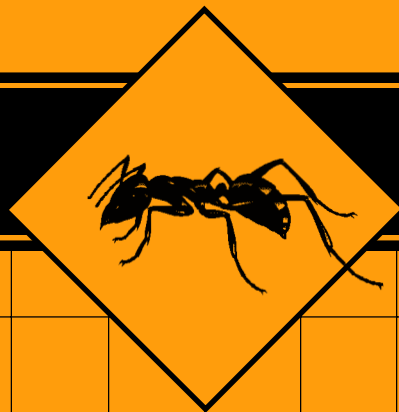




# Texas Poultry Pest-Control Practices

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# Texas Poultry Pest-Control Practices

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**IRE ANTS AND** darkling beetles have emerged as major pest problems in the Texas poultry industry, according to poultry operators surveyed in 1996. The survey found that about half of the market broiler producers reported economic losses from fire ants, and 40 percent of poultry producers reported losses from darkling beetles.

In the survey, 242 poultry producers completed questionnaires on pest problems and pest-control needs and practices. Results showed that since a similar survey in 1983, flies and mites have been reduced significantly as major pests in the industry. In 1983, northern fowl mites and house flies caused the most economic damage to poultry operations. However, in 1996 only 5 percent of respon-

dents named house flies as causing the most economic damage, and just 1 percent listed mites. But problems with fire ants are increasing, respondents reported.

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Comments by respondents on the fire ant problem included:

- ☆ "We need to know what to use to kill fire ants—not control them."
- ☆ "Fire ants eat chicks."
- ☆ "I expect fire ants to become a major problem in the future."
- ☆ "In the last year they have caused \$1,500 damage in electrical equipment."
- ☆ "Fire ants cause major stress on my birds."
- ☆ "Mirex was the most effective product for fire ants. Mirex was not environmentally safe and removed from the market for that reason. We need a similar product at a reasonable cost or fire ants will rule the world. They are a danger to all poultry and livestock."

One can begin to grasp the frustration Texas poultry producers are experiencing with fire ants.

Fire ants, along with other pests such as mice, darkling beetles and rats, are a menace to poultry production. Insect and rodent pests transmit diseases and reduce efficiency in broiler and egg production. If not controlled, they lower not only income for poultry producers, but also product quality for consumers.

Pest problems and control methods change over time. Current information on pests and control practices can help producers, manufacturers, distributors of pest-control products, researchers, Extension workers and government agencies make business decisions. For example, when making registration decisions, the U.S. Environmental Protection Agency uses data on pest problems and control practices to evaluate pesticides' benefits and risks.

Poultry is produced in Texas primarily in the East, in Nacogdoches, Shelby and surrounding counties, with a secondary pocket in Gonzales and surrounding counties south of Austin. A new broiler company in Brazos County recently began contracting growers, but was not operating at the time of the survey.

