PEST AND PESTICIDE USE ASSESSMENT AND PERSONAL PROTECTIVE EQUIPMENT USE FOR FIELD CORN PRODUCTION SYSTEMS IN NEW YORK STATE FOR 1994

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INTRODUCTION

The overall assessment and effectiveness of pest control techniques for field corn production systems are an ongoing process for scientists at Cornell University's College of Agriculture and Life Sciences. Not only must the specifics of pest dynamics and pest-induced losses be assessed, but the general problem of designing and implementing appropriate pest management systems for grower acceptance must be addressed as well.

New York Agricultural Statistics 1993-1994 reports that field corn was harvested on 1.4 million acres in New York in 1993. Nationally, New York State ranked second behind Wisconsin in corn silage production and seventeenth in corn grain production. Over $349 million, or 27% of the State's $1.3 billion agricultural receipts came from field corn production. Field corn is produced in 54 of New York's 57 counties. Five hundred and eighty thousand acres of corn for grain were harvested at an average yield of 105 bushels per acre, and 560,000 acres of corn for silage were harvested at an average of 14.5 tons per acre in 1993. Field corn plays a critical role in the nutrition and health of dairy cattle and other livestock by providing an economical source of high quality carbohydrates (energy) and fiber. In addition, corn has numerous food uses for humans, including starches, syrups and sweeteners, and many nonfood uses such as for drugs, cosmetics and industry.

Pest problems in field corn can be responsible for as much as 20-50% annual losses. Losses from western corn rootworm are expected to increase greatly within this decade as this pest migrates eastward across the state. Insecticide usage for corn rootworm adults has more than doubled in the last decade. Disease losses from leaf blights, stalk rots, ear rots and interactions with insects may be considerable. Seventy to 90% of all field corn acreage receives an herbicide treatment for annual weeds (A Long-Range Plan for the New York State Integrated Pest Management Program, 1992).

Present pest management techniques rely heavily on pesticides. This dependence on chemical control can have serious consequences, including the development of pesticide resistance, the destruction of natural enemies of these pests, negative impact on endangered species, and the contamination of groundwater. The latter is, perhaps, of significant importance in light of the New York State Pesticide and Groundwater Strategy: Draft Generic State Management Plan (GSMP), which, in the Environmental Protection Agency's (EPA) federal strategy, establishes goals and a general framework and foundation upon which more specific pesticide management plans and implementation activities will be built. It is a beginning for approaches to manage pesticide use and protect groundwater.

The goal of the GSMP is to prevent adverse effects to human health and the environment, and to protect the integrity of the State's groundwater resources. At the same time, it recognizes the need to sustain the productivity and economic viability of New York's agriculture, and to provide control of pests which pose significant threats to food production, human health, and natural ecosystems. Nowhere is this more complicated than in the case of field corn.

Under the provisions of the 1990 Farm Bill, the United States Department of Agriculture (USDA) Soil Conservation Service (SCS) must ensure conservation compliance for erosion control by farmers eligible for USDA farm program benefits. However, with decreased tillage, the need for herbicides greatly increases, and thus the potential for leaching into groundwater also increases. The possibility of a suspension/cancellation action on atrazine (which has already been detected in ground and surface water in many states) is a real problem for field corn producers, as conservation tillage programs for corn production rely heavily on atrazine for weed control. There are a number of registered herbicides for use on field corn, but they do not control the same spectrum of weeds, nor are they as effective as atrazine.

Disease prevention of field corn is of primary importance to New York growers. At present, more than 95% of field corn seed planted is treated by the seed supplier with a protectant fungicide for control of seed decay and seedling blight. Yield losses in New York without a seed treatment are estimated at approximately 7.5% (Bergstrom, 1991). Another important disease is stalk rot. Plant pathologists estimate that each year up to 10 percent of the nation's corn yield is lost due to lodging, stalk breakage and other difficulties related to stalk rot (DowElanco, Form No. 134-1956). Although chemicals play a relatively minor role in the management of corn diseases, in certain instances, such as when growers purchase seed that is not pretreated, they are urged to thoroughly mix fungicides with the seed in the hopper at planting time (Bergstrom, Managing Diseases in Corn).

Cultural methods such as crop rotation have historically been integral components in pest management programs. From 1960 until 1985, however, cultural practices as pest management techniques received less attention and use because of increased emphasis on the economics of corn production (A Long-Range Plan for the New York State Integrated Pest Management Program, 1992). Numerous farmers in New York grow corn in the same field for two or more years even though it has been documented that insect pests such as corn rootworm become very severe in continuously cropped corn fields. Because of increasing environmental concerns in agriculture, cultural practices, such as crop rotation and appropriate tillage practices, must once again become integral pest management techniques in any pest management program.

The importance of the availability of comprehensive detailed pesticide usage inventories, giving geographic locations, application rates and timing of use cannot be understated. Pesticide use data supports the development, and implementation of preventive approaches to groundwater contamination, improves response to EPA regulatory activity, provides information for Cornell Cooperative Extension educational programs, identifies research needs and emerging new pest problems, and helps in developing IPM strategies that provide alternative pesticide use. Such data is available in this report.

In addition, many pesticide handlers are unaware of the hazards of pesticide exposure and uninformed about the type of personal protective equipment (PPE) that should be worn. The health risks for these workers extend beyond the workplace when pesticide contaminated clothing is worn into the home or when it is washed with the family laundry. Worker safety also affects employers through lost workdays and costly litigation. Pesticide handlers, their families, and their employers need information about PPE that is based on current legislation, national education efforts, and ongoing research. To continue to serve the educational needs of pesticide handlers and their families, information is needed about their current practices and attitudes regarding the use of PPE. This report gives such information and reflects the requirements outlined in the new EPA Worker Protection Standard (WPS), and is based on specific pesticides and cultural practices of field corn producers.

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OBJECTIVES

A. To obtain the following information for field corn production systems within New York State for the 1994 growing season:
    1. Acres planted, average yield, method of tillage, rotations used:
        Corn for grain
        Corn for silage
    2. For each pest affecting the crop (weeds, insects, diseases), compare corn grown for gain and corn grown for silage, and rotational versus continuous corn
        a) Chemicals used for control
            (1) Acres treated
            (2) Rate of application
            (3) Method of application
            (4) Time of application
            (5) Basis for application
        b) Cost comparison of chemicals
    3. Bird and other vertebrate pest control
    4. Equipment calibration, storage and disposal of pesticides and miscellaneous information
    5. Alternative pest control methods
    6. Pesticide applications by commercial applicators
    7. Comments and concerns of New York State growers
B. To obtain the following information about the current practices and attitudes regarding the use of personal protective equipment for those applying pesticides in field corn production systems:
    1. Use of work clothing and personal protective equipment
    2. Laundering procedures
    3. Replacement of work clothing and PPE
    4. Maintenance and storage of PPE
    5. Label requirements
    6. Use of enclosed vehicles
    7. Educational resources and applicator training programs

8. Short- and long-term health problems associated with exposure to pesticides.

C. To develop informational programs for growers and expand the database of information currently accessible through Cornell's CENET system for access by university, USDA, NYSDEC, regulatory personnel and others needing pesticide impact assessment information.

PROJECT DESIGN, IMPLEMENTATION AND ANALYSIS

Questionnaires were developed from previous NAPIAP and other surveys that had been conducted in New York State. The first drafts were reviewed by field corn specialists in the areas of weed, insect and disease control, IPM specialists and extension agents for comment and critique. Copies were also sent to Mississippi State, where the same survey was to be conducted. Final survey forms were printed and duplicated (see Appendix for survey form samples) based on input from these groups.

Letters were sent to field crops/dairy extension agents explaining the project and requesting assistance in the implementation of the survey. A one hour pesticide applicator training presentation on WPS and personal protective equipment use was given prior to the completion of the survey questionnaire. In order to attract growers to the meetings, two recertification credits were given to all those who participated. Six meetings were held throughout New York State where attendance ranged from ten to 100 growers. Mail surveys were sent to growers from mailing lists supplied to us by seven county agents. Response ranged from zero to 25 percent. Approximately 10% of the mailed surveys were returned uncompleted because the grower either "did not grow field corn in 1994," "did not use pesticides in 1994," or "had a custom applicator apply pesticides in 1994."

In addition to the mail surveys and courses, a booth was provided at the Dairy Day in Cobleskill, and the Corn Congress in Waterloo and Batavia. Surveys were handed out to interested growers and returned by mail. Ten surveys were returned. Mail surveys were also sent to 116 commercial applicators in the state; nine were returned completed and six were returned uncompleted because they "did not spray in 1994."

Once data were collected, database management files were developed using FileMaker Pro 2.0 for compilation and analysis of the data. This report contains data pertaining to the objectives stated previously.

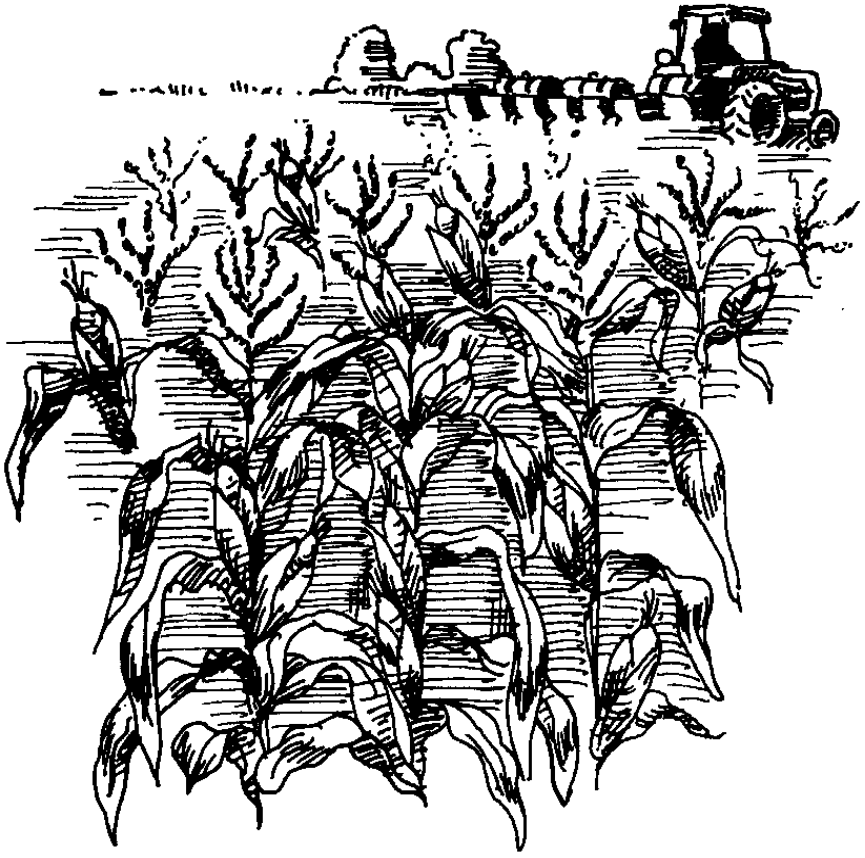
Certain words and/or terms used throughout this paper are defined below:

- Active ingredient (ai) - The portion of the pesticide product which controls the pest.
- Grower - The owner or employee who filled out the survey, a field corn producer.
- Record - One survey complete with all responses within that survey (synonymous with one grower or one field corn producer).
- Response - One entry within a record (survey). Since there can be more than one response to certain questions, the distinction between records (growers) and responses is important.
- Pre-treated seed - Purchased seed that was pre-treated with a fungicide and/or

insecticide by the seed supplier prior to purchase.

- Trade name - The name designated for a chemical by a company. Similar formulations can have different trade names.
- Herbicides - Chemicals that control weeds.
- Insecticides - Chemicals that control insects.
- Seed treatments - Chemicals that are mixed with the seed either before planting or at planting to control diseases and/or insects. This may be done regardless of whether or not the seed was pre-treated by the seed supplier.
- Work clothing - Garments growers have in their closet for everyday wear. They may be worn for pesticide work if the label does not require any special protection, they may be required by the label, or they may be worn under a protective garment.
- Personal Protective Equipment (PPE) - Garments that are worn specifically to protect from pesticides or pesticide residues.
- Coveralls - One or two-piece garment that covers, at a minimum, the entire body except the hands, feet, and head.
- Woven coveralls - Coveralls made of woven fabric, cotton or cotton/polyester and worn as the outer garment, but not over work clothes.
- Woven coveralls over work clothes - Cotton or cotton/polyester coveralls worn as the outer garment, but over other work clothes.
- Insulated coveralls - Padded coveralls for warmth.
- Nonwoven coveralls (Limited use or disposable) - Coveralls made from fabric that is made by bonding fibrous webs. Examples are: Tyvek®, Kleenguard®, and Comfort Gard®.
- Chemical-resistant coveralls - One or two-piece coveralls of plastic or rubber, or of fabrics coated with plastic or rubber. Examples are: PVC, Saranex-coated, Tyvek®, or rainsuits which are nylon fabric with PVC coating.
- Barrier laminate - Lightweight laminate that resists permeation from a wide range of chemicals. Examples are: Silver Shield® and 4-H®.

PART I: PEST AND PESTICIDE USE ASSESSMENT



RESULTS AND DISCUSSION

DEMOGRAPHICS

One hundred and sixty-seven field corn producers filled out a pesticide use survey. For purposes of this survey, the state was divided into five areas by geography and climate as in a 1945 corn survey conducted by Cooperative G. L. F. Exchange, Inc., Ithaca, NY: (1) North Country, (2) Hudson River, (3) Catskills/Capitol, (4) Southern Tier and (5) Upstate (Figure 1).

