An Economic Assessment of Red Imported Fire Ant Impacts on Texas Production Agriculture

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ABSTRACT

A survey of 3,612 Texas agricultural producers was conducted to estimate the economic damage Red Imported Fire Ants impose on agricultural producers. Statewide and regional damage estimates for crop losses, livestock losses, equipment repair and equipment replacement, medical expenses, veterinary cost, farmstead damages, and control costs are derived. Agricultural damages in Texas annually exceed $90 million and 37% of the damage is a consequence of lost crop yield. Average per farm loss, for farms reporting losses, range from a low of $26 for farms located in agricultural district 2-N in West Texas to a high of $9,438 for farms located in agricultural district 10-S located in Southeastern Texas.

KEYWORDS: RIFA, Economic Impacts, Damages

Red Imported Fire Ant (RIFA) infestations were first documented in Texas in 1953, and today over 56 million Texas acres are infested with RIFA (Barr and Drees, 1996). Beginning in 1958, the Texas Department of Agriculture initiated a county quarantine program to control the spread of RIFA by quarantining the state's six most eastern counties. The quarantine required producers to obtain a permit to move products (primarily agricultural), that are known to contribute to the spread of RIFA, from a quarantined county into or through a non-quarantined county. After 43 years of continuous quarantine, the quarantine program has proven ineffective as RIFA infestations steadily moved westward, and 160 Texas counties are now under quarantine. In 1997, in an effort designed to both control the spread of RIFA and to document the severity of the RIFA infestations, the Texas legislature funded a 6-year initiative, known as the Texas Fire Ant Initiative. The general objectives of the initiative are to document the economic and biological severity of RIFA, and to discover appropriate and cost-effective management programs that may alleviate continued damage from this pest in the future. One specific goal of the Texas Fire Ant Initiative is to determine the economic impacts of RIFA activity on production agriculture. Knowledge of the agricultural impacts are intended to serve as a benchmark for measuring the economic benefits and costs of implementing either statewide or regional management control programs.Prior research on the economic impact of RIFA to Texas agriculture has relied exclusively on using a combination of published secondary data, derived under narrowly controlled experimental conditions, and statistical techniques to estimate statewide agricultural damages. For example, in the first two year cycle of the Texas Fire Ant Initiative, Polk, Teal and Segarra (1999) applied statistical procedures to limited published data on RIFA induced yield losses for a variety of crops grown under diverse conditions throughout the southeastern United States to estimate annual RIFA crop losses to Texas at $45.5 million. In a complementary study, also funded by the Texas Fire Ant Initiative program, Teal et. al. (1998) again used limited published secondary data to estimate annual RIFA damage losses to the Texas Cattle industry at $255 million. Due to a poor statistical fit, their 95% confidence interval estimate was extremely large, having a lower bound of $27.8 million, and an upper bound of $572.9 million. Given the lack of precision and wide variation in existing damage estimates, there was a legitimate need for a primary agricultural producer level survey to collect spatially disaggregated producer data for purposes of estimating the agricultural costs and benefits (if any) associated with RIFA infestations. This study addresses this need by developing regional and statewide agricultural estimates for RIFA damages using survey data collected from 3,612 agricultural producers.

DATA COLLECTION METHODS

The data collection phase of the study was completed in the fall of 1999 and winter of 2000. The data reflected costs and benefits of RIFA activity for the 1999 calendar year. A structured questionnaire was developed in association with the Texas Agricultural Statistical Service (TASS). A multiple choice, discussion and fill-in-the-blank survey design was utilized to collect the necessary data and facilitate the respondent's ability to meaningfully respond to the survey. Moreover, the survey design permitted easy tabulation of the collected survey data using the SAS Statistical Analysis System.

The TASS area frame sampling procedure was utilized to assure the data were obtained from an appropriately stratified and representative sample of agricultural producers. The TASS area frame sampling procedure is commonly used to provide accurate regional and county level estimates on crop acreage, crop yields, numbers of agricultural producers, and input use. The TASS administered the personal interviews as an addendum to their 1999 Fall Area Survey. The sample design provided 3,612 useable surveys.