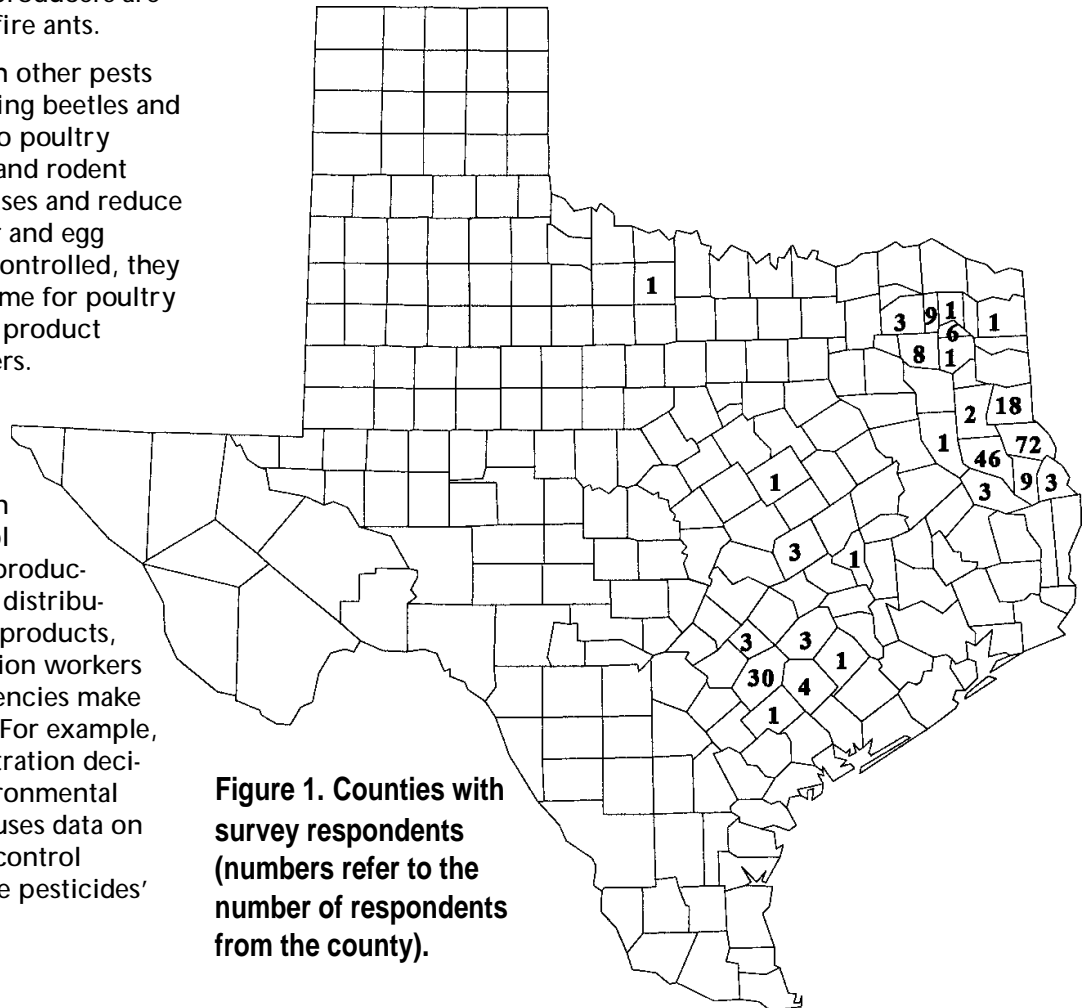
A 1995 poultry inventory found 16 million laying hens and 395.2 million broilers in Texas. Egg production was valued at more than \$218 million; broiler production reached \$646 million (TASS, 1996).

To obtain information about pest problems and control practices in the Texas poultry industry, questionnaires were distributed to 966 Texas poultry producers (more

than 60 percent of all Texas producers) via mail and poultry-company field representatives. Of the 242 who returned completed questionnaires, most were from Shelby, Nacogdoches and Gonzales counties (see Figure 1).

## Results

Of the poultry operations surveyed, most produced market poultry broilers, with a few having more than one type of operation (see Table 1). Seventy-two percent (165 farms) produced market poultry broilers; 9 percent (21 farms), market turkeys; 8.6 percent (20 farms), broiler breeders; and the rest produced broiler pullets, commercial eggs, commercial egg layer breeders or commercial egg layer pullets.



**Figure 1. Counties with survey respondents (numbers refer to the number of respondents from the county).**

In comparison, the 1983 survey of 25 Texas poultry producers found that the vast majority produced eggs. Then, 84 percent of those interviewed operated independent egg-producing farms; 8 percent produced broilers; 4 percent were egg contract farms; and 4 percent had a combination of these operations.

The primary problem pests reported by poultry operations in 1996 were fire ants, mice and darkling beetles (see Table 2). Fire ants were listed as causing problems for 94 percent of respondents; mice, 84 percent; and darkling beetles, 83 percent.

Other pests named include house flies (listed by 71 percent of respondents), rats (65 percent), varmints (28 percent), black flies (28 percent) and mosquitoes (24 percent). Pests listed by less than 15 percent of respondents include chicken mites, northern fowl mites, chiggers, soldier flies, bed bugs, depluming mites, lice and fowl ticks.

Survey participants ranked the difficulty of controlling each pest. Those ranked most difficult to control were fire ants, darkling beetles, black flies, house flies, mice and rats (see Table 3).

Respondents also were asked to list the two pests causing the greatest economic loss in their operation if left untreated (see Table 4). A total of 18 pests were named, with the top four answers being mice (listed by 58 percent of respondents), fire ants (51 percent), rats (47 percent) and darkling beetles (40 percent).