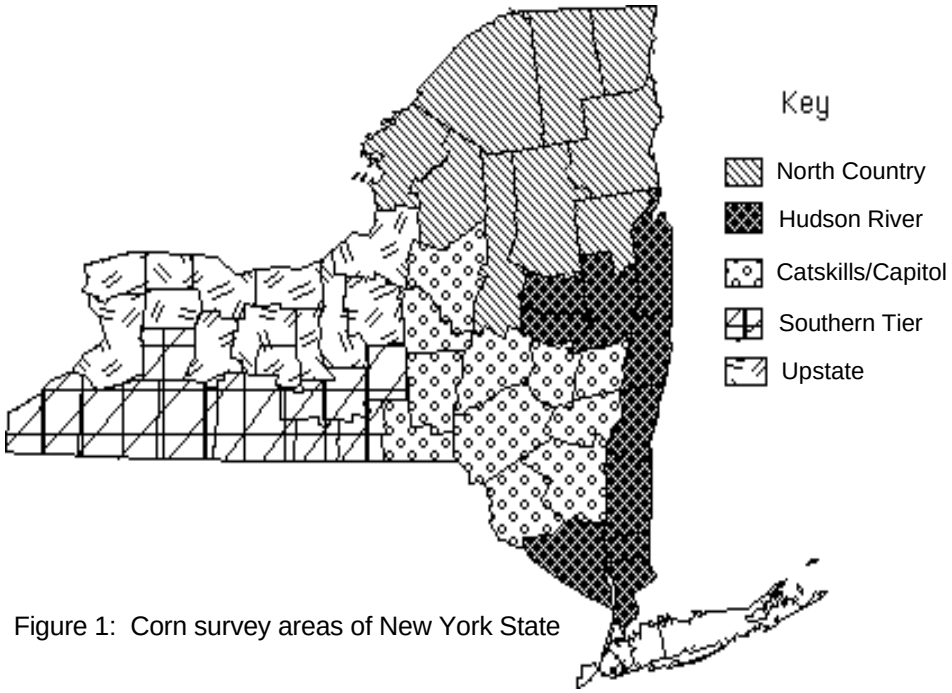


Figure 1: Corn survey areas of New York State

One hundred and fourteen growers (68.3%) grew corn for grain on 11,984.2 acres with an average yield of 131.8 bushels/acre (Table 1). Planting date for maximum yield should occur between April 28 and May 15 unless in an area where late frosts occur. If soil conditions are wet in late April or early May, planting date should be delayed until the soil can be worked without excessive compaction (Cornell Field Crops and Soils Handbook). Corn for grain, in this survey, was planted on average between May 10 and May 15, well within the recommended dates. The average seeding rate was between 25,500 and 27,600 and average row spacing was between 31 and 32 inches. Both of these fall within recommendations for corn for grain.

Table 1: Number of acres planted, average planting date, average seeding rate, average row spacing and average yield of field corn grown for **grain** by New York State growers in 1994 (114 growers)

Area County	# of growers	# of fields	# of acres	Avg. planting date (Range)	Avg. seeding rate	Avg. row spacing	Avg. yield
Catskills/Capitol	8	11	418.0	May 11	25,545.5	32.4	109.8 +/- 14.4
Delaware	1	1	10.0	(Apr 30 - May 23)			
Sullivan	6	9	308.0				
Ulster	1	1	100.0				
Hudson River	4	6	809.0	May 10	27,616.7	31.0	142.7 +/- 15.3
Columbia	3	3	762.0	(Apr 30 - May 21)			
Dutchess	1	3	47.0				
Southern Tier	54	110	3,056.6	May 15	27,173.6	31.8	132.3 +/- 36.2
Allegany	1	1	40.0	(May 8 - May 22)			
Chautauqua	11	18	395.2				
Chemung	1	1	100.0				
Cortland	5	15	421.2				
Steuben	26	57	1,219.5				
Tioga	1	1	12.0				
Tompkins	8	16	836.9				
Wyoming	1	1	32.0				
Upstate	48	88	7,700.4	May 15	27,601.1	31.8	131.6 +/- 23.8
Cayuga	30	55	5,604.0	(May 6 - May 24)			
Erie	1	3	20.6				
Livingston	2	3	20.6				
Onondaga	7	10	711.0				
Ontario	1	3	38.9				
Oswego	2	3	77.0				
Seneca	3	5	450.0				
Wayne	1	1	272.0				
Yates	1	5	288.8				
Totals	114	215	11,984.2	May 15	27,277.7	31.8	131.8 +/- 30.5

One hundred and four growers (62.3%) grew corn for silage on 6,207.1 acres with an average yield of 16.8 tons/acre (Table 2). Corn for silage was planted between May 4 and May 21, average seeding rate was between 27,300 and 29,500 and average row spacing was 31 to 36 inches. All of these fall within the recommendations given in Cornell Field Crops and Soils Handbook.

Table 2: Number of acres planted, average planting date, average seeding rate, average row spacing and average yield of field corn grown for **silage** by New York State growers in 1994 (104 growers)

Area County	# of growers	# of fields	# of acres	Avg. planting date (Range)	Avg. seeding rate	Avg. row spacing	Avg. yield
Catskills/Capitol	19	45	727.5	May 20	29,584.4	31.9	16.4 +/- 4.6
Chenango	1	3	26.0	(May 9 - May 31)			
Delaware	9	26	179.0				
Madison	1	2	32.0				
Schoharie	1	4	55.0				
Sullivan	6	9	235.5				
Ulster	1	1	200.0				
Hudson River	2	4	50.0	May 4	28,000.0	31.3	14.2 +/- 0.0
Columbia	1	1	21.0				
Dutchess	1	2	29.0				

(continued)

Table 2: Demography, **silage** (continued)

Area County	# of growers	# of fields	# of acres	Avg. planting date (Range)	Avg. seeding rate	Avg. row spacing	Avg. yield
North Country	1	4	50.0	May 13	30,250.0	36.0	14.2 +/- 0.0
Jefferson	1	4	50.0				
Southern Tier	64	114	3,175.0	May 21	27,363.5	32.2	16.3 +/-\ 4.5
Cattaraugus	1	1	80.0	(May 8 - June 3)			
Chautauqua	16	18	652.0				
Chemung	2	2	85.0				
Cortland	11	17	791.5				
Steuben	32	74	1,467.5				
Tompkins	2	2	57.0				
Wyoming	1	1	42.0				
Upstate	17	24	2,204.1	May 14	29,195.8	31.5	17.8 +/- 3.8
Cayuga	9	10	955.0	(May 4 - May 24)			
Erie	1	2	19.6				
Onondaga	4	8	484.0				
Oswego	1	1	65.0				
Seneca	1	2	47.0				
Wayne	1	1	634.0				
Totals	104	191	6,207.1	May 19	28,187.4	32.1	16.8 +/- 4.6

Ninety growers (78.9%) used a conventional tillage system to grow corn for grain on 6,404.6 acres (53.4%, Table 3). The remaining tillage systems used for corn for grain were conservation (28.1% of growers, 43.9% of acreage), no-till (4.4% of growers, 2.6% of acreage), and one grower (0.8%) did not specify the type of tillage system used. Average yield did not appear to differ between conventional and conservation tillage for corn grown for grain. Due to the small number of growers using a no-till system, yield comparisons are not valid. As with grain, the most common tillage system used by growers of corn for silage was conventional (77.9% of growers, 61.6% of acreage). Yields were for conventional and conservation tillage.

Table 3: Type of tillage used on fields grown to corn in New York State in 1994

Corn type Tillage type	# of growers	# of fields	# of acres	Average yield
Grain	114	215	11,984.2	131.8
Conventional	90	154	6,404.6	133.0
Conservation	32	54	5,257.1	132.1
No-till	5	5	311.5	101.0
No answer	1	2	11.0	117.7
Silage	104	191	6,207.1	16.8
Conventional	81	140	3,823.5	16.0
Conservation	27	44	2,315.6	18.2
No-till	2	4	48.0	13.2
No answer	1	3	20.0	11.7

According to the Cornell Field Crops and Soils Handbook, for maximum corn production and sustained soil productivity, corn should be rotated out of a field after 3 years, therefore, for this survey, any field that had corn grown on it in 1991, 1992 and 1993 was considered to be continuous corn in 1994. Table 4 shows the field rotation used by New York State field corn growers. Thirty-nine and one-half percent of the

grain acreage in 1994 was continuous corn and 35.7% was first year corn. Yield did not differ between rotations. Corn grown for silage showed similar results; 32.5% of the acreage was continuous corn, 29.8% was first year corn, and yield did not differ between rotations.

Table 4: Field rotation used by New York State growers from 1991-1993 on fields grown to corn in 1994

Corn type 1994 Corn crop	# of growers	# of fields	# of acres	Average yield
Grain	114	215	11,984.2	131.8
1st year corn	56	77	4,282.6	132.0
2nd year corn	32	37	1,278.8	125.7
3rd year corn	26	34	1,383.0	129.5
Continuous corn	44	65	4,734.8	134.4
No answer	2	2	309.0	123.8
Silage	104	191	6,207.1	16.8
1st year corn	50	69	1,850.1	15.9
2nd year corn	31	38	1,010.0	16.3
3rd year corn	28	34	1,014.0	17.3
Continuous corn	42	49	2,083.0	16.3
No answer	1	1	250.0	28.0

Although most seed dealers pretreat corn with a fungicide before sale, 14.2% of the corn for grain acreage and 15.5% of the corn for silage acreage was planted with seed that was not pre-treated (Table 5).

Table 5: Use of pre-treated seed by New York State growers on fields grown to corn in 1994

Corn type Was seed purchased treated?	# of growers	# of fields	# of acres	Average yield
Grain	114	215	11,984.2	131.8
Yes	105	197	10,277.2	132.0
No	9	18	1,707.0	130.1
Silage	104	191	6,207.1	16.8
Yes	91	168	5,247.1	16.2
No	13	23	960.0	20.3

HERBICIDE USE

New York weather is favorable for weed development, and weed pressure is extensive in almost every crop grown in the State, especially field corn. Since weeds often harbor insects and pathogens as well as significantly reducing crop yields through competition for site and nutrients, their presence in crop settings cannot be tolerated without substantial crop loss (Long Range Plan, 1992). In the 1970s, herbicide use to control weeds expanded due to (1) the substantial reductions in unit costs of production, (2) the increased availability of herbicides for specific weed problems that could be used with the crop, reducing the need for soil-incorporated herbicides, and thus tillage and (3)

the increased concern over soil degradation (Conacher, 1986). However, with increased use, weed tolerances and chemical resistance increased. In addition, herbicides turned out to be not as risk-free as originally believed. Corn has the greatest need for herbicides of all major crops; annual grasses are physiologically similar to corn and thus compete for germination, and world corn crop losses due to weeds have been estimated at 13% (Conacher, 1986). Therefore, a program that balances reduced tillage with reduced herbicide use is being utilized at present.

Table 6 shows the percent of total acres planted to field corn grown for grain that was treated with herbicides in New York State in 1994. Ninety-nine percent of the grain acreage in this survey was treated with herbicides, ranging from 98.8% in the Southern Tier to 100% in the Hudson River area.

Table 6: Percent of total acres planted to field corn grown for **grain** that was treated with herbicides in New York State in 1994 (114 growers)

Area	# of	# of	Total	Acres treated	
County	growers	fields	acreage	number	% of total
Catskills/Capitol	8	11	418.0	417.0	99.8
Delaware	1	1	10.0	9.0	
Sullivan	6	9	308.0	308.0	
Ulster	1	1	100.0	100.0	
Hudson River	4	6	809.0	809.0	100.0
Columbia	3	3	762.0	762.0	
Dutchess	1	3	47.0	47.0	
Southern Tier	54	110	3,056.8	3,018.8	98.8
Allegany	1	1	40.0	40.0	
Chautauqua	11	18	395.2	395.2	
Chemung	1	1	100.0	100.0	
Cortland	5	15	421.2	421.2	
Steuben	26	57	1,219.5	1,181.5	
Tioga	1	1	12.0	12.0	
Tompkins	8	16	836.9	836.9	
Wyoming	1	1	32.0	32.0	
Upstate	48	88	7,700.4	7,615.4	98.9
Cayuga	30	55	5,604.0	5,604.0	
Erie	1	3	20.6	20.6	
Livingston	2	3	239.0	164.0	
Onondaga	7	10	711.0	701.0	
Ontario	1	3	38.0	38.0	
Oswego	2	3	77.0	77.0	
Seneca	3	5	450.0	450.0	
Wayne	1	1	272.0	272.0	
Yates	1	5	288.8	288.8	
Totals	114	215	11,984.2	11,860.2	98.9

Ninety-nine percent of the total acres planted to field corn for silage was also treated with herbicides in 1994 (Table 7). However, two growers in the Southern Tier did not use any herbicides on their 64 acres of silage corn, making the range of herbicide treatment 96.3% in the Southern Tier to 100% in the Upstate and Hudson River areas.