The data collected from each agricultural producer included information on (1) irrigated and non-irrigated acres of cropland in the operation, (2) crop losses related to RIFA, (3) livestock losses related to RIFA, (4) equipment repair costs due to RIFA, (5) equipment replacement cost due to RIFA, (6) RIFA damages to the farmstead, (7) RIFA related medical expenditures, (8) RIFA related veterinary expenditures, (9) cost of RIFA control materials, (10) special equipment purchased to apply RIFA control materials, and (11) the agricultural benefits of RIFA infestations. The complete text of the questionnaire is available from the authors upon request.

Secondary data were used to augment the survey data. Secondary data sources used consist of the 1997 United States Census of Agriculture, and other data annually compiled by the TASS. The TASS provided the sample design expansion factors (weights) necessary to aggregate the survey data into damage estimates for each of the fifteen Texas agricultural statistics districts, and the statewide totals. The 15 Texas agricultural statistics districts are identified in Figure 1.

RIFA DAMAGES TO PRODUCTION AGRICULTURE

Statewide Overview

Estimated RIFA damages annually exceed $90 million for Texas agricultural producers (Table 1). Crop yield losses due to RIFA activity are the largest damage category at $33.4 million and comprise 36.9% of all damages. Equipment repair cost is the second largest damage category at nearly $17 million and is closely followed by expenditures for control materials at $16 million. Thus, statewide, crop yield losses, equipment repairs, and control material expenditures account for 73.3% of all RIFA damages. Farmstead damages and equipment replacement cost account for $9.1 million and $7.4 million of RIFA damages, respectively, and livestock losses are a relatively small fraction of annual damages at $4.6 million. Somewhat surprisingly, the medical ($0.56 million) and veterinary ($0.86 million)

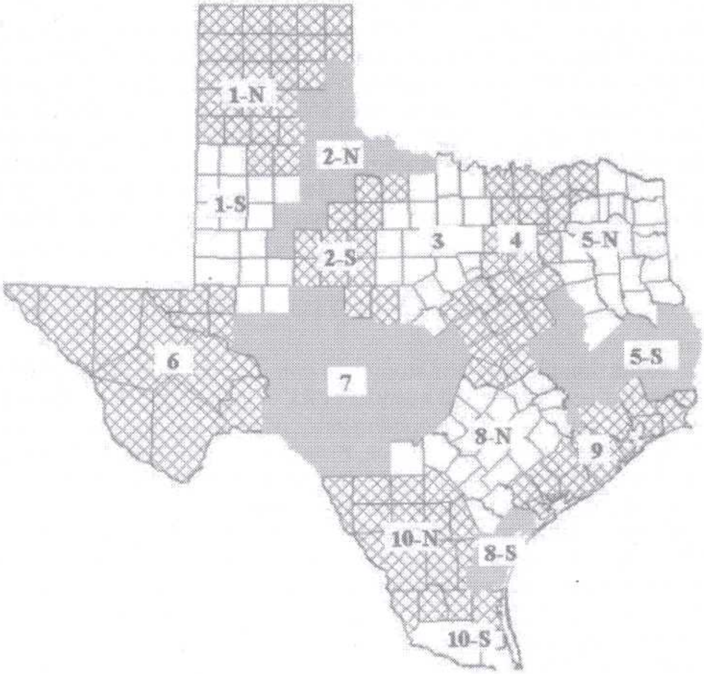

Figure 1. Texas Agricultural Districts.

Table 1. Statewide breakdown of all damages by loss and expenditure category.

Damage Category	Damage	%of Total Damage	# of Reporting Damage	%of FarmsReporting Damage
Crop Yield Loss	$33,441,777	36.92	259	7.17
Livestock Loss	$4,627,030	5.11	211	5.84
Repair Cost	$6,956,961	18.72	375	10.38
Replacement Cost	$7,390,836	8.16	135	3.74
Farmstead Cost	$9,056,496	10.00	240	6.64
Medical Cost	$561,356	0.62	87	2.41
Veterinary Cost	$860,856	0.95	40	1.11
Control Cost	$16,019,737	17.69	1,181	32.70
Equipment Cost	$1,656,983	1.83	113	3.13
State Total	$90,572,032	100.00	1,358	37.60

Note: The farm survey consisted of 3,612 observations.

[1]The value for the total number of farms reporting damages is not equal to the sum of the number of observations in each damage category. The state total value is the number of surveyed farms reporting at least one type of damage, but many farms reported more than one type of damage.

costs associated with RIFA each comprise less than 1% of total agricultural damages. Statewide totals, for the number of farms and percentage of farms reporting damages in each each specific damage category are tabulated in Table 1.