In comparison, the 1983 survey found the principal poultry pest problems in Texas to be insects, mites, odors and rodents. Neither fire ants nor darkling beetles were addressed in that survey. The pests most difficult to control and causing the greatest economic

**Table 1. Types and numbers of poultry operations.**

Product	Number of operations
Market poultry broilers <sup>1</sup>	165
Market turkey producers <sup>2</sup>	21
Broiler breeders <sup>3</sup>	20
Broiler pullets <sup>4</sup>	10
Commercial eggs <sup>5</sup>	6
Commercial egg layer breeders <sup>6</sup>	5
Commercial egg layer pullets <sup>7</sup>	4

<sup>1</sup> Feed out chickens to slaughter size.

<sup>2</sup> Feed out turkeys to slaughter size.

<sup>3</sup> Produce eggs for supplying chicks for the broiler producers.

<sup>4</sup> Grow out pullets to become broiler breeders.

<sup>5</sup> Keep laying hens for producing eggs for human consumption.

<sup>6</sup> Produce eggs to hatch out to become laying hens.

<sup>7</sup> Grow out laying hen pullets to become laying hens.

**Table 2. Percentage of poultry operations reporting problems with various pests.**

Pest	% reporting
Fire ants	94%
Mice	84%
Darkling beetles	83%
House flies	71%
Rats	65%
Varmints	28%
Black flies	28%
Mosquitoes	24%
Chicken mites	13%
Northern fowl mites	10%
Chiggers	10%
Soldier flies	10%
Bed bugs	10%
Depluming mites	9%
Lice	9%
Fowl ticks	8%

**Table 3. Difficulty of controlling pests.**

Pest	Ranking
Fire ants	3.3
Darkling beetles	2.8
Black flies	2.7
House flies	2.7
Mice	2.6
Rats	2.4
Varmints	2.0
Mosquitoes	2.0
Soldier flies	1.7
Chicken mites	1.6
Chiggers	1.5
Northern fowl mites	1.5
Bed bugs	1.4
Lice	1.4
Depluming mites	1.2
Fowl ticks	1.2

Note: Ranked on a scale of 1 to 4, with 1 being not difficult and 4, very difficult.

damage were northern fowl mites and house flies.

The 1996 survey asked respondents how fire ants had affected their poultry operations the previous year. Forty-six percent marked fire ants as just a nuisance; 42 percent said fire ants caused minor economic loss; 5 percent

**Table 4. Percentage of poultry operators listing various pests as one of two most economically harmful.**

Pest	% listing
Mice	58%
Fire ants	51%
Rats	47%
Darkling beetles	40%
House flies	5%
Varmints	4%
Black flies	1%
Mites	1%
Chicken mites	1%
Fowl mites	1%

said they caused major economic loss; and 1 percent reported having no fire ants.

Pest control was ranked very important by 64 percent of respondents; 32 percent marked pest control as important; 3 percent, semi-important; and 1 percent, not important. By comparison, in the 1983 survey, pest control was ranked important by 100 percent of respondents.

Pests are controlled with and without chemicals. Chemical control employs a variety of insecticides, of which some are applied directly on the birds, some are incorporated into feed, and others treat premises. Nonchemical methods include controlling weeds to reduce fly habitat, disposing of dead birds properly and practicing rigid sanitation.

Of the 1996 survey participants, 81 percent reported using some type of insecticide to protect their birds or poultry facilities from insect pests in the previous year. Ninety-four percent reported that

pest-control products applied in the previous year did not harm the birds treated. Six percent were unsure.

Asked if and/or when they rotate pest-control products to avoid resistance development, 29 percent said they rotate them semiannually; 25 percent rotate annually; 4 percent, occasionally or when needed; and 32 percent never rotate pest-control products. Sixty percent said they understand federal pesticide-use record-keeping requirements.

Leading nonchemical pest-control methods include destroying or removing dead animals, used by 93 percent of respondents; managing manure, 86 percent; and keeping feeders and waterers sanitary, 80 percent (see Table 5). Other nonchemical methods listed include controlling weeds to reduce flies; cleaning thoroughly between flocks; setting traps to control rats, varmints and flies; practicing rigid sanitation; segregating infected animals; introducing fly parasites; and installing electrified screens.

A few respondents mentioned using other means of nonchemical pest control: cats, bullets, composting, disinfecting/cleaning flat, and water control.