Table 7: Percent of total acres planted to field corn grown for **silage** that was treated with herbicides in New York State in 1994 (104 growers)

Area County	# of growers	# of fields	Total acreage	Acres treated number	 % of total
Catskills/Capitol	19	45	727.5	727.0	99.9
Chenango	1	3	26.0	26.0	
Delaware	9	26	179.0	178.5	
Madison	1	2	32.0	32.0	
Schoharie	1	4	55.0	55.0	
Sullivan	6	9	235.5	235.5	
Ulster	1	1	200.0	200.0	
Hudson River	2	3	50.0	50.0	100.0
Columbia	1	1	21.0	21.0	
Dutchess	1	2	29.0	29.0	
North Country	1	4	50.0	49.0	98.0
Jefferson	1	4	50.0	49.0	
Southern Tier	65	115	3,175.0	3,057.0	96.3
Cattaraugus	1	1	80.0	80.0	
Chautauqua	16	18	652.0	570.0	
Chemung	2	2	85.0	85.0	
Cortland	11	17	791.5	785.5	
Steuben	32	74	1,167.5	1,437.5	
Tompkins	2	2	57.0	57.0	
Wyoming	1	1	42.0	42.0	
Upstate	17	24	2,204.6	2,204.6	100.0
Cayuga	9	10	955.0	955.0	
Erie	1	2	19.6	19.6	
Onondaga	4	8	484.0	484.0	
Oswego	1	1	65.0	65.0	
Seneca	1	2	47.0	47.0	
Wayne	1	1	634.0	634.0	
Totals	104	191	6,207.1	6,137.6	98.9

Table 8 shows a summary of herbicides used by New York State growers on corn grown for grain in 1994. Although atrazine (AAtrex) was used by the greatest number of growers (50.9%), pendimethalin was used on the greatest number of acres of corn for grain (54.1%), and the greatest amount of active ingredient applied (18,640.7 lbs) was a combination of atrazine and metolachlor (Bicep). There was a total of 49,603.9 lbs herbicide active ingredient applied to 11,860.2 acres of corn for grain making an average of 4.18 lbs ai/acre applied in 1994. The greatest amount of ai/acre was applied in the Upstate area (4.77 lbs) followed by the Capitol/Catskills area (4.4. lbs, Figure 2).

Table 8: Summary of herbicides used by New York State growers who grew corn for **grain** in 1994 by active ingredient (114 growers)

Active Ingredient Trade name	# of growers	# of fields	Acres treated	% of treated acres	Average am't of product used (lb or gal)	Am't of ai applied (lb)
pendimethalin	**52**	**102**	**6,418.8**	**54.1**		**10,725.8**
Prowl (liquid)	29	41	2,995.5		0.46	5,528.9
Prowl 3.3 EC (liquid)	23	38	3,423.3		0.46	5,196.9
atrazine & metolachlor	**33**	**57**	**5,786.2**	**48.8**		**18,333.6**
Bicep (liquid)	19	28	2,808.2		0.57	9,601.8
Bicep Lite (liquid)	14	27	2,887.0		0.60	8,731.8
atrazine	**58**	**112**	**4,094.7**	**34.5**		**5,090.0**
AAtrex 4L (liquid)	33	51	1,321.1		0.31	1,638.4
AAtrex Nine-O (dry)	25	61	2,773.6		1.38	3,451.6
metolachlor	**29**	**47**	**2,948.1**	**24.9**		**6,183.6**
Dual 8E (liquid)	27	45	2,900.1		0.27	6,157.9
Dual IIG (dry)	1	1	8.0		12.00	24.0
Dual 25G (dry)	1	1	40.0		0.17	1.7
dicamba	**19**	**35**	**2,206.0**	**18.6**		**2,284.8**
Banvel (liquid)	19	35	2,206.0		0.26	2,284.8
cyanazine	**24**	**34**	**1,322.9**	**11.1**		**2,888.9**
Bladex 90DF (dry)	14	24	795.9		1.53	1,093.9
Bladex 4L (liquid)	10	10	527.0		0.85	1,795.0
glyphosate	**12**	**20**	**962.0**	**8.1**		**1,267.4**
Roundup	12	20	962.0		0.33	1,267.4
nicosulfuron	**5**	**5**	**809.0**	**6.8**		**332.5**
Accent (dry)	5	5	809.0		0.55	332.5
alachlor	**7**	**13**	**654.6**	**5.5**		**1,121.4**
Lasso (liquid)	7	13	654.6		0.43	1,121.4
2,4-D	**5**	**7**	**287.0**	**2.4**		**155.8**
Amine 4 (liquid)	5	7	287.0		0.14	155.8
dicamba & atrazine	**2**	**3**	**206.0**	**1.7**		**260.9**
Marksman (liquid)	2	3	206.0		0.40	260.9
alachlor & atrazine	**6**	**7**	**143.0**	**1.2**		**379.0**
Bullet (liquid)	5	6	123.0		0.72	354.0
Lariat (liquid)	1	1	20.0		0.31	25.0
primisulfuron methyl	**6**	**10**	**142.0**	**1.2**		**5.2**
Beacon (dry)	6	10	142.0		0.05	5.2
butylate	**2**	**3**	**120.0**	**1.0**		**502..5**
Sutan + 6.7E (liquid)	2	3	120.0		0.63	502.5
bentazon & atrazine	**2**	**2**	**61.0**	**0.5**		**69.9**
Laddok (liquid)	2	2	61.0		0.35	69.9
MCPA	**2**	**2**	**13.0**	**0.1**		**3.0**
MCPA Amine (liquid)	2	2	13.0		0.60	3.0
					Total	**49,603.9**

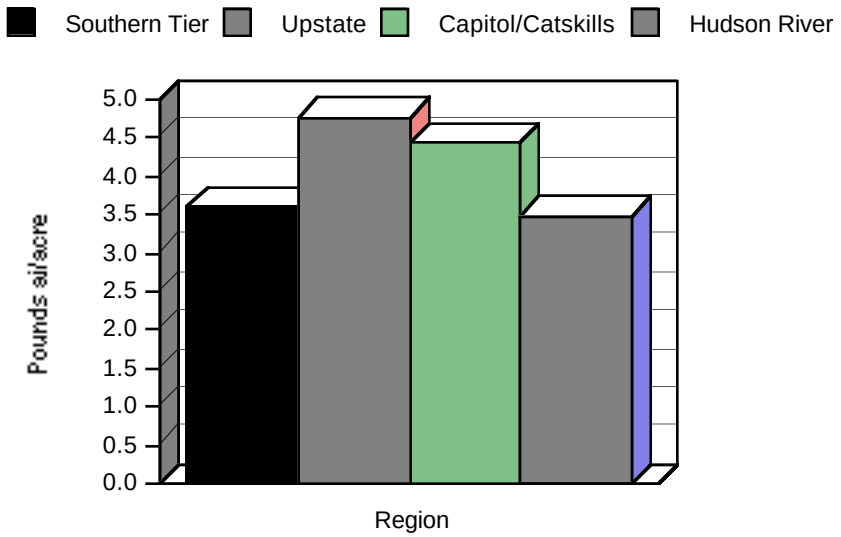


Figure 2: Total pounds of herbicide active ingredient applied per acre to field corn for **grain** in four regions of New York State in 1994

Table 9 shows who applied the herbicides, the application equipment used, the timing and method of application, and the basis for application of herbicide applied to field corn grown for grain in New York in 1994. Eighty-eight percent of the fields, and 84.5% of the treated acreage had herbicides applied by the grower. The application equipment used most often was a boom sprayer (95.3% of fields, 93.7% of treated acreage). Herbicides were applied pre-emergence on more than half of the fields and 64.3% of the acreage, and were broadcast almost exclusively. The most common reasons that herbicides were applied were "routine application" (49.8% of fields, 53.4% of treated acreage), and "presence of pest on the basis of scouting" (39.1% of field, 60.1% of treated acreage).

Table 9: Who applied, application equipment, timing, method and basis of application used by New York State growers applying herbicides to corn grown for **grain** in 1994 (114 growers)

Action	# of fields	% of fields[1/]	# of acres	% of treated acres[1/]
Who applied				
Grower	189	87.9	10,024.0	84.5
Custom applicator	26	12.1	1,829.2	15.4
Not specified	3	1.4	50.0	0.4
Application Equipment				
Boom sprayer	205	95.3	11,107.2	93.7
Airplane	4	1.9	120.0	1.0
Not specified	8	3.7	678.0	5.7
Timing				
Pre-emergence	119	55.3	7,625.4	64.3
Post emergence	74	34.4	2,664.7	22.5
Preplant surface	27	12.6	1,575.5	13.3
Preplant incorporated	25	11.6	1,655.9	14.0
Not specified	3	1.4	59.0	0.5

(continued)

Table 9: Application, **grain** (continued)

Action	# of fields	% of fields[1/]	# of acres	% of treated acres[1/]
Method				
Broadcast	206	95.8	11,633.2	98.1
Spot	10	4.7	127.0	1.1
Banded	5	2.3	178.0	1.5
Not specified	5	2.3	89.0	0.8
Basis for application				
Routine application	107	49.8	6,336.1	53.4
Presence of pest on the basis of scouting	84	39.1	7,124.9	60.1
Advice from CMA or consultant	38	17.7	1,361.9	11.5
Appearance of crop	21	9.8	485.9	4.1
Advice from Cooperative Extension	16	7.4	749.2	6.3
Previous pest problem/field history	9	4.2	748.0	6.3
Not specified	10	4.7	553.0	4.7

[1/] May not add up to 100% since each field can receive more than one herbicide application

Table 10 shows a summary of herbicides used by New York State growers on corn grown for silage in 1994. As with corn for grain, atrazine (AAtrex) was used by the greatest number of growers (55.9%), and pendimethalin was used on the greatest number of acres of corn for silage (48.2%). In contrast to corn for grain, the greatest amount of active ingredient applied (4,760.0 lbs.) was pendimethalin (Prowl). There was a total of 21,909.7 lbs. herbicide active ingredient applied to 6,137.6 acres of corn for silage making a total of 3.57 lbs. ai applied per acre in 1994. This is almost three quarters of a pound of herbicide active ingredient less per acre on corn for silage than on corn for grain. The greatest amount of ai/acre was applied in the Catskills/Capitol area (6.34 lbs/acre) followed by the North Country (4.30 lbs/acre, Figure 3).

Table 10: Summary of herbicides used by New York State growers who grew corn for **silage** in 1994 by active ingredient (102 growers)

Active Ingredient Trade name	# of growers	# of fields	Acres treated	% of treated acres	Average am't of prod. used (lb or gal)	Am't of ai applied (lb)
pendimethalin	**47**	**81**	**2,956.0**	**48.2**		**4,760.0**
Prowl (liquid)	30	57	2,291.5		0.41	3,741.8
Prowl 3.3 EC (liquid)	17	24	664.5		0.46	1,018.2
atrazine	**57**	**107**	**2,863.6**	**46.7**		**5,834.2**
AAtrex 4L (liquid)	41	77	2,056.6		0.39	3,210.4
AAtrex Nine-O (dry)	16	30	1,807.0		1.61	2,623.8
glyphosate	**10**	**22**	**1,474.0**	**24.0**		**770.2**
Roundup	9	12	504.0		0.38	760.2
Ranger (liquid)	1	1	10.0		0.50	10.0
atrazine & metolachlor	**23**	**43**	**1,332.5**	**21.7**		**4,680.8**
Bicep (liquid)	13	21	809.0		0.66	3,212.9
Bicep Lite (liquid)	10	22	523.5		0.56	1,467.9
dicamba	**9**	**10**	**970.0**	**15.8**		**654.3**
Banvel (liquid)	9	10	970.0		0.17	654.3
cyanazine	**16**	**25**	**463.0**	**7.5**		**2,494.5**
Bladex 90DF (dry)	8	9	136.0		1.88	229.8
Bladex 4L (liquid)	8	16	327.0		1.73	2,264.7

(continued)

Table 10: Herbicides, **silage** (continued)

Active Ingredient Trade name	# of growers	# of fields	Acres treated	% of treated acres	Average am't of prod. used (lb or gal)	Am't of ai applied (lb)
metolachlor	**16**	**21**	**436.0**	**7.1**		**1,037.1**
Dual 8E (liquid)	16	21	436.0		0.30	1,037.1
alachlor	**5**	**8**	**299.6**	**4.8**		**299.6**
Lasso (liquid)	5	8	299.6		0.25	299.6
alachlor & atrazine	**5**	**8**	**236.0**	**3.8**		**603.0**
Bullet (liquid)	4	7	196.0		0.71	553.0
Lariat (liquid)	1	1	40.0		0.31	50.0
metolachlor & cyanazine	**3**	**6**	**149.0**	**2.4**		**471.8**
Cycle (liquid)	3	6	149.0		0.79	471.8
nicosulfuron	**3**	**4**	**122.0**	**2.0**		**3.6**
Accent (liquid)	2	3	100.0		0.04	2.9
Accent SP (dry)	1	1	22.0		0.04	0.7
dicamba & atrazine	**2**	**2**	**88.5**	**1.4**		**120.2**
Marksman (liquid)	2	2	88.5		0.42	120.2
bentazon & atrazine	**1**	**1**	**35.0**	**0.6**		**29.1**
Laddok (liquid)	1	1	35.0		0.25	29.1
MCPA	**3**	**3**	**27.0**	**0.4**		**6.2**
MCPA Amine (liquid)	3	3	27.0		0.06	6.2
2,4-D	**1**	**4**	**24.5**	**0.4**		**2.9**
Amine 4 (liquid)	1	4	24.5		0.03	2.9
butylate	**1**	**2**	**23.0**	**0.4**		**134.8**
Eradicane 6.7E (liquid)	1	2	23.0		0.88	134.8
primisulfuron methyl	**1**	**1**	**10.0**	**0.2**		**0.4**
Beacon (dry)	1	1	10.0		0.05	0.4
bentazon	**1**	**1**	**7.0**	**0.1**		**7.0**
Basagran (liquid)	1	1	7.0		0.25	7.0
					Total	**21,909.7**