Despite an annual statewide RIFA damage estimate of $90 million, only 37.6% of the 3,612 surveyed farms reported damages in at least one RIFA related damage category, with the most common damage being expenditures for control materials (32.7%). Moreover, only 7.2% of the surveyed farms reported RIFA related crop losses even though yield losses account for nearly 37% of all damages. Hence, crop yield losses tend to be concentrated on a few farms in regions susceptible to RIFA activity or farms specializing in crops susceptible to RIFA.

In addition to damages not being uniformly distributed over damage categories, damages are not uniformly distributed over agricultural districts within the state. RIFA damages for the two Northeastern Texas Agricultural Statistical Districts (Districts 4 and 5-N) comprise more than 53% of all reported damages even though these two districts account for only 13% of the state's area. The high reported damages for these two districts may be explained by Adams et al. (1983) and Semevki et al. (1996) findings, which report that corn and soybean yields are sensitive to RIFA density levels. These two districts have a relatively high level of soybean and corn production and the RIFA density levels in these districts are the highest in the state (Thorvilson). A breakdown of total RIFA damage for each agricultural statistical district is reported in Table 2. Generally speaking, the eastern districts have the greatest percentage of farms reporting damages with nearly 73% of all farms in District 8-S reporting damages. A combination of warm temperature and high soil moisture create favorable RIFA habitat. In the hot relatively dry Texas High Plains Districts (1-N, 1-S, and 2-N) and arid District 6 of West Texas less than 1% (7 farms) of the surveyed 738 farms in these four districts reported RIFA damages. This finding is consistent with the fact that none of the 68 counties comprising these four districts are currently under a RIFA quarantine.

Table 2. Summary data on number of farms surveyed, number farms reporting damages, and total reported damages by district.

District	Total Damage	District Percent State Damages	Distric Farms Surveyed	Surveyed District Farms with Damage	Percent Farms Reporting Damages
1-N	$6,256	0.01	257	1	0.39
1-S	$66,640	0.07	262	3	1.15
2-N	$2,808	0.00	186	3	1.61
2-S	$70,556	0.08 7.73	243	6	2.47
3	$6,998,447	28.52	350	215	61.43
4	$25,826,786	24.50	506	252	49.80
5-N	$22,194,130	7.73	346	189	54.62
5-S	$7,002,361	28.52 24.50	285	126	44.21
6	$0	7.73	33	0	0.00
7	$4,590,655	0.00	325	185	56.92
8-N	$8,529,670	5.07	347	185	53.31
8-S	$6,847,868	9.42	33	24	72.73
9	$4,508,108	7.56 4.98	247	129	52.23
10-N	$2,568,191	2.84	137	37	27.01
10-S	$1,359,557	1.50	55	3	5.45
State Total	$90,572,032	100.00	3612	1358	37.60

[1]State total for percentage of farms reporting damages is a weighted statewide average value.

Statewide per Farm and per Acre Damages

Table 3 provides a statewide breakdown for the percentage of farms reporting each type of damage loss, and two average per farm damage measures by damage category. The first average per farm damage measure is limited to farms reporting a loss in each damage category, whereas the second average per farm damage measure calculates per farm damages by damage category for all surveyed farms. As expected, calculated average damages per farm, by damage category, is considerably higher for farms reporting a loss than the average for all surveyed farms. Crop yield loss is the the largest damage category under both measures at $2,145 per farm for farms reporting a crop yield loss (7.17% of surveyed farms), and $125 per farm for all surveyed farms. However, the relative ranking of the two damage measures do not always coincide. For example, livestock losses at $922 per farm is the second largest damage category for farms reporting a particular RIFA damage, but is the sixth highest ranked damage category among all surveyed farms at $22 per farm due to the fact that only 5.84% of surveyed farms reported livestock losses. Average total damage is $941 for farms reporting a damage in at least one damage category (37.6% of the surveyed farms), which is nearly three times greater than the average total damage value of $354 for all surveyed farms. Thus, using the average damage value for all farms, significantly understates the average damage to impacted farms.

Table 4 is similar to Table 3 except that damages are expressed on a per acre basis to control for differences in farm size. As before, the first damage measure calculates per acre damage by damage category for crop acreage of farms reporting damages in each damage category, whereas the second measure calculates per acre damage by damage category for all surveyed farms. Statewide, per acre yield damage is the largest damage category by both per acre measures. Moreover, on a per impacted acre basis, the ranking of the three highest damage categories is consistent with the damage ranking attained on a per

Table 3. Statewide breakdown of average farm damage by loss and expenditure category.