**Table 5. Percentage of poultry operators using various nonchemical pest-control methods.**

Method	% using
Destruction or removal of dead birds	93%
Manure management	86%
Keeping feeders and waterers sanitary	80%
Control of weeds to reduce flies	75%
Thorough cleaning between flocks	63%
Traps and/or barriers to control rats and varmints	41%
Rigid sanitation	32%
Fly traps	11%
Segregation of infected animals	6%
Fly parasites	3%
Electrified screens	1%

The survey asked respondents to check the most extensive clean-out and disinfection their poultry houses receive at least once a year (see Table 6). More than half reported that they clean out, wash and disinfect all poultry houses at least once a year.

Respondents also were asked to list disinfectants used in their poultry sanitation program (see Table 7). Iodine and Poulphene® were named most often, but more than 50 percent of respondents either left the spaces blank or entered "none," "unknown" or "company" (meaning the contracting company handled disinfectants).

In all, 44 different products were named. Twenty-eight percent of the operators used one product, 16 percent used two products, and 5 percent used three products. Respondents ranked their satisfaction with the control attained by each disinfectant from 1, lowest satisfaction, to 4, highest satisfaction. Iodine averaged 3.22; Poulphene®, 2.85.

The survey also asked producers to report the amount of disinfectant they used. Iodine applications to market broilers ranged from 0.5 to 8 fluid ounces per 1,000 birds, with a median of 1.8 fluid ounces per 1,000 birds (50 percent applied 1.8 fluid ounces or more per 1,000 and 50 percent applied 1.8 fluid ounces or less per 1,000). Poulphene® applications to market broilers ranged from 0.5 to 2.7 fluid ounces per 1,000 birds, with a median of 1.3 fluid ounces per 1,000 birds.

Only 3 percent of survey respondents listed chemical products they applied directly on birds to control pests. Products named were Sevin® dust, Insectrin®, malathion, Permet®, and Rabon®. Just 10 percent named chemical products they incorporated into feed. Listed were Larvadex® (19 respondents), Hygromycin® (three respondents) and copper sulfate (one). The majority of respondents marked “none” or gave no answer regarding applying chemical pest-control products directly on the birds or incorporating treatment in feed. Some participants said they did not know what products were applied or that the contracting company made the applications.

Seventy-four percent of respondents reported using at least one product to control

insect pests on premises (see Table 8). Sevin® was the primary insecticide used, followed by diazinon and Terminator®.

In all, respondents listed 33 different chemical products used to control pests on the premises. Forty-four percent of respondents used only one product; 20 percent used two products; 8 percent used three; and 3 percent used four.

To control weeds in their operations, 46 percent of survey participants reported using herbicides (see Table 9). A total of nine different herbicides were listed, with Roundup® and Grazon® being preferred. Nine percent reported that they mowed weeds or controlled them by some other mechanical means. Forty-five percent did not answer the question or answered “none,” “company” or “unknown.” The average control satisfaction for Roundup® was 3.2 and 3.1 for Grazon® (scale of 1 to 4, 4 being the highest satisfaction).

Of those indicating whether they treated for pests themselves or contracted with others, 88 percent said they treated for pests themselves, 5 percent said they contracted with others and 7 percent said both (226 of the 241 survey respondents answered this question).

Respondents also listed the two products they relied on most for

**Table 6. Percentage of poultry operators conducting various sanitation practices at least once a year.**

Practice	% respondents
Clean out <b>part</b>	6%
Clean out and wash <b>part</b>	1%
Clean out, wash, and disinfect <b>part</b>	7%
Clean out <b>all</b>	23%
Clean out and wash <b>all</b>	12%
Clean out, wash, and disinfect <b>all</b>	51%

**Table 7. Percentage of poultry operators using various disinfectants.**

Disinfectant	% using
None, company, unknown	51%
Iodine	14%
Poulphene®	12%
Bleach	10%
Aldacide®	7%

**Table 8. Percentage of poultry operators using various pest-control products on premises.**

Product	% using
None, Company, Unknown	26%
Sevin®	32%
Diazinon and Terminator® <sup>2</sup>	29%
Various insecticides <sup>1</sup>	19%
Tempo®	15%
Rodenticides	11%
Fire ant products	10%

<sup>1</sup> Product name with number of respondents: Dursban 2, Golden Malrin 4, Insectrin 8, malathion 9, Orthene 7, Safecide 7, Boric acid 2, Permet 2, Ravap 2, Permethrin 1, Fly bait 1, Beetle bait 1, Reward 1.