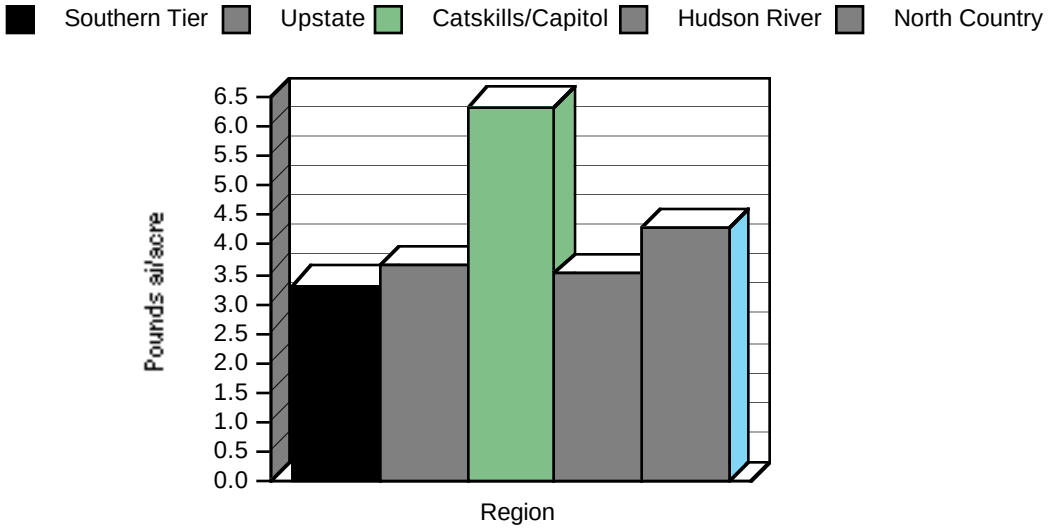


Figure 3: Total pounds of herbicide active ingredient applied per acre to field corn for **silage** in five regions of New York State in 1994

Table 11 shows who applied the herbicides, the application equipment used, the timing and method of application, and the basis for application of herbicides applied to field corn grown for silage in New York in 1994. Eighty-eight percent of the fields, and 92.1% of the treated acreage had herbicides applied by the grower. Other than not specifying type of application equipment, all herbicides on corn for silage were applied with a boom sprayer. Almost one-half of the fields and over one-half of the acreage had herbicides applied preemergence and more than 91% were broadcast. The most common reason for herbicide applications on corn for silage was "routine application" (52.4% of fields, 49.8% of acreage), followed by "presence of pest on the basis of scouting" (30.8% of fields, 39.3% of acreage).

Table 11: Who applied, application equipment, timing, method and basis of application used by New York State growers applying herbicides to corn grown for **silage** in 1994 (102 growers)

Action	# of fields	% of fields[1/]	# of acres	% of treated acres[1/]
Who applied				
Grower	162	87.6	5,655.1	92.1
Custom applicator	25	13.5	1,072.5	17.5
Not specified	3	1.6	20.0	0.3
Application Equipment				
Boom sprayer	173	93.5	5,992.6	97.6
Not specified	12	6.5	145.0	2.4
Timing				
Preemergence	88	47.6	3,301.1	53.8
Postemergence	73	39.5	2,233.0	36.4
Preplant surface	20	10.8	1,481.5	24.1
Preplant incorporated	9	4.9	139.0	2.3
Not specified	6	3.2	71.0	1.2
Method				
Broadcast	170	91.9	5,614.6	91.5
Banded	9	4.9	452.0	7.4
Spot	2	1.1	22.0	0.4
Not specified	8	4.3	177.0	2.9
Basis for application				
Routine application	97	52.4	3,059.1	49.8
Presence of pest on the basis of scouting	57	30.8	2,410.0	39.3
Advice from CMA or consultant	30	16.2	1,187.0	19.3
Advice from Cooperative Extension	24	13.0	1,187.0	19.3
Appearance of crop	24	13.0	613.5	10.0
Previous pest problem/field history	11	5.9	1,029.5	16.8
Not specified	21	11.4	1,169.0	19.0

[1/] May not add up to 100% since each field can receive more than one herbicide application

A cost comparison of herbicides used in field corn production is shown in Table 12. Because the average amount of active ingredient rate per acre is based on what growers indicated they used on their surveys, some of the costs per acre per application may not be exact. It is easy to see, however, why atrazine is so widely used. The cost per acre per application makes it an attractive herbicide, especially if a grower has many acres to treat.

Table 12: Cost comparison of herbicides used in field corn production

Trade name	Active Ingredient	Average rate/A (lbs of ai)[a/]	Median cost/lb of ai[b/]	Cost per acre per application
AAtrex 4L	atrazine	1.44	$3.12	$4.49
AAtrex Nine-O	atrazine	1.35	2.78	3.75
Accent	nicosulfuron	0.22	511.28	112.48
Accent SP	nicosulfuron	0.03	511.28	15.33
Banvel	dicamba	0.86	19.99	17.19
Basagran	bentazon	1.00	15.50	15.50
Beacon	primisulfuron methyl	0.04	40.05	1.60
Bicep	atrazine & metolachlor	3.69	4.75	17.53
Bicep Lite	atrazine & metolachlor	2.90	4.75	13.78
Bladex 90DF	cyanazine	1.53	5.36	8.20
Bladex 4L	cyanazine	5.16	5.53	28.53
Bullet	alachlor & atrazine	2.86	4.47	12.78
Dual 8E	metolachlor	2.28	7.42	16.92
Dual IIG	metolachlor	3.00	6.76	20.28
Dual 25G	metolachlor	0.04	6.76	0.27
Eradicane 6.7E	butylate	5.90	3.37	19.88
Laddok	bentazon & atrazine	1.16	15.19	17.62
Lariat	alachlor & atrazine	1.24	4.47	5.54
Lasso	alachlor	1.36	5.99	7.85
Marksman	dicamba & atrazine	1.31	6.93	9.08
Prowl	pendimethalin	1.74	5.99	10.42
Prowl 3.3 EC	pendimethalin	1.52	8.00	12.16
Ranger	glyphosate	1.00	15.48	15.48
Roundup	glyphosate	1.42	10.82	15.36
Sutan + 6.7E	butylate	4.22	2.53	10.68

[a/] Based on what was reported by growers in this survey

[b/] Price obtained from "AGCHEMPRICE Current U.S.A. Prices of Non-Fertilizer Agricultural Chemicals," June 1994. Published by DPRA Incorporated.

Table 13 shows a comparison of rotation on the percent of field corn acres treated with herbicides in New York in 1994. As expected, there appears to be little difference in herbicide treatments due to crop rotation for corn grown for grain, or corn grown for silage. However, pounds per acre of herbicide active ingredient appears to be affected.

Table 13: Comparison of rotation on percent of total acres planted to field corn that were treated with herbicides in NYS in 1994

Corn type Rotation	# of growers	# of fields	Total acreage	Acres treated number	Acres treated percent
Grain					
1st year corn	56	77	4,282.6	4,244.6	99.1
2nd year corn	32	37	1,278.8	1,203.8	94.1
3rd year corn	26	34	1,383.0	1,372.0	99.2
Continuous corn	44	65	4,734.8	4,734.8	100.0
No answer	2	2	305.0	305.0	100.0
Silage					
1st year corn	50	69	1,850.1	1,849.6	100.0
2nd year corn	31	38	1,010.0	980.0	97.0
3rd year corn	28	34	1,014.0	983.0	96.9
Continuous corn	42	48	2,083.0	2,055.0	98.7
No answer	1	1	250.0	250.0	100.0

Figure 4 illustrates pounds ai/acre applied to corn by rotation. Third year and continuous grain corn had 4.6 and 4.35 lbs ai/acre applied versus 4.05 and 3.65 lbs ai/acre for first and second year corn, respectively. The difference is even more dramatic for corn grown for silage. First and second year corn had only 3.13 and 2.73 lbs ai/acre applied, while 3.6 lbs/acre were applied to third year corn and 4.25 lbs/acre were applied to continuous corn.

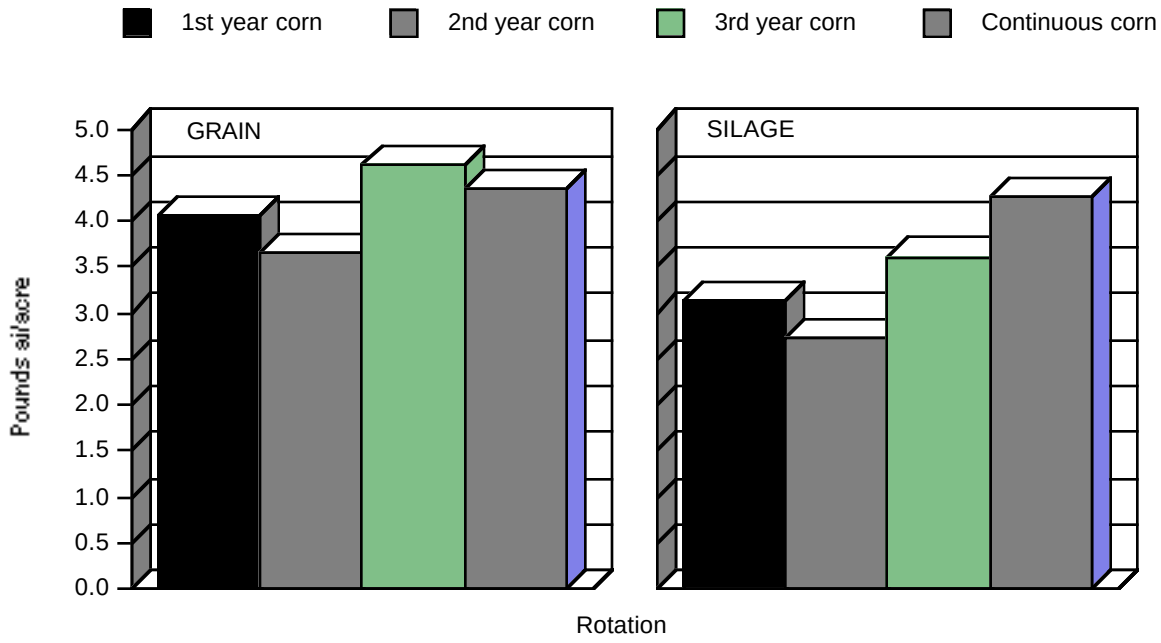


Figure 4: Total pounds of herbicide active ingredient applied per acre to field corn in New York State in 1994 by rotation

Table 14 shows a comparison of type of tillage used on the percent of field corn acres that were treated with herbicides. As expected, 100% of the no-till acres for both grain and silage, were treated. Growers who grew corn for grain using no-till applied only 2.33 lbs ai/acre, versus 4.0 for conventional and 4.74 for conservation (Figure 5). The same is true for corn grown for silage: 3.07 lbs ai/acre for no-till, 3.13 lbs/acre for conservation and 4.25 lbs/acre for conventional. The low number of growers in this survey using no-till systems is probably the reason for lower herbicide rates in no-till systems versus conventional practices.

Table 14: Comparison of tillage on percent of total acres planted to field corn that were treated with herbicides in NYS in 1994

Corn type Tillage	# of growers	# of fields	Total acreage	Acres treated number	 percent
Grain					
Conventional	90	154	6,404.6	6,280.6	98.1
Conservation	32	54	5,257.1	5,257.1	100.0
No-till	5	5	311.5	311.5	100.0
Silage					
Conventional	81	140	3,823.5	3,790.0	99.1
Conservation	27	44	2,315.6	2,279.6	98.4
No-till	2	4	48.0	48.0	100.0

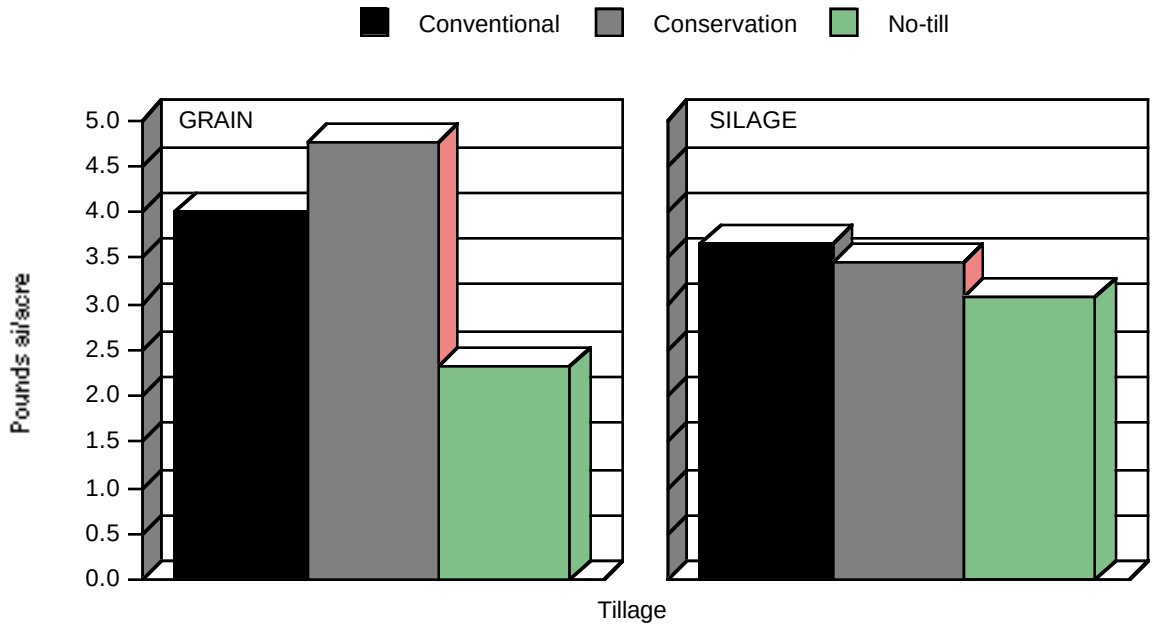


Figure 5: Total pounds of herbicide active ingredient applied per acre to field corn in New York State in 1994 by tillage

Table 15 shows the type of weeds for which New York State growers treated corn for grain in 1994. The Table shows only the seven most commonly used active ingredients. Annual broadleaves were the major weed problem followed by annual grasses. The perennial grasses and broadleaves were of little importance for most of the acreage. Table 16 shows the same information for corn grown for silage. Again, annual weeds were of the greatest importance, and perennial weeds were of the least.