Damage Category	% Farms Reporting Damage by Category	Average Damage for Farms Reporting each Damage	Average per Farm Damage for all Surveyed Farms by Damage Category
Crop Yield Loss	7.17	$2,145	$125
Livestock Loss	5.84	$992	$22
Repair Cost	10.38	$664	$69
Replacement Cost	3.74	$816	$30
Farmstead Cost	6.64	$547	$36
Medical Cost	2.41	$212	$2
Veterinary Cost	1.11	$278	$4
Control Cost	32.70	$175	$57
Equipment Cost	3.13	$233	$7
Total	37.60	$941	$354

Note: The farm survey consisted of 3,612 observations.

[1] The sum of average per farm damage for each damage category does not sum to average total per farm damage for farms reporting damages. The average damage reported for each specific cost category for farms reporting damages is the average for farms reporting a specific damage. Not all farms reporting a damage have damages in all damage categories. Average total per farm damage for farms reporting damage is the average damage of all farms reporting a damage in at least one damage category.

Table 4. Statewide breakdown of per acre cropland damage by loss and expenditure category.

Category	% of Surveyed Acreage Impacted	Survey Acres Impacted	Average Damage per Acre for FarmsReporting each Damage	Average Damage per acre for all Surveyed Farms by Damage Category
Crop Yield Loss	3.26	67,627	$6.69	$0.22
Livestock Loss	1.52	31,501	$2.52	$0.04
Repair Cost	5.72	118,676	$2.10	$0.12
Replacement Cost	2.11	43,696	$2.52	$0.05
Farmstead Cost	3.00	62,228	$2.11	$0.06
Medical Cost	0.55	11,329	$0.75	$0.00
Veterinary Cost	0.79	16,282	$0.85	$0.01
Control Cost	10.87	225,272	$0.92	$0.10
Equipment Cost	1.43	29,620	$0.89	$0.01
Total	13.41	278,059	$4.60	$0.62

Note: Total crop acres for all surveyed farms is 2,073,010 acres.
[1]The sum of average per acre damage for each damage category does not sum to average total per acre damage for farms reporting damages. Average per acre cropland damage for each specific cost category is the average for the cropland acreage associated with farms reporting each specific damage. Not all farms reporting a damage had damages in all damage categories and thus impacted acres vary by damage category. Average total per acre damage for all cropland acreage is associated with farms reporting a damage in at least one damage category.

impacted farm basis, crop yield loss is highest, livestock losses are second highest, and machinery repair cost is the third highest loss category. As was the case on a per farm basis, per acre yield damage is greater for farms reporting a yield loss than for all farms ($6.69 per acre versus $0.22 per acre). Given that 7.17% of all surveyed farms had cropyield damages (Table 3) and that the acreage associated with those losses accounts for only 3.26% of all surveyed cropland (Table 4), the average farm reporting a yield loss had roughly one-half the crop acreage of all surveyed farms. As is discussed in subsequent sections, smaller farms tend to specialize in higher valued crops, such as soybean, corn, and citrus, which are more susceptible to RIFA yield losses.

District per Farm and per Acre Total Damages

Table 5 presents a statewide district level comparison for the percentage of surveyed farms reporting RIFA damage, and the two measures of per farm total damage. As before, the first measure is average total farm damage by district for farms reporting RIFA damages, and the second measure is average total farm damage by district for all surveyed farms. For farms reporting damage losses, District 10-S in South Texas has the highest noted that only 5.5% of the surveyed farms in this district reported RIFA damages. The great majority of farms in this district are not small citrus orchards and do not invest heavily in the specialized chemicals and application equipment used by citrus growers. This is borne out by the fact that the average total damage measure, per farm, for all farms surveyed in District 10-S is $515 which is only 45% higher than the corresponding statewide average per farm damage of $354. By both per farm damage measures, damages tend to be above the statewide average in the eastern districts and well below the statewide average in the western districts.

Table 6 complements Table 5 and presents the per acre total damage comparisons by district. As expected, average per acre damage for farms reporting damages is greatest in South Texas District 10-S. However, close inspection of Table 6 reveals that only 0.03% of the surveyed acres in this District are associated with farms reporting damages (exclusively citrus orchards), and per acre damage for all surveyed acreage in this District is below the state average ($0.45 versus $0.62).