<sup>2</sup> Terminator® is a brand name for a diazinon product.

Notes: Rodenticides included: Boot Hill®, D-cease®, Rat poison, Havoc®, Hawk®, Tomcat®, and E-Raticate®. Fire ant products included these responses: Amdro®, Logic®, Ortho® fire ant, Killer fire ants, and ant bait. Sevin®, diazinon, and Tempo® are general insecticides applied to control fire ants as well as flies, darkling beetles and other insects. Average control satisfaction for Sevin® was 2.6 on a scale of 1 to 4, 4 being the highest satisfaction. Average control satisfaction for diazinon was 2.57. It was 3.26 for Tempo®.

**Table 9. Percentage of poultry operators using various weed-control methods.**

Method	% using
None, Company, Unknown	45%
Roundup®	35%
Grazon®	10%
<b>Mow</b>	<b>9%</b>

pest control. Products listed and percentage of respondents listing them included:

- ☆ Insecticides, 76 percent;
- ☆ Rodenticides, 33 percent;
- ☆ Herbicides, 24 percent;
- ☆ None, company, unknown, 19 percent;
- ☆ Fire ant products, 9 percent; and
- ☆ Disinfectants, 3 percent.

Although fire ant products are insecticides also, products specifically for fire ant control were singled out. No doubt fire ants were a target pest of other insecti-

cide applications as well. Sevin® (listed by 24 percent of the respondents) and diazinon and Terminator® (22 percent together) were the principal insecticide products named. A total of 52 different products were listed.

Respondents were asked to name products they would use as alternatives if the ones they relied on most were unavailable. Fifty-five percent of those relying most on Sevin® listed no alternative; 22 percent reported they did not know what they would use as an alternative; 9 percent named diazinon; and 5 percent, malathion. Of those naming an

alternative for Sevin®, seven said the alternative product's effectiveness would be the same, three said it would be less effective and two, more effective. No answer and "unknown" were the principle responses given for alternatives to diazinon, followed by Sevin®. Of the nine respondents rating the effectiveness of diazinon alternatives, six said it would be less effective than diazinon and three said it would be the same.

These results indicate that producers do not want to give up materials currently on the market. The products are doing a fair job of controlling pests, and few alternatives are available.

In the 1983 survey, respondents reported using at least eight different insecticides. Sevin® in dust or spray form was most popular.

The 1996 survey asked respondents to rank several factors as to their importance in determining what chemical pest-control products to use (see Table 10). Factors were ranked from 1 to 6, with 1 being most important. Ranked highest was product performance, at 2.23; followed by environmental and food safety concerns, 2.62; potential for problem to escalate, 3.56; product cost, 3.81; ease and convenience of application, 3.91; and origin of the birds, 4.88.

Asked how they determined when to apply pest-control products, 58 percent of respondents reported they used personal observation of damage or infestation level. Thirty-six percent used established preventive programs. Six percent used both personal observation and a preventive program.

The survey also asked operators to name their primary source of pest-control information. Company field service personnel were listed most often (see Table 11), followed by neighbors or other poultry producers.

**Table 10. Important factors in choosing pest-control chemicals.**

Factor	Rank
Performance of product	2.23
Environmental, food safety concerns	2.62
Potential for problem to escalate	3.56
Cost of product	3.81
Ease, convenience of application	3.91
Origin of birds	4.88

Note: Factors ranked on a scale of 1 (most important) to 6 (least important).

**Table 11. Sources of pest-control information, and percentage of respondents relying on them.**

Source	% respondents
Company field service personnel	84%
Neighbor—other poultry producers	48%
Extension service	32%
Newspaper and magazines	24%
Retail store	16%
Veterinarian	12%
Commercial sales representative	10%
Commercial applicator	9%
Consultant	4%
Radio/TV	4%

In the 1983 survey, 72 percent of the participants listed Extension agent as an information source they relied on most; 68 percent named newspapers or magazines; and 56 percent, chemical sales personnel. In a 1995 survey of Texas feedlot operators, respondents listed veterinarian, consultant and commercial sales representative as the three sources of information they relied on most for information on pest control. A 1994 Texas cow/calf and stocker survey found the top three sources to be veterinarian, newspapers/magazines, and Extension service.