Table 15: Summary of weeds treated for by New York State growers who grew corn for **grain** in 1994 by active ingredient (114 growers)

Active Ingredient Weed	# of growers	Acres treated	% of acres	Active Ingredient Weed	# of growers	Acres treated	% of acres
pendimethalin	**52**	**6,418.8**		**dicamba**	**19**	**2,206.0**	
Annual Broadleaves		4,585.8	71.4	Annual Broadleaves		1,612.0	73.1
Annual Grasses		3,895.8	60.7	Annual Grasses		1,045.0	47.4
Yellow Nutsedge		2,223.7	34.6	Perennial Broadleaves		920.0	41.7
Triazine Resistant		1,919.4	29.9	Triazine Resistant		898.0	40.7
All Weeds		600.0	9.3	Perennial Grasses		611.0	27.7
Perennial Grasses		489.0	7.6	Yellow Nutsedge		648.0	29.4
Perennial Broadleaves		281.4	4.4	Biennial Weeds		10.0	0.5
No Answer		232.0	3.6	**cyanazine**	**24**	**1,322.9**	
Biennial Weeds		198.4	3.1	Annual Broadleaves		866.9	65.5
atrazine & metolachlor	**35**	**5,786.2**		Annual Grasses		688.0	52.1
Annual Broadleaves		4,555.2	78.7	Sedges		348.0	26.3
Annual Grasses		3,434.2	59.4	Triazine Resistant		340.0	25.7
Sedges		2,982.0	51.5	Biennial Weeds		180.0	13.6
Triazine Resistant		1,501.0	25.9	Perennial Grasses		146.0	11.0
Perennial Grasses		423.0	7.3	General Weeds		100.0	7.6
Perennial Broadleaves		60.0	1.0	Perennial Broadleaves		6.0	0.5

(continued)

Table 15: Weed, **grain** (continued)

Active Ingredient Weed	# of growers	Acres treated	% of acres	Active Ingredient Weed	# of growers	Acres treated	% of acres
atrazine	**58**	**4,094.7**		**glyphosate**	**12**	**962.0**	
Annual Broadleaves		3,078.0	75.2	Quackgrass		727.0	75.6
Annual Grass		2,283.2	55.8	Yellow Nutsedge		110.0	11.4
Perennial Grasses		1,099.5	26.9	Annual Grass		108.0	11.2
Sedges		941.6	23.0	Bindweeds		100.0	10.4
Triazine Resistant		848.9	20.7	No answer		100.0	10.4
Perennial Broadleaves		774.4	18.9	Triazine Resistant		35.0	3.6
Biennial Weeds		279.4	6.8	Annual Broadleaves		8.0	0.8
No Answer		100.0	2.4				
Ryegrass		19.0	0.5				
Everything		14.0	0.3				
metolachlor	**29**	**2,948.1**					
Yellow Nutsedge		1,669.6	56.6				
Annual Grasses		1,327.1	45.0				
Annual Broadleaves		1,269.1	43.0				
Triazine Resistant		837.7	28.4				
Perennial Grasses		480.0	16.3				
Perennial Broadleaves		206.7	7.0				
Biennial Weeds		186.7	6.3				

Table 16: Summary of weeds treated for by New York State growers who grew corn for **silage** in 1994 by active ingredient (102 growers)

Active Ingredient Weed	# of growers	Acres treated	% of acres	Active Ingredient Weed	# of growers	Acres treated	% of acres
atrazine	**57**	**3,863.6**		**dicamba**	**9**	**970.0**	
Annual Broadleaves		3,282.1	84.9	Quackgrass		661.0	68.1
Annual Grasses		1,540.1	39.9	Perennial Broadleaves		656.0	67.6
Triazine Resistant		724.5	18.8	Triazine Resistant		281.0	30.0
Perennial Grasses		718.5	18.6	Annual Broadleaves		144.0	14.8
Sedges		385.0	10.0	**glyphosate**	**10**	**514.0**	
Perennial Broadleaves		285.5	7.4	Annual Grasses		236.0	45.9
Biennial Weeds		70.0	1.8	Quackgrass		234.0	45.5
No answer		48.0	1.2	Bindweeds		210.0	40.9
pendimethalin	**47**	**2,956.0**		Yellow Nutsedge		200.0	38.9
Annual Broadleaves		2,231.0	75.5	All Weeds		80.0	15.6
Triazine Resistant		1,294.0	43.8	Annual Broadleaves		10.0	1.9
Annual Grasses		1,037.0	35.1	Triazine Resistant		10.0	1.9
Perennial Grasses		744.5	25.2	**cyanazine**	**16**	**463.0**	
Sedges		402.0	13.6	General Weeds		200.0	43.2
General Weeds		200.0	6.8	Annual Grasses		172.0	37.1
No answer		59.0	2.0	Annual Broadleaves		155.0	33.5
Perennial Grasses		14.0	3.0	No answer		75.0	16.2
Perennial Broadleaves		55.0	1.9	Perennial Broadleaves		36.0	7.8
Biennial Weeds		10.0	0.3	Yellow Nutsedge		14.0	3.0
atrazine & metolachlor	**23**	**1,332.5**					
Annual Broadleaves		1,099.5	82.5				
Annual Grasses		682.5	51.2				
Triazine Resistant		631.0	47.4				
Sedges		532.0	39.9				
Quackgrass		226.0	17.0				
Perennial Broadleaves		29.0	2.2				

Figure 6 illustrates the percent of acreage treated with herbicides for specific weed types by area of the State. Corn grown for grain (Figure 8) in the Catskills/Capitol area had a much greater problem with perennial grasses than in the other regions, and the Southern Tier and Upstate areas treated more acreage for annual grasses than either the Catskills/Capitol or Hudson River areas. Sedges and annual weeds were a big problem in the North Country in corn grown for silage, while perennial broadleaves were more of a problem in the Hudson River area.

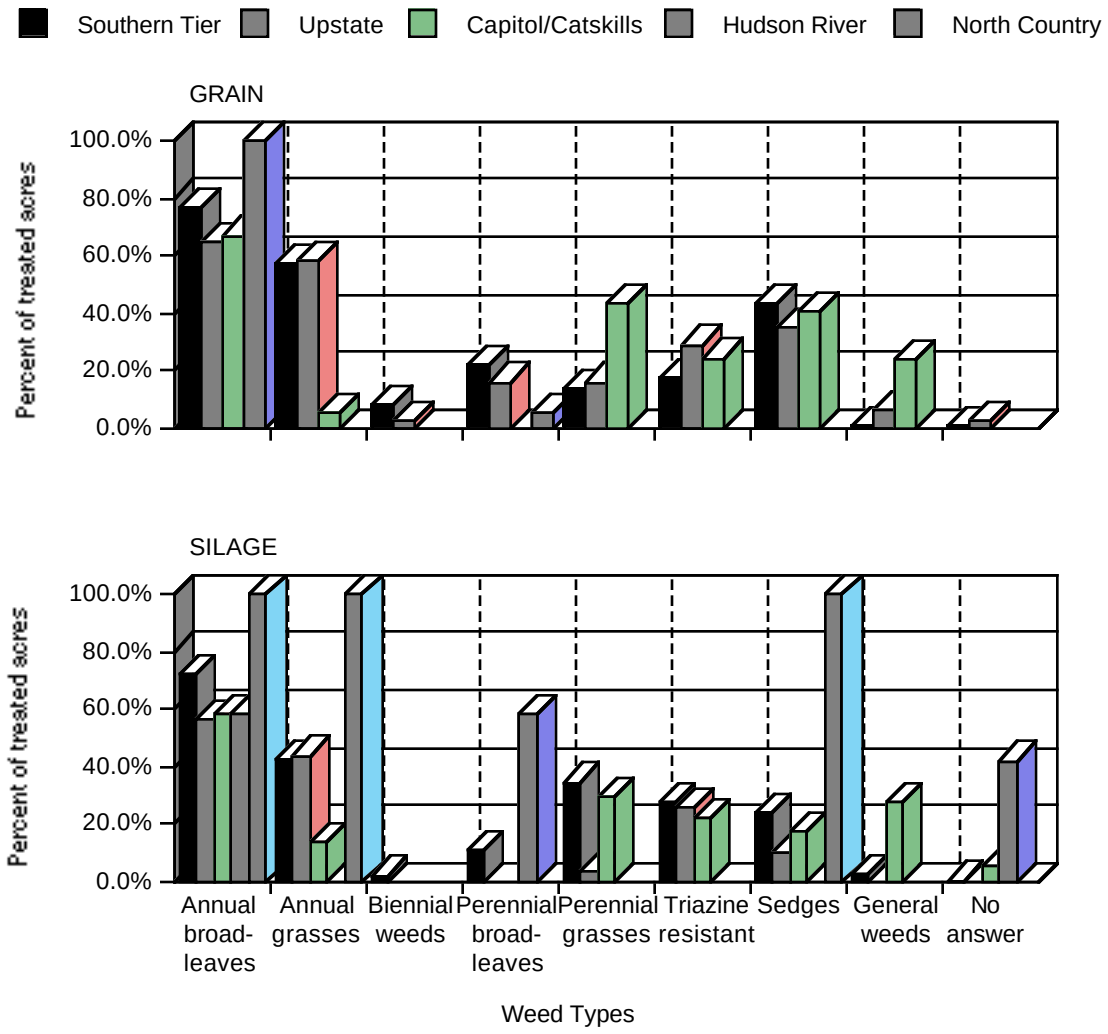


Figure 6: Types of weeds for which New York State growers treated field corn in 1994 by region

The effect of rotation on types of weeds treated for is illustrated in Figure 7 for both corn for grain, and corn for silage. Third year corn appears to have a bigger problem with triazine resistant weeds and perennial grasses in corn grown for grain. Less than one-third of the corn grown for silage, regardless of rotation, was treated for anything other than annual weeds.

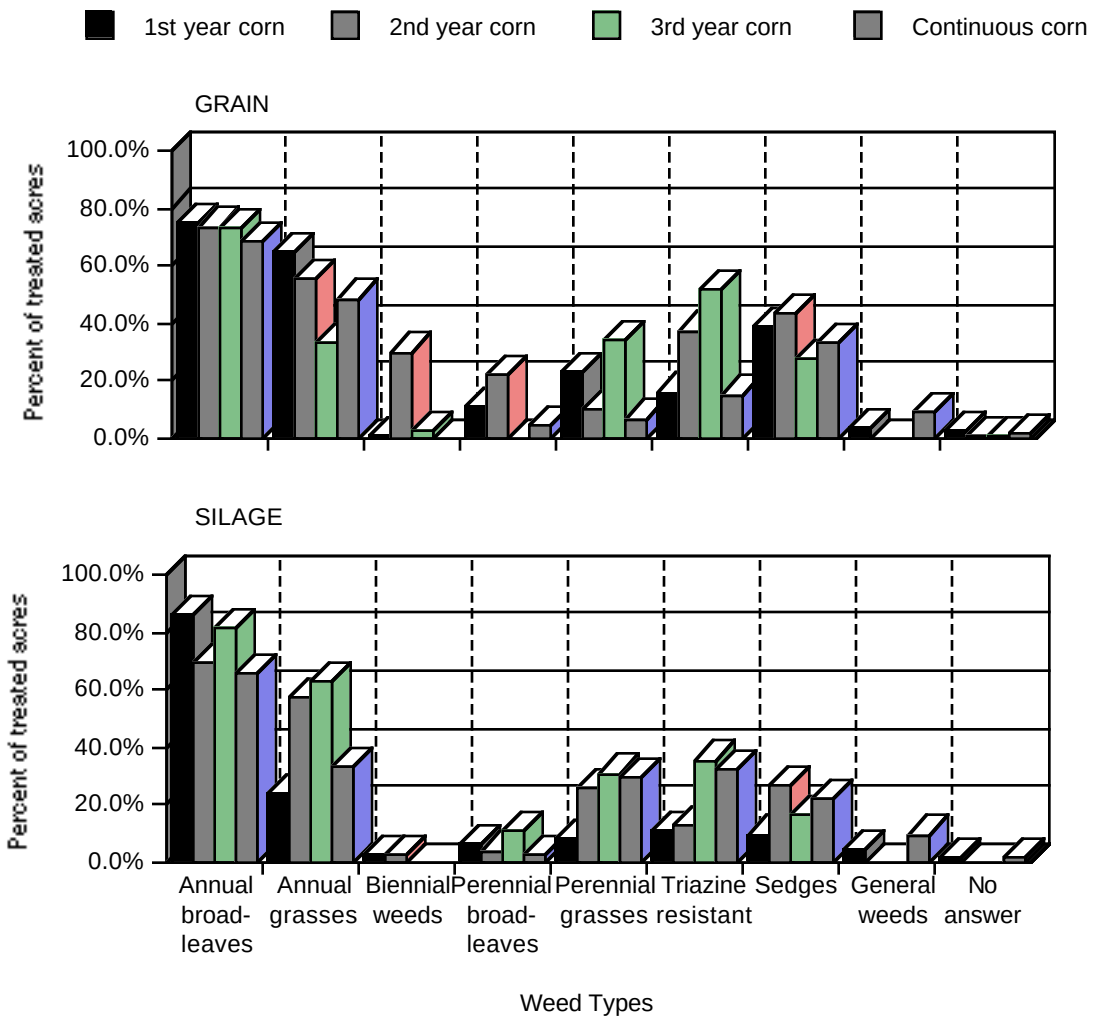


Figure 7: Type of weeds for which New York State growers treated field corn in 1994 by rotation

Finally, the effect of tillage system used on types of weeds treated for is illustrated in Figure 8. In both types of corn, perennial grasses appear to be a major problem in no-till corn, while annual weeds are a minor or non-existent problem. This makes sense as perennial weeds tend to build up in no-till fields.