Per acre damages for farms reporting damages are highest in District 5-N (northeastern Texas) at $13.25 per acre, and lowest in District 1-N (Texas panhandle) at $0.11 per acre. Over 75% of the acreage in District 5-N is associated with farms reporting RIFA damages, whereas only 0.3% of the crop acreage in District 1-N is associated with farms reporting RIFA damages. Excluding agricultural District 6, located in arid West Texas where no surveyed farm reported RIFA damage, all districts whose average farm size is less than the statewide average (Districts 3, 4, 5-N, 5-S, 6, 7, 8-N, and 9) have damages considerably above the statewide per acre average for all surveyed farms. The average per acre damage in these districts ranged from a low of $2.04 per acre to a high of $9.99 per acre in comparisions to the statewide average figure of $0.62 per acre. This result is the consequence of these districts having climatic conditions favorable to RIFA infestations and the tendency of smaller farms to specialize in higher value crops susceptible to RIFA yield losses.

Table 5. Summary data on number of farms surveyed, percentage of farms reporting damages, per farm damage for farms reporting damages, and per farm damage or all surveyed farm damages by district.

District	Number Surveyed Farms	% Surveyed Farms with Damage	Average Farm Damage for Reporting Farms	Average Farm Damage for all Surveyed Farms
1-N	257	0.39	$150.00	$0.58
1-S	262	1.15	$46.67	$0.53
2-N	186	1.61	$26.33	$0.42
2-S	243	2.47	$311.83	$7.70
3	350	61.43	$655.29	$402.53
4	506	49.80	$1,385.17	$689.85
5-N	346	54.62	$1,611.94	$880.51
5-S	285	44.21	$570.25	$252.11
6	33	0.00	$0.00	$0.00
7	325	56.92	$716.77	$408.01
8-N	347	53.31	$669.38	$356.88
8-S	33	72.73	$1,159.71	$843.42
9	247	52.23	$552.74	$288.68
10-N	137	27.01	$697.11	$188.27
10-S	55	5.45	$9,438.33	$514.82
State	3,612	37.60	$941.37	$353.93

Note: State averages are weighted averages.

Table 6. Summary data on cropland acres for farms surveyed, percentage of Cropland acres with damages, total per acre damage for cropland acres associated with farms reporting damages, and total per acre damage for all surveyed acreage by district.

District	Cropland Acreage all Survey Farms	% Surveyed Acreage of Farms Reporting at Least One Damage Category	Average Per Acre for Farms Reporting Damage	Average Per Acre Damage for All Surveyed Farms
1-N	451,528	0.29	$0.11	$0.00
1-S	271,114	0.80	$30.73	$0.00
2-N	176,646	0.65	$0.07	$0.00
2-S	300,971	2.62	$0.24	$0.01
3	63,954	40.07	$5.50	$2.20
4	164,337	56.75	$3.74	$2.12
5-N	30,508	75.39	$13.25	$9.99
5-S	22,209	77.25	$4.19	$3.24
6	5,876	0.00	$0.00	$0.00
7	58,020	40.42	$5.65	$2.29
8-N	55,611	33.13	$6.72	$2.23
8-S	131,443	29.19	$0.73	$0.21
9	35,026	52.91	$3.85	$2.04
10-N	242,182	4.08	$2.61	$0.11
10-S	63,585	0.03	$1,584.79	$0.45
State	2,073,010	13.41	$4.60	$0.62

[1] Per acre average damage for farms reporting damage is calculated as total district damage divided by total cropland acres for all surveyed district farms reporting at least one type of damage.
[2] Per acre average damage for all surveyed farms is calculated as total district damage divided by the total cropland acres for all surveyed district farms.

District Comparisions of Damage Categories

The percentage of surveyed farms reporting RIFA damages in each damage category varies considerably by district (Table 7). For example, farms reorting expenditures for control cost range from a low of 0% in District 6 to a high of 63.6% in District 8-S, with the overall state average being 32.7%. The percentage of farms reporting repair cost damages also varies considerably between districts, ranging from a low of 0% in Districts 1-N, 1-S, 2-N, and 6 to a maximum of 21.21% in District 8-S, with the state average being 10.38%. Moreover, within a district, if the percentage of farms reporting damages in a given damage category is above average, it is likely the other damage categories will have an above average percentage of farms reporting damages.