In the 1996 survey, poultry producers reported their pest-control "needs" (see Table 12). They said they most needed products that: give lasting control (listed by 67 percent of respondents); give more effective control (63 percent); and cost less (53 percent).

Feedlot operators' primary needs were products that: were less expensive (75 percent); were more effective (63 percent); and offered longer-lasting control (63 percent).

### Market broiler, market turkey operations compared

Of the survey respondents, 165 produce market broilers (MB) and 21 produce market turkeys (MT) (see Table 13). Black flies posed more problems for MB producers, whereas house flies were more of a problem for MT producers. MT producers were more likely to clean and disinfect their poultry houses than MB producers. Eighty-nine percent of the MT respondents used the disinfectant, Aldicide® and 33 percent used Triphenol®. None of the MB respondents used either disinfectant.

**Table 12. Pest-control needs listed by poultry operators, and percentage listing them.**

Need	% respondents
Products giving lasting control	67%
Products that give more effective control	63%
Less expensive products	53%
Products less susceptible to resistance	43%
More pest-control information	34%
Easier access to control products	30%
More effective fire ant control	20%
More convenient application techniques	18%
Easier container disposal	17%
More effective rat and mouse control	17%

Herbicides, particularly Roundup®, were more important to more MB than MT producers. Only a small percentage of both MB and MT producers said they apply insecticide directly on the birds. However, a higher percentage of MT producers (9 percent) apply insecticide directly on the birds than MB producers (1 percent).

### Regional differences

There were a few significant differences between the responses of the 148 market broiler poultry producers in the East Region (ER) of Nacogdoches and Shelby and surrounding counties, and those of the nine producers in the South Region (SR) in Gonzales and surrounding counties south of Austin (see Table 14). There were too few responses to compare other types of poultry operations by region.

South producers were more likely to clean out poultry houses at least once a year, but less likely than East producers to wash and disinfect poultry houses. More East (77 percent) than South (44 percent) operators control weeds to reduce flies. South Region

producers were four times as likely to use fire ant products.

### Summary

In 1996, Texas poultry producers completed questionnaires on pest problems and pest-control practices and needs. The majority of the respondents (71 percent) produced market broilers. Some produced market turkeys (9 percent). A small portion had laying hens producing commercial eggs (3 percent). In contrast, of Texas poultry producers surveyed in 1983, 84 percent had independent egg-producing operations and only 8 percent had broiler operations.

The 1996 survey found that:

- ☆ Fire ants, mice, darkling beetles, house flies and rats were the industry's primary problem pests. Pests causing the most economic damage if left untreated were mice, fire ants and rats. Forty-two percent of respondents reported that fire ants cause minor economic damage and 5 percent reported major economic damage.



**Table 13. Percentage of market broiler and market turkey operations listing various practices, problems. (Percentages are significantly different at the 95% confidence level.)**

Practice or problem	% MB respondents	% MT respondents
Used an insecticide in the past year	78%	100%
House flies are a problem	65%	100%
Fire ants cause economic loss	52%	26%
Conduct through cleaning between flocks	53%	81%
Clean out, wash, and disinfect all houses at least once a year	39%	86%
Clean out all houses at least once a year	30%	0%
Clean out and wash all houses at least once a year	16%	33%
Darkling beetles cause economic loss	41%	68%
Black flies are a problem	29%	5%
Use a disinfectant	41%	100%
Rotate pest control products semiannually	23%	47%
Practice rigid sanitation	27%	57%
Use iodine to disinfect	13%	33%
Use fly traps as non-chemical pest control practice	6%	38%
House flies cause economic loss	1%	32%
Use Aldacide® to disinfect	0%	89%
Use Triphenol® to disinfect	0%	33%
Apply insecticides directly to birds	1%	9%
Use diazinon	29%	0%
Use Tempo®	7%	52%
Use Insectrin®	0%	24%
Use Roundup®	39%	14%
An insecticide is 1 of 2 pest-control products relied on most	55%	86%
A herbicide is 1 of 2 pest-control products relied on most	26%	5%
Tempo® is 1 of 2 pest-control products relied on most	7%	48%
Havoc® is 1 of 2 pest-control products relied on most	2%	29%
Insectrin® is 1 of 2 pest-control products relied on most	0%	24%
Roundup® is 1 of 2 pest-control products relied on most	19%	0%
Used personal observation to determine when to apply pest-control products <sup>1</sup>	65%	33%
Rely on neighbors or other poultry producers for information on pest control	48%	19%
Rely on retail store for information on pest control	18%	0%
Need more effective pest-control products to control flies	2%	11%
Need easier disposal of pest-control product containers	18%	0%

<sup>1</sup> Although not significant, market turkey producers were more likely than market broiler producers to use an established preventive program (37 percent MB, 52 percent MT) or both an established program and observation (4% MB, 14% MT) to determine when to apply pest-control products.