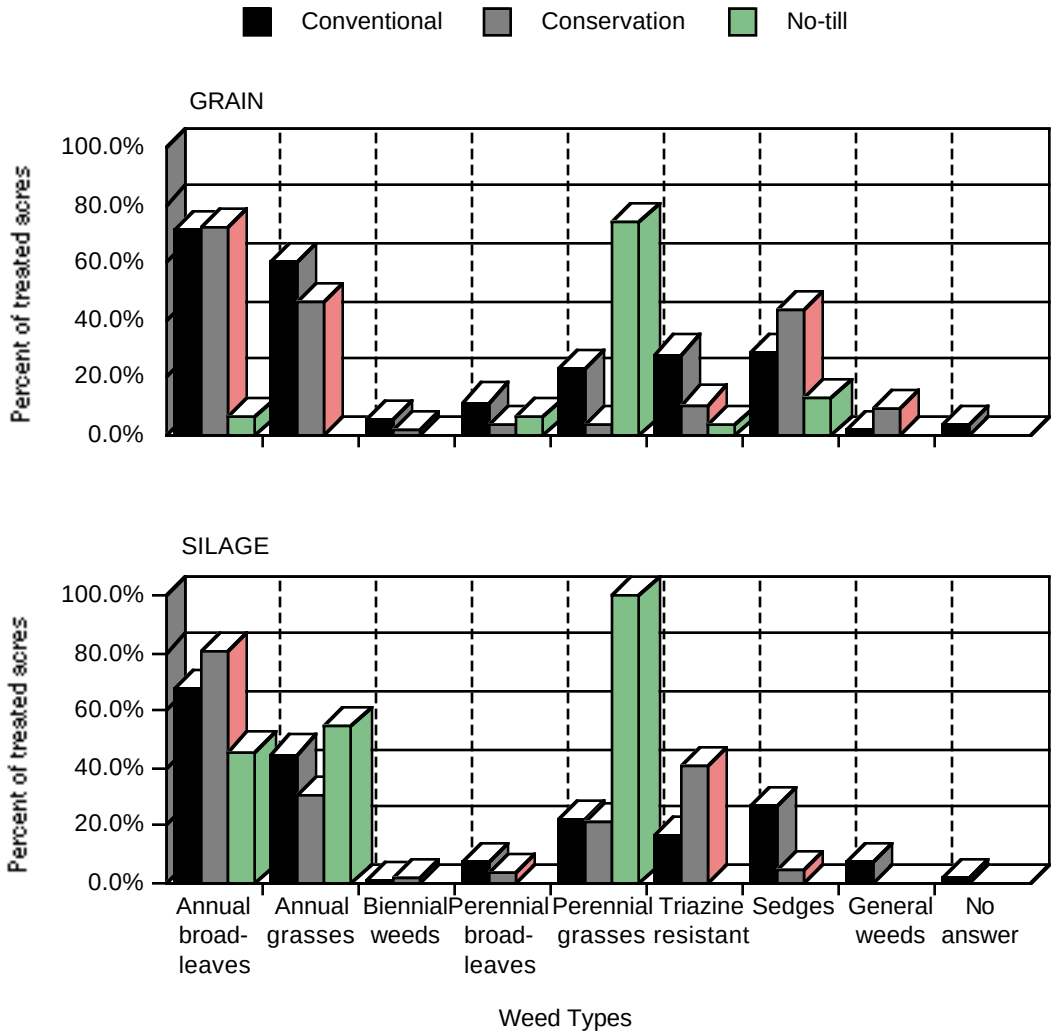


Figure 8: Types of weeds for which New York State growers treated field corn in 1994 by tillage

INSECTICIDE USE

Insects become pests in crop production when their numbers and/or damage have surpassed the level at which they begin to threaten farmers' return on investment (Ortega, 1987). As stated previously, yield losses of field corn can be as great as 20-50% due to insect pests, especially corn rootworm. For this reason, many field corn growers use a soil-applied insecticide to control this and other insect pest problems.

Table 17 shows the percent of total acres planted to field corn grown for grain that were treated with insecticides in New York State in 1994. Fifty-one percent of the grain

acreage in this survey was treated with insecticides, ranging from 27.3% in the Southern Tier, to 92.0% in the Hudson River area. Only 27.9% of the total acres planted to field corn for silage were treated with insecticides in 1994 (Table 18). No insecticides were used in the Hudson River or North Country areas, while 54.4% was treated in the Catskills/Capitol area.

Table 17: Percent of total acres planted to field corn grown for **grain** that were treated with insecticides in NYS in 1994 (114 growers)

Area	# of	# of	Total	Acres treated	
County	growers	fields	acreage	number	% of total
Catskills/Capitol	8	11	418.0	284.0	67.9
Delaware	1	1	10.0	0.0	
Sullivan	6	9	308.0	184.0	
Ulster	1	1	100.0	100.0	
Hudson River	4	6	809.0	744.0	92.0
Columbia	3	3	762.0	744.0	
Dutchess	1	3	47.0	0.0	
Southern Tier	54	110	3,056.8	833.6	27.3
Allegany	1	1	40.0	40.0	
Chautauqua	11	18	395.2	262.0	
Chemung	1	1	100.0	0.0	
Cortland	5	15	421.2	75.0	
Steuben	26	57	1,219.5	71.0	
Tioga	1	1	12.0	0.0	
Tompkins	8	16	836.9	385.6	
Wyoming	1	1	32.0	0.0	
Upstate	48	88	7,700.4	4,289.8	55.7
Cayuga	30	55	5,604.0	3,580.0	
Erie	1	3	20.6	0.0	
Livingston	2	3	239.0	0.0	
Onondaga	7	10	711.0	421.0	
Ontario	1	3	38.0	0.0	
Oswego	2	3	77.0	0.0	
Seneca	3	5	450.0	0.0	
Wayne	1	1	272.0	0.0	
Yates	1	5	288.8	288.8	
Totals	114	215	11,984.2	6,151.4	51.3

Table 18: Percent of total acres planted to field corn grown for **silage** that were treated with insecticides in NYS in 1994 (104 growers)

Area	# of	# of	Total	Acres treated	
County	growers	fields	acreage	number	% of total
Catskills/Capitol	19	45	727.5	395.5	54.4
Chenango	1	3	26.0	0.0	
Delaware	9	26	179.0	0.0	
Madison	1	2	32.0	0.0	
Schoharie	1	4	55.0	37.0	
Sullivan	6	9	235.5	158.5	
Ulster	1	1	200.0	200.0	
Hudson River	2	3	50.0	0.0	0.0
Columbia	1	1	21.0	0.0	
Dutchess	1	2	29.0	0.0	
North Country	1	4	50.0	0.0	0.0
Jefferson	1	4	50.0	0.0	

(continued)

Table 18: Acres planted, **silage** (continued)

Area County	# of growers	# of fields	Total acreage	Acres treated number	 % of total
Southern Tier	65	115	3,175.0	579.0	18.2
Cattaraugus	1	1	80.0	0.0	
Chautauqua	16	18	652.0	122.0	
Chemung	2	2	85.0	0.0	
Cortland	11	17	791.5	250.0	
Steuben	32	74	1,167.5	207.0	
Tompkins	2	2	57.0	0.0	
Wyoming	1	1	42.0	0.0	
Upstate	17	24	2,204.6	760.0	34.5
Cayuga	9	10	955.0	700.0	
Erie	1	2	19.6	0.0	
Onondaga	4	8	484.0	60.0	
Oswego	1	1	65.0	0.0	
Seneca	1	2	47.0	0.0	
Wayne	1	1	634.0	0.0	
Totals	104	191	6,207.1	1,734.5	27.9

Table 19 shows a summary of insecticides used by New York State growers on corn grown for grain in 1994. Only 35 growers applied insecticide to their grain corn crop. Tefluthrin (Force) was used on the greatest number of acres (37.8% of insecticide treated acreage), and the greatest amount of active ingredient applied (2,546.9 lbs.) was chlorpyrifos. There was a total of 5,533.4 lbs. insecticide active ingredient applied to 6,151.4 acres of corn for grain, making an average of 0.9 lbs. ai applied per acre in 1994. The greatest amount of ai/acre was applied in the Southern Tier (1.19 lbs/acre), followed by the Upstate area (0.92 lbs/acre, Figure 9).

Table 19: Summary of insecticides used by New York State growers who grew corn for **grain** in 1994 by active ingredient (35 growers)

Active Ingredient Trade name	# of growers	# of fields	Acres treated	% of treated acres	Average am't of product used (lb or gal)	Am't of ai applied (lb)
tefluthrin	**14**	**24**	**2,322.6**	**37.8**		**416.9**
Force 1.5 (dry)	11	20	1,828.0		10.29	282.2
Force 3G (dry)	3	4	494.6		9.08	134.7
chlorpyrifos	**11**	**24**	**1,682.3**	**27.3**		**2,564.9**
Lorsban 15G (dry)	8	17	1,457.3		9.57	2,090.8
Lorsban 4E (liquid)	3	7	225.0		0.53	474.1
terbufos	**8**	**11**	**1,239.5**	**20.1**		**2,027.6**
Counter 15G (dry)	6	8	949.5		9.51	1,354.8
Counter 20CR (dry)	2	3	290.0		11.6	672.8
carbofuran	**1**	**1**	**744.0**	**12.0**		**372.0**
Furadan 4F (liquid)	1	1	744.0		0.13	372.0
fonofos	**1**	**2**	**90.0**	**1.5**		**90.0**
Dyfonate 20-G (dry)	1	2	90.0		5.0	90.0
phorate	**1**	**1**	**70.0**	**1.1**		**56.0**
Thimet 20-G (dry)	1	1	70.0		4.0	56.0
carbaryl	**1**	**1**	**3.0**	**0.5**		**6.0**
Sevin 80S (dry)	1	1	3.0		2.5	6.0
					Total	**5,533.4**

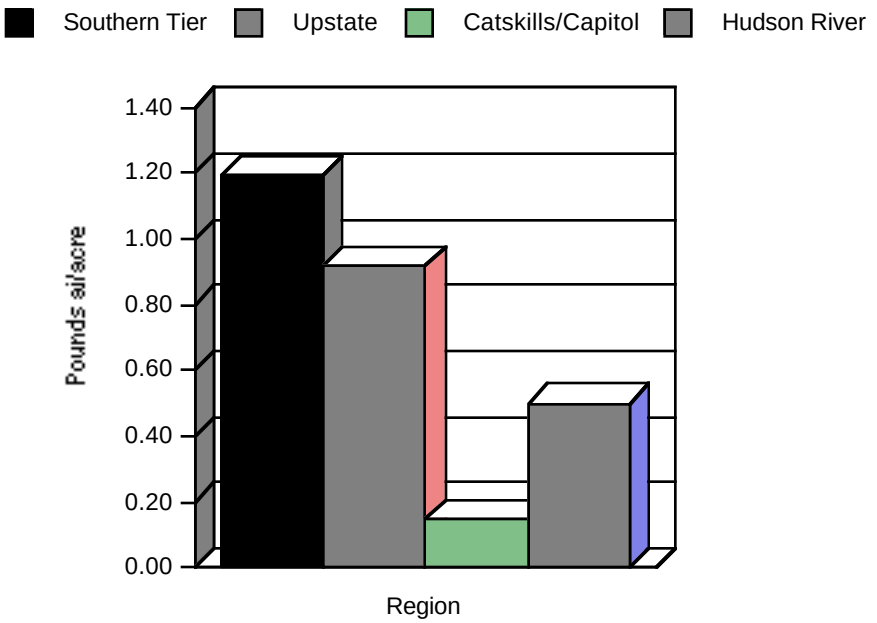


Figure 9: Pounds of insecticide active ingredient applied per acre to corn grown for **grain** in New York in 1994 by region

Table 20 shows who applied the insecticides, the application equipment used, the timing and method of application, and the basis for application of insecticides applied to field corn grown for grain in New York in 1994. One hundred percent of insecticides were applied by the grower. A planter box was used almost exclusively for applying insecticides. They were applied at planting (89.1% of fields, 85.3% of treated acreage), and were banded (71.9% of fields, 70.3% of treated acreage). The most common reasons that insecticides were applied were "routine application" (50.0% of fields, 70.3% of treated acreage) and "presence of pest on the basis of scouting" (48.4% of fields, 51.7% of treated acreage).