However, the relative percentage of farms reporting losses by damage category does not provide an accurate measure of the intensity of the economic damage to impacted farms. For example, 8.92% of the farms in District 7 report equipment replacement damage compared to only 2.89% in District 5-N. But for farms with equipment replacement cost damages, per farm replacement cost is nearly 14 times larger in district 5-N than in district 7 ($4,267 versus $310). In District 5-N, the high RIFA mound density levels cause frequent damage to combine cutting surfaces during harvest and the sickle must be frequently

Table 7. Percentage of surveyed farms reporting damages by district and damage category.

	Agricultural Districts							
Damage Category	1-N	1-S	2-S	2-N	3	4	5-N	5-S
Crop Yield Loss	0.00	0.00	0.00	0.00	7.14	11.07	13.29	7.37
Livestock Loss	0.00	0.00	0.00	0.00	1.43	4.74	2.89	1.40
Repair Cost	0.00	0.00	1.23	0.00	16.29	10.87	15.90	12.28
Replacement Cost	0.00	0.00	1.23	0.00	6.00	4.55	2.89	3.86
Farmstead Cost	0.00	0.00	0.00	0.00	8.86	14.03	13.87	7.72
Medical Cost	0.00	0.00	0.00	0.54	0.86	1.98	1.16	4.91
Veterinary Cost	0.00	0.00	0.00	0.00	3.14	2.17	1.45	2.46
Control Cost	0.39	1.15	1.23	1.61	59.43	41.50	47.69	37.54
Equipment Cost	0.00	0.00	0.41	0.54	1.71	4.15	10.40	3.86
Total	0.39	1.15	2.47	1.61	61.43	49.80	54.62	44.21
Sample Size	257	262	243	186	350	506	346	285
	Agricultural Districts: continued							
Damage Category	6	7	8-N	8-S	9	10-N	10-S	State
Crop Yield Loss	0.00	5.23	6.34	12.12	6.07	3.65	0.00	5.84
Livestock Loss	0.00	3.38	5.48	3.03	2.02	0.73	0.00	2.21
Repair Cost	0.00	16.31	16.71	21.21	10.93	17.52	1.82	10.38
Replacement Cost	0.00	8.92	6.92	9.09	3.24	1.46	1.82	3.74
Farmstead Cost	0.00	5.85	7.20	12.12	6.07	2.92	1.82	6.64
Medical Cost	0.00	0.31	0.58	0.00	2.02	0.00	0.00	1.11
Veterinary Cost	0.00	0.62	2.59	3.03	0.00	0.00	0.00	1.38
Control Cost	0.00	47.38	46.40	63.64	19.71	19.71	5.45	32.70
Equipment Cost	0.00	1.54	4.32	12.12	2.92	2.92	3.64	3.13
Total	0.00	56.92	53.31	72.73	27.01	27.01	5.45	37.60
Sample Size	33	325	347	33	247	137	55	3,612

Note: The total category represents surveyed farms which reported damages for at least one damage category.

replaced. Even though the incidence of farms reporting damages may be small, damages to those farms are often significant. Table 8 illustrates this point for district 5-N on a per farm and per acre basis for each specific damage category.

RIFA BENEFITS TO PRODUCTION AGRICULTURE

There is an ongoing debate concerning the existence and magnitude of potential agricultural benefits to RIFA infestations. Some researchers have found that RIFA preys on agricultural pests such as boll weevils and corn ear work (Semevski et al. 1996, Sterling 1987). If the economic magnitude of this benefit is sufficiently large, it potentially could offset RIFA damages on some crops or in some regions of the state. Table 9 reports our survey-based estimate of RIFA benefits. Probably the most interesting finding is that 3.74% (135 out of 3,612) of the surveyed farms reported RIFA benefits, but only 10 of the 135 farmers reporting a benefit could provide a dollar measure of the benefit value. As many as 10% of the farms in the heavy corn producing Districts 4,5-N, 8-N, 8-S, and 9 report benefits, but most were unable to numerically quantify the benefit value. Even though most farmers reporting benefits in these four districts were unable to quantify the benefit value they received from RIFA infestations, they generally responded that their primary benefit is due to the reduction in the corn ear work population. Other benefits mentioned less frequently were the control of ticks and the boll weevil populations. The $1.54 million statewide benefit estimate provided in Table 8 is derived only from those respondents stating there was a benefit value). Thus, it is likely that our survey results significantly understates the statewide agricultural benefit.

Table 8. District 5-N per farm and per acre damages by damage category.

	Per Farm			Per Acre		
	Percent Farms with Damage	Farms Reporting Damage	All Farms Surveyed	Percent Acreage w/ Damage	Farms Reporting Damage	All Farms Surveyed
Crop Yield Loss	13.29	2,524.65	335.65	48.01	7.93	3.81
Livestock Loss	2.89	865.00	25.00	9.95	2.85	0.28
Repair Cost	15.90	876.09	139.26	46.77	3.38	1.58
Replacement Cost	2.89	4,267.00	123.32	2.88	48.54	1.40
Farmstead Cost	13.87	1,119.90	155.36	42.19	4.18	1.76
Medical Cost	1.16	188.75	2.18	0.10	25.17	0.02
Veterinary Cost	1.45	185.00	2.67	10.80	0.28	0.03
Control Cost	47.69	165.69	79.01	61.17	1.47	0.90
Equipment Cost	10.40	173.42	18.04	35.13	0.58	0.20
Total	54.62	1,611.94	880.51	75.39	13.25	9.99

Note: Not all farms reported damages in all damage categories. Thus, the number of farms and their associated acres vary by damage category. Average total per farm and per acre damage for farms reporting damage is for those farms and associated acreage reporting damage in at least one damage category.

CONCLUSION

RIFA damages annually cost Texas agricultural producers $90 million. Reduced crop yields accounts for nearly 37% of these losses. Machinery repair costs and expenditures for chemical and mechanical controls account for another 36.4% of the agricultural damages. Medical and veterinary costs collectively comprise only 1.57% of the cost imposed on agricultural producers. Over 92% of surveyed farms reporting RIFA benefits were unable to quantify the benefit value. Only 10 out 135 farms reporting RIFA benefits were able to quantify the benefit value. Only 10 out of the 135 farms reporting RIFA benefits were able to quantify the benefit value. Thus, it is likely that the agricultural benefit is significantly understated.

Agricultural damage is not uniformly distributed over the state, as over 53% of statewide damages are concentrated in the northeastern corner of the state. Hight precipitation levels create favorable RIFA habitat, and those areasof the state generally have largest RIFA damages. Crop selection is also a factor in RIFA damage estimation. Citrus growers spend more than 10 times the state average on control measures and special application equipment for crop protection. Producers of lower value agricultural crops find it more cost-effective to accept RIFA-induced yield losses instead of attempting to control RIFA infestations. Statewide, crop yield loss damages are more than two times larger than control cost expenditures which suggests that existing control technologies are not cost

Table 9. Summary data on number of farms surveyed, percentage of surveyed farms reporting benefits, number of farms reporting benefits, and total benefits by district.

		Farms Reporting Benefits but Unable to Quantify Benefit Value		Farms Reporting Benefits and Able to Quantify Benefit Value		
District	Surveyed Farms	Percent	Number	Percent	Number	Estimated Benefit
1-N	257	0.00	0	0.00	0	$0
1-S	262	0.38	1	0.00	0	$0
2-N	186	0.00	0	0.00	0	$0
2-S	243	0.00	0	0.00	0	$0
3	350	1.43	5	0.57	2	$6,558
4	506	4.94	25	0.99	5	$1,500,204
5-N	346	6.65	23	0.87	3	$31,503
5-S	285	2.81	8	0.00	0	$0
6	33	0.00	0	0.00	0	$0
7	325	3.38	11	0.00	0	$0
8-N	347	10.37	36	0.00	0	$0
8-S	33	9.09	3	0.00	0	$0
9	247	8.10	20	0.00	0	$0
10-N	137	2.19	3	0.00	0	$0
10-S	55	0.00	0	0.00	0	$0
State	3,612	3.74	135	0.28	10	$1,538,264

Note: Estimated district benefit was calculated by applying the TASS expansion factors to the survey benefit data.

effective for agricultural producers producing lower value crops. Areas of the state specializing in corn, soybean, sorghum, peanut and rice production generally report higher per acre yield loss damages than other areas of the state. Additional research is needed on understanding crop yield response for these five crops to RIFA density levels, and the rate of RIFA spread. Knowledge of these bio-physical relationships will enhance the ability of agricultural economists to target areas of Texas where comprehensive RIFA control programs will be cost-effective.

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