg, and per-harvested hectare basis) during crop years 1993-1996.

Year	Per Mg	Per hectare	Total
	$	$	$
1993	35.49	74.85	31,323,102
1994	7.31	24.22	9,934,705
1995	34.38	105.34	37,723,520
1996	11.93	37.21	12,349,621
Average	22.28	60.41	22,697,737

the sheller level caused considerable industry losses (Tables 1, 3, 5). In crop year 1995, blanching accounted for more than 63% of the southeast peanut shellers cost associated with aflatoxin (Fig. 2c). Blanching was followed by remilling at almost 21%, which suggest that in high aflatoxin years, further processing of rejected lots to remove aflatoxin accounts for 84% of total net cost. Insurance, testing, and equipment combined for 16% of the total aflatoxin cost in crop year 1995 (Fig. 2c).

Southeast Peanut Industry Level. Segregation III lots and aflatoxin cost the farmer, buying point, and sheller segments of the southeast U.S. peanut industry $25,960,260 annually (Table 6). Crop year 1994 had the lowest net cost in the Southeast at $10,106,854 and crop year 1995 recorded the highest at $43,745,426. On a total Segregation I farmer stock basis, aflatoxin cost the southeast peanut industry an average of $25.97/Mg, ranging from $7.63/Mg (cy 1994) to $42.13/Mg (cy 1993). The southeast net cost of aflatoxin on a per-hectare basis averaged $69.33/ha, ranging from $24.98 (cy 1994) to $124.14 (cy 1995) (Table 6).

Table 6. Estimated southeast farmer, buying point, and sheller net cost of aflatoxin (total, per-Mg, and per-harvested hectare basis) during crop years 1993-1996.

Year	Per Mg	Per hectare	Total
	$	$	$
1993	42.13	89.43	37,124,296
1994	7.63	24.98	10,106,854
1995	41.62	124.14	43,745,426
1996	12.50	38.79	12,864,463
Average	25.97	69.33	25,960,260

In conclusion, results from this study confirm that aflatoxin imposes considerable economic cost annually to all segments of the southeast U.S. peanut industry. In years where Segregation III lots are more prevalent and incoming aflatoxin levels are increased, the costs due to aflatoxin are increased due to product diversion, remilling and/or blanching, and the associated product loss. However, even in years of low Segregation III lots and presumably low incoming aflatoxin levels, the potential for aflatoxin adds cost to peanuts due to risk management strategies and long-term capital investments in equipment. In either case, the competitiveness of the southeast U.S. peanut industry is decreased due to the potential or actual detection of aflatoxin. As domestic and international standards for acceptable levels of aflatoxin in shelled peanut lots decrease, the competitiveness of the southeast U.S. peanut industry will be further decreased unless cost effective technology to manage preharvest aflatoxin is adopted.

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