Table 20: Who applied, application equipment, timing, method and basis of application used by New York State growers applying insecticides to corn grown for **grain** in 1994 (35 growers)

Action	# of fields	% of fields	# of acres	% of treated acres
Who applied				
Grower	64	100.0	6,151.4	100.0
Application Equipment				
Planter box	30	98.4	6,148.4	99.95
Boom sprayer	1	1.6	3.0	0.05
Timing				
At planting	57	89.1	5,244.4	85.3
Preplant surface	1	1.6	744.0	12.1
Preplant incorporated	5	7.8	160.0	2.6
Postemergence	1	1.6	3.0	0.05

(continued)

Table 20: Application, **grain** (continued)

Action	# of fields	% of fields	# of acres	% of treated acres
Method				
Banded	46	71.9	4,327.4	70.3
In furrow	12	18.8	1,983.5	32.2
Not specified	4	6.3	120.0	2.0
Broadcast	1	1.6	40.0	0.7
Spot	1	1.6	3.0	0.05
Basis for application				
Routine application	32	50.0	4,324.4	70.3
Presence of pest on the basis of scouting	31	48.4	3,179.6	51.7
Advice from CMA or consultant	11	17.2	466.6	7.6
Advice from Cooperative Extension	5	7.8	409.6	6.7
Appearance of crop	1	1.6	150.0	0.2
Previous pest problem/field history	1	1.6	140.0	2.3
Not specified	4	6.3	92.0	1.5

Table 21 shows a summary of insecticides used by New York State growers on corn grown for silage in 1994. Twenty-three growers applied insecticide to their silage corn crop. As with corn for grain, tefluthrin (Force) was applied to the greatest number of acres (54.7% of treated acreage), but unlike corn for grain, the greatest amount of active ingredient applied (787.3 lbs) was terbufos. There was a total of 1,182.6 lbs insecticide active ingredient applied to 1,734.5 acres of corn for silage, making an average of 0.68 lbs ai applied per acre in 1994. The greatest amount was applied in the Upstate area (1.06 lbs ai/acre, Figure 10).

Table 21: Summary of insecticides used by New York State growers who grew corn for **silage** in 1994 by active ingredient (23 growers)

Active Ingredient Trade name	# of growers	# of fields	Acres treated	% of treated acres	Average am't of product used (lb or gal)	Am't of ai applied (lb)
tefluthrin	**11**	**13**	**948.0**	**54.7**		**143.3**
Force 1.5 (dry)	8	10	746.0		8.81	98.6
Force 3G (dry)	3	3	202.0		7.38	44.7
terbufos	**6**	**9**	**535.0**	**30.8**		**787.3**
Counter 15G (dry)	6	9	535.0		9.81	787.3
chlorpyrifos	**5**	**6**	**203.5**	**11.7**		**200.4**
Lorsban 15G (dry)	5	6	203.5		6.57	200.4
fonofos	**1**	**1**	**36.0**	**2.1**		**36.0**
Dyfonate 20-G (dry)	1	1	36.0		5.0	36.0
phorate	**1**	**2**	**12.0**	**0.7**		**15.6**
Thimet 20-G (dry)	1	2	12.0		5.0	15.6
					Total	**1,182.6**

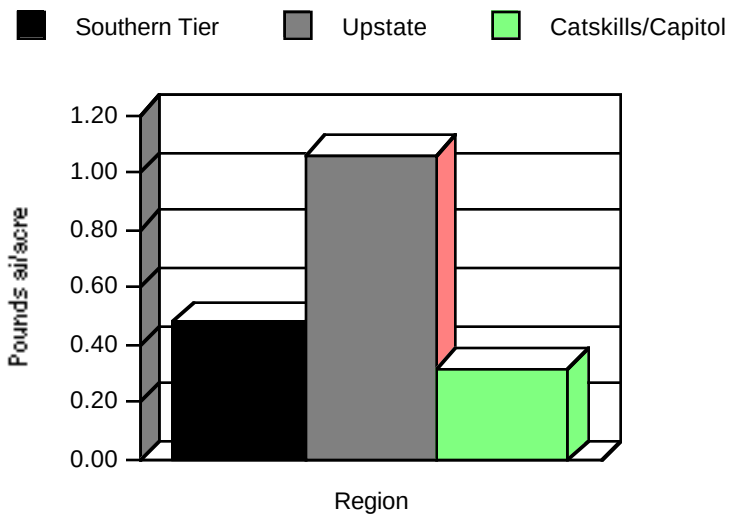


Figure 10: Pounds of insecticide active ingredient applied per acre to field corn grown for silage in New York in 1994 by region

Table 22 shows who applied the insecticides, the application equipment used, the timing and method of application, and the basis for application of insecticides applied to field corn grown for silage in New York in 1994. Ninety-seven percent of the fields, and 99.3% of the treated acreage were sprayed by the grower using a planter box. The insecticides were applied at planting (93.5% of fields, 95.4% of treated acreage), and were banded (67.7% of fields, 77.9% of treated acreage). The most common reason insecticides were applied to a particular field was "presence of pest on the basis of scouting" (54.8%). A cost comparison of insecticides used in field corn production is shown in Table 23.

Table 22: Who applied, application equipment, timing, method and basis of application used by New York State growers applying insecticides to corn grown for **silage** in 1994 (23 growers)

Action	# of fields	% of fields	# of acres	% of treated acres
Who applied				
Grower	30	96.8	1,722.5	99.3
Custom applicator	1	3.2	12.0	.7
Application Equipment				
Planter box	30	96.8	1,714.5	98.8
Boom sprayer	1	3.2	20.0	1.2
Timing				
At planting	29	93.5	1,654.5	95.4
Preplant incorporated	1	3.2	60.0	3.5
Preplant surface	1	3.2	20.0	1.2
Method				
Banded	21	67.7	1,352.0	77.9
In furrow	9	29.0	322.5	18.6
Broadcast	1	3.2	60.0	3.5
Basis for application				
Presence of pest on the basis of scouting	17	54.8	873.0	50.3
Advice from CMA or consultant	3	9.7	499.0	28.8
Advice from Cooperative Extension	2	6.5	480.0	27.7
Previous pest problem/field history	1	3.2	340.0	19.6
Not specified	8	25.8	309.0	17.8
Routine application	5	16.1	229.5	17.3

Table 23: Cost comparison of insecticides used in field corn production

Trade name	Active Ingredient	Average rate/A (lbs of ai)[a/]	Median cost/lb of ai[b/]	Cost per acre per application
Counter 15G	terbufos	1.45	$10.67	$15.47
Counter 20CR	terbufos	2.32	10.60	24.59
Dyfonate 20-G	fonofos	1.00	9.65	9.65
Force 1.5	tefluthrin	0.19	108.67	20.65
Force 3G	tefluthrin	0.25	108.67	27.17
Furadan 4F	carbofuran	0.52	12.50	6.25
Lorsban 15G	chlorpyrifos	1.21	10.07	12.18
Lorsban 4E	chlorpyrifos	2.12	10.90	23.11
Sevin 80S	carbaryl	2.00	5.56	11.12
Thimet 20-G	phorate	0.90	8.45	7.60

a/ Based on what was reported by growers in this survey

b/ Price obtained from "AGCHEMPRICE Current U.S.A. Prices of Non-Fertilizer Agricultural Chemicals," June 1994. Published by DPRA Incorporated.

Table 24 shows a comparison of rotation on the percent of field corn acres treated with insecticides in New York in 1994. One would expect that the need for insecticide treatments would be less in first and second year corn versus third and continuous corn. This is the pattern for corn grown for silage, but in corn grown for grain, 37.2% of the total 1st year corn acreage was treated with insecticides versus only 29.4% of 3rd year corn acreage. This same pattern appears when comparing pounds of insecticide active ingredient applied per acre (Figure 11). Pounds active ingredient per acre for third year corn for grain is much higher than the others (2.62 lbs/acre), but the amount applied to continuous corn (0.76 lbs/acre) is less than both first and second year corn (1.06 and 1.0 lbs/acre, respectively). The same is true for corn for silage, but the difference is greater. One half pound, and one-quarter pound less active ingredient per acre was applied to continuous corn versus first and second year corn, respectively.

Table 24: Comparison of rotation on percent of total acres planted to field corn that were treated with insecticides in NYS in 1994

Corn type Rotation	# of growers	# of fields	Total acreage	Acres treated number	Acres treated percent
Grain					
1st year corn	56	77	4,282.6	1,593.5	37.2
2nd year corn	32	37	1,278.8	302.1	23.6
3rd year corn	26	34	1,383.0	407.0	29.4
Continuous corn	44	65	4,734.8	3,548.8	75.0
No answer	2	2	305.0	300.0	98.4
Silage					
1st year corn	50	69	1,850.1	61.0	3.3
2nd year corn	31	38	990.0	248.0	24.6
3rd year corn	28	34	1,014.0	475.5	46.9
Continuous corn	42	48	2,103.0	700.0	33.6
No answer	1	1	250.0	250.0	100.0

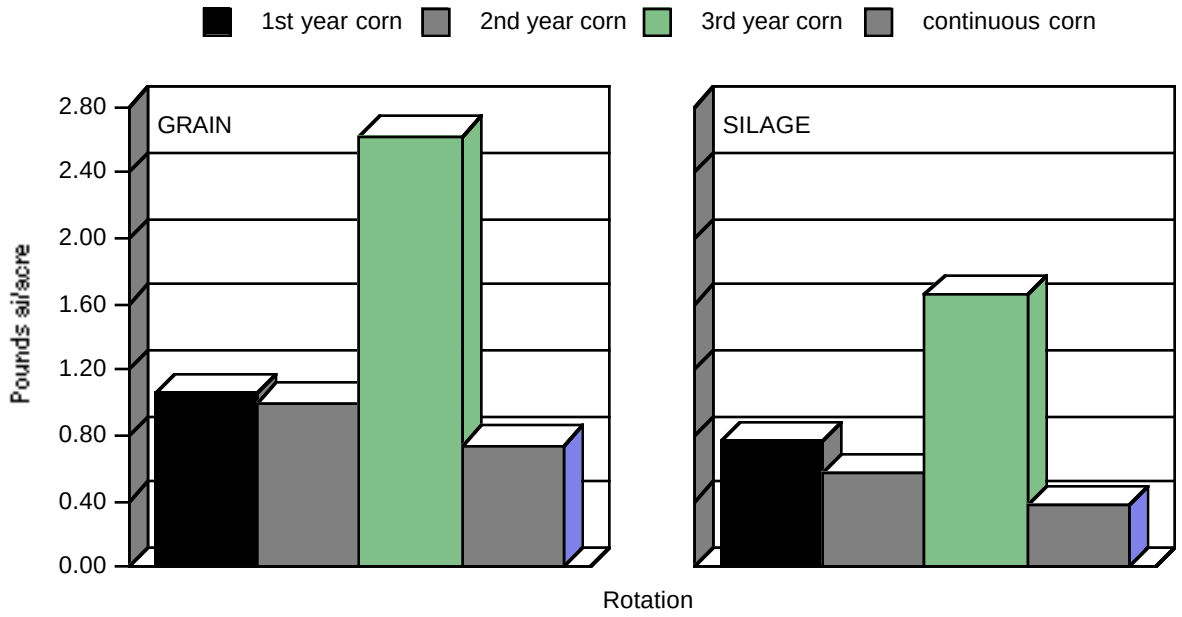


Figure 11: Pounds of insecticide active ingredient applied per acre to field corn in New York in 1994 by rotation

Table 25 shows a comparison of type of tillage used on the percent of field corn acreage that was treated with insecticides. Corn grown for grain and for silage show the same pattern in regard to percent of acres treated based on tillage. Growers using no-till systems treated little to no acreage with insecticides, while growers using conservation tillage systems treated 12 to 24% more acreage than those with conventional tillage systems. The amount of active ingredient applied to corn grown for grain appears to be inversely related to the percent of acreage treated. That is, no-till corn for grain had 1.76 lbs ai/acre applied, versus 0.57 lbs ai/acre applied to corn grown with conservation tillage (Figure 12). Amount of active ingredient applied to corn for silage was about the same regardless of the tillage system used.