**Table 14. Differences in poultry operations between the East Region and South Region, comparing percentages of 148 market broiler poultry producers in the East Region (ER) of Nacogdoches and Shelby and surrounding counties to those of nine producers in the South Region (SR) in Gonzales and surrounding counties south of Austin. (Percentages are significantly different at the 95% confidence level.)**

Item or practice	% ER respondents	% SR respondents
Control weeds to reduce flies	77%	44%
Destroy or remove dead birds	95%	78%
Clean out all houses at least once a year	29%	71%
Clean out, wash, and disinfect all houses at least once a year <sup>1</sup>	39%	14%
Use fire ant products (Amdro® or Logic®)	11%	44%
Use Tempo® to control insects on the premises	5%	33%
Listed a herbicide as one of the two pest-control products they rely on the most <sup>1</sup>	30%	0%
Need easier access to pest-control products	34%	0%
Need longer lasting control from pest-control products	68%	100%

<sup>1</sup> not significant at 95% confidence, however.

- ☆ Since the 1983 survey, flies and mites have been significantly reduced as major pests to the industry. Fire ants and darkling beetles have emerged as major poultry pest problems.
- ☆ Producers need additional compounds and/or management methods to control pests. They do not want reduced the number and type of compounds currently available. Producers have seen the success of integrated pest management decisions.
- ☆ Primary pest-control needs were pest-control products that are longer lasting (67 percent), more effective (63 percent) and less expensive (53 percent).
- ☆ Very few, 3 percent, of respondents applied insecticides directly on birds to control pests. Slightly more, 10 percent, incorporated insecticides into the birds' feed. Larvadex® was the only feed insecticide reported to have been used. Broiler breeders accounted for over half, 52 percent, of Larvadex® users.
- Three-fourths of all respondents used at least one pesticide on their premises. Sevin® was most popular, followed by diazinon. Three-fourths of survey respondents included an insecticide as one of the two pest-control products they rely on most; one-third included a rodenticide; and one-fourth named a herbicide. Very few respondents listed alternative products they would use if the products they rely on most were unavailable.
- ☆ Product performance was respondents' leading factor in determining what chemical pest-control products to use. The next most common choice was environmental and food safety concerns.
- ☆ Forty-six percent of respondents used herbicides, mostly Roundup® and Grazon®, to control weeds.
- ☆ The most common nonchemical pest-control practices used by respondents were destroying or removing dead birds; managing manure; keeping feeders and waterers sanitary; controlling weeds to reduce flies; and thoroughly cleaning between flocks. Over half, 51 percent, of all respondents reported they clean out, wash, and disinfect their poultry houses at least once a year. Iodine, Poulphene®, and bleach were the most popular disinfectants. Aldacide® was most popular among turkey producers.
- ☆ Most respondents said they obtain pest-control information from company field service personnel (84 percent). Forty-eight percent included "neighbor—other poultry producers"; and 32 percent included "Extension service—county agent/specialist."
- ☆ Production practices of market broiler producers in the East Texas region differed little from those in the South Region. One significant difference, however, was that market broiler producers in the East Region were more likely to use herbicides and to control weeds to reduce flies than were market poultry producers in the South Region.

- ☆ Turkey producers were more likely than market broiler producers to disinfect their poultry houses. More turkey producers relied on insecticides for pest control; more market broiler producers relied on herbicides.
- ☆ Under almost all contract arrangements, the contracting company retains ownership of the birds; thus, any decisions concerning potential use of pest-control products are of utmost importance to the company, which must assure product quality and safety. Future educational and training programs addressing these clientele will be very effective in facilitating the adoption of

new technology and research information.

- ☆ As individual units within some sectors of the poultry industry become larger, individual decisions become much more important. Yet as long as there are contract producers, there will be a need for local, relevant and practical information concerning pest control.

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