Table 25: Comparison of tillage on percent of total acres planted to field corn that were treated with insecticides in NYS in 1994

Corn type Tillage	# of growers	# of fields	Total acreage	Acres treated number	 percent
Grain					
Conventional	90	154	6,404.6	2,653.6	41.4
Conservation	32	54	5,257.1	3,446.8	65.6
No-till	5	5	311.5	40.0	12.8
Silage					
Conventional	81	140	3,823.5	889.0	23.3
Conservation	27	44	2,315.6	822.0	35.5
No-till	2	4	48.0	0.0	0.0

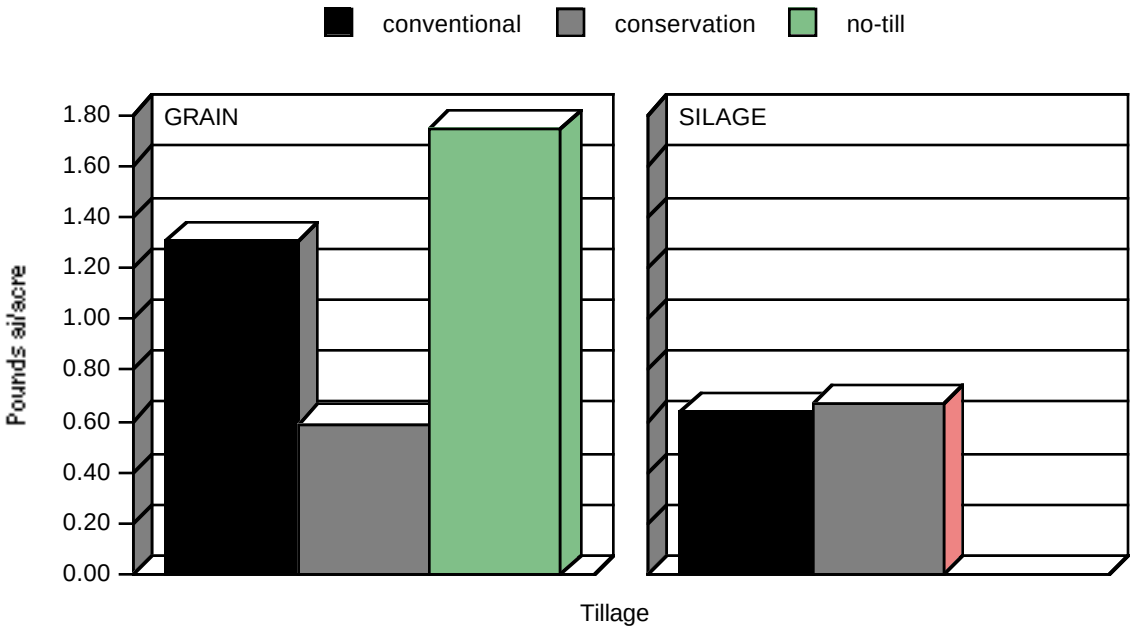


Figure 12: Pounds insecticide active ingredient applied per acre to field corn in New York in 1994 by tillage

Table 26 shows the types of insects for which New York State growers treated corn for grain in 1994. Corn rootworm larval stage, was the major insect for which growers treated. More than half of the acreage was treated in order to control corn rootworm. This was true for all active ingredients used except carbofuran and carbaryl. The same pattern applies to corn for silage (Table 27), where greater than three-quarters of the treated acreage was treated to control corn rootworm, except with the active ingredient chlorpyrifos, where cutworms were the major insect pest.

Table 26: Summary of insects treated for by New York State growers who grew corn for **grain** in 1994 by active ingredient (35 growers)

Active Ingredient Insect	# of growers	# of fields	% of fields	Acres treated	% of acres
tefluthrin	**14**	**24**		**2,322.6**	
Corn rootworm (larval)		16	66.7	1,635.6	70.4
Cutworms		8	33.3	1,287.6	55.4
No answer		4	16.7	465.0	20.0
Corn earworm		3	12.5	119.6	5.1
Seedcorn maggot		4	16.7	58.0	2.5
Wireworms		4	16.7	30.6	1.3
Slugs		2	8.3	27.0	1.2
European corn borer		2	8.3	19.6	0.8
chlorpyrifos	**11**	**24**		**1,682.3**	
No answer		3	12.5	975.0	58.0
Corn rootworm (larval)		21	87.5	707.3	42.0
Corn rootworm (adult)		1	4.2	150.0	8.9
Nematodes		1	4.2	150.0	8.9
Cutworms		8	33.3	131.0	7.8
Wireworms		8	33.3	131.0	7.8

(continued)

Table 26: Insects, **grain** (continued)

Active Ingredient Insect	# of growers	# of fields	% of fields	Acres treated	% of acres
terbufos	**8**	**11**		**1,239.5**	
Corn rootworm (larval)		8	72.7	1,101.5	88.9
Corn rootworm (adult)		1	9.1	240.0	19.4
Wireworms		2	18.2	190.0	15.3
No answer		3	27.3	138.0	11.1
Cutworms		1	9.1	8.0	0.6
Maize billbugs		1	9.1	8.0	0.6
carbofuran	**1**	**1**		**744.0**	
European corn borer		1	100.0	744.0	100.0
Cutworms		1	100.0	744.0	100.0
fonofos	**1**	**2**		**90.0**	
Corn rootworm (larval)		2	100.0	90.0	100.0
Cutworms		2	100.0	90.0	100.0
phorate	**1**	**1**		**70.0**	
No answer		1	100.0	70.0	100.0
carbaryl	**1**	**1**		**3.0**	
Corn earworm		1	100.0	3.0	100.0

Table 27: Summary of insects treated for by New York State growers who grew corn for **silage** in 1994 by active ingredient (23 growers)

Active Ingredient Insect	# of growers	# of fields	% of fields	Acres treated	% of acres
tefluthrin	**11**	**13**		**948.0**	
Corn rootworm (larval)		6	54.5	683.0	72.0
Corn earworm		1	9.1	200.0	21.1
Corn rootworm (adult)		2	18.2	152.0	16.0
No answer		2	18.2	150.0	15.8
Cutworms		1	9.1	80.0	8.4
Seedcorn maggot		4	36.4	43.0	4.5
Wireworms		3	27.3	23.0	2.4
terbufos	**6**	**9**		**535.0**	
Corn rootworm (larval)		4	44.4	475.0	88.8
Corn rootworm (adult)		1	11.1	70.0	13.1
European corn borer		2	22.2	40.0	7.5
No answer		3	33.3	20.0	3.7
chlorpyrifos	**5**	**6**		**203.5**	
Cutworms		2	33.3	86.0	42.3
No answer		1	16.7	60.0	29.5
Corn rootworm (adult)		2	33.3	43.5	21.4
Corn rootworm (larval)		2	33.3	26.0	12.8
Wireworms		1	16.7	12.0	5.9
fonofos	**1**	**1**		**36.0**	
Corn rootworm (larval)		1	100.0	36.0	100.0
Cutworms		1	100.0	36.0	100.0
phorate	**1**	**2**		**12.0**	
Corn rootworm (larval)		2	100.0	12.0	100.0

Figure13 illustrates the percent of acreage treated with insecticides for specific insect pests by area of the State. Maize billbugs, nematodes, and slugs were only a problem in the Southern Tier in corn grown for grain, while they were not even indicated as a pest in corn grown for silage. Upstate New York (for both grain and silage) only had a major problem with corn rootworms, while the other areas had more insect pests for which they applied insecticides.

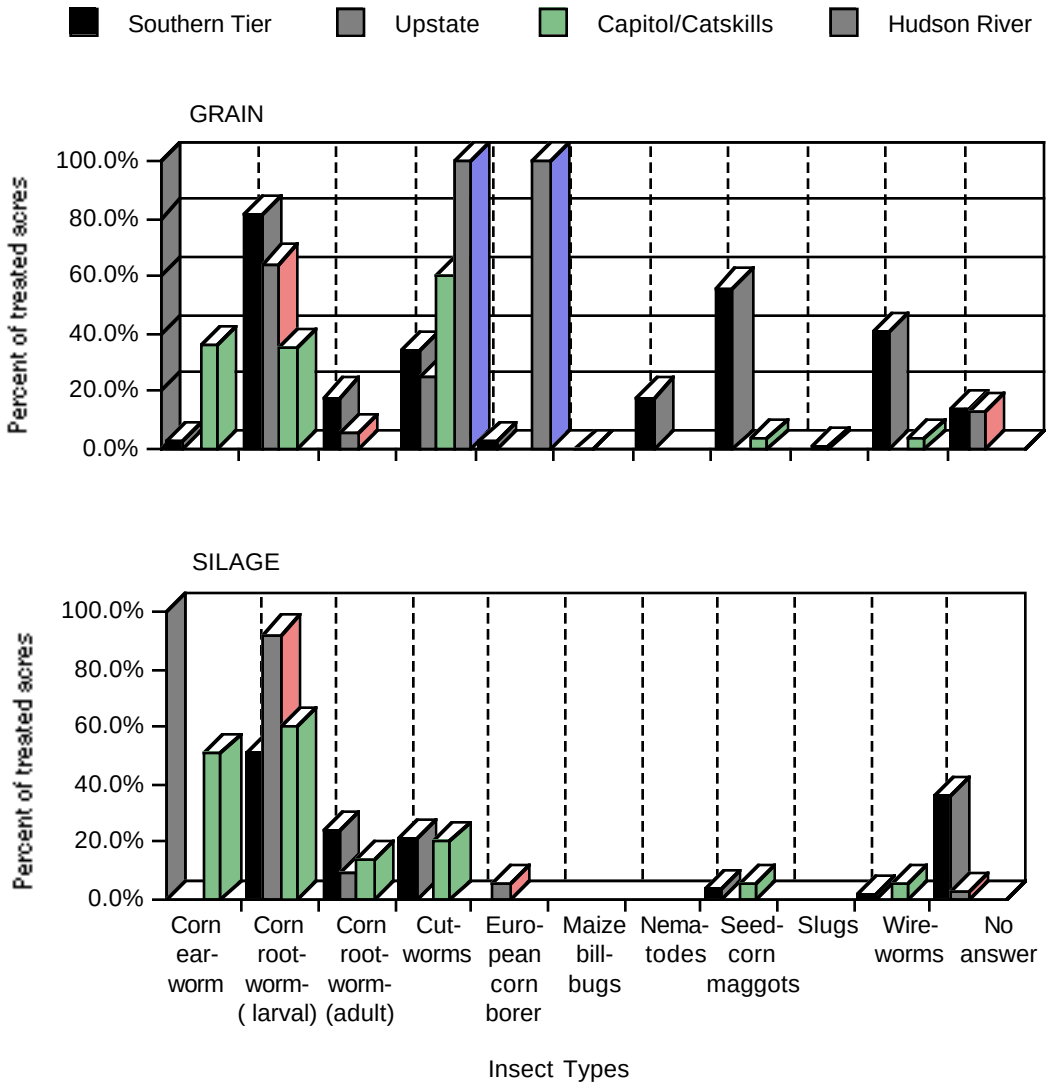


Figure 13: Type of insects for which New York State growers treated corn by region

The effect of rotation on types of insect pests is illustrated in Figure 14 for both types of corn. As expected, corn rootworms (larval stage) appear to be a bigger problem in third year and continuous corn versus first and second year corn.

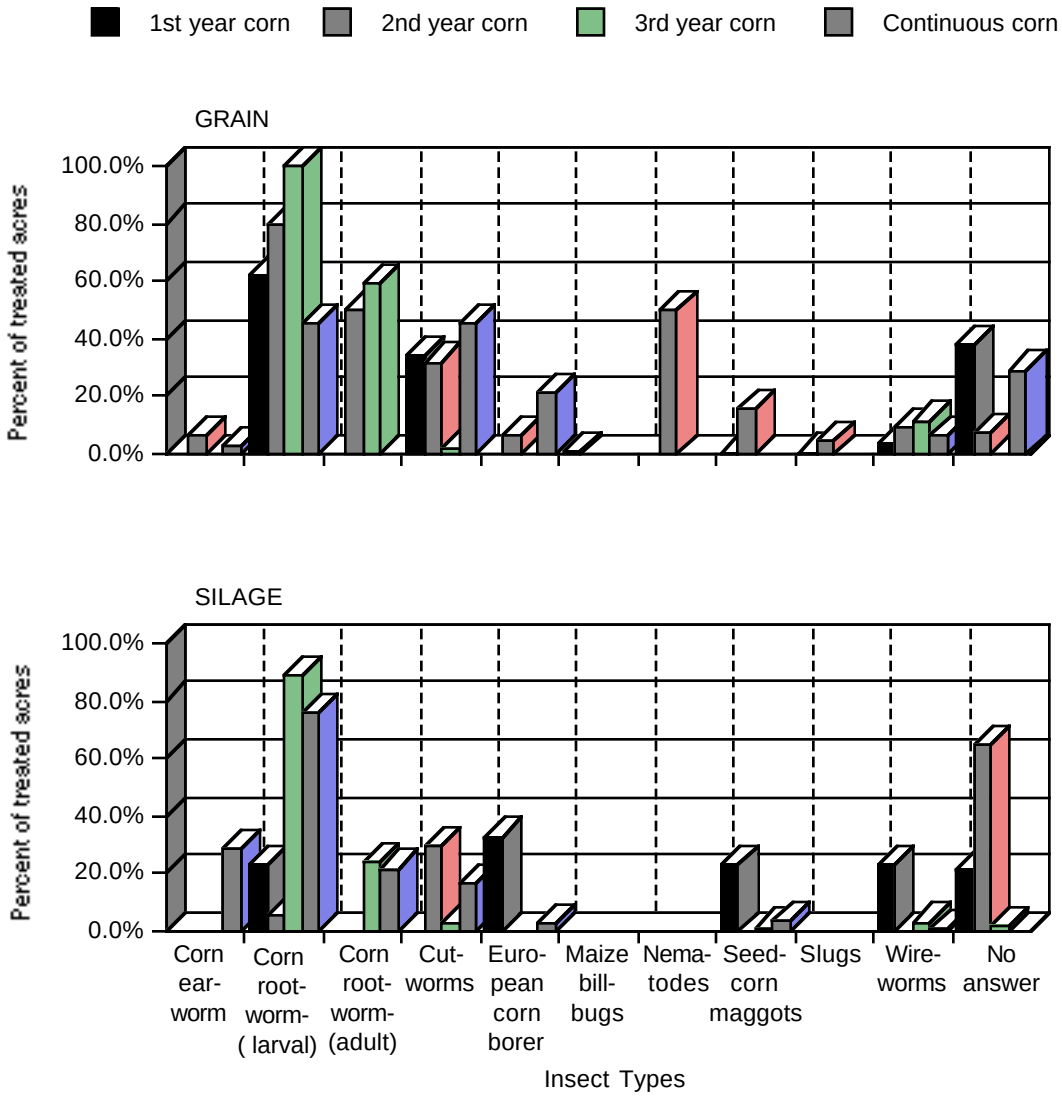


Figure 14: Type of insects for which New York growers treated field corn in 1994 by rotation

The effect of type of tillage on insect pests appears to be that corn grown in conventional tillage systems are treated for more types of insect pests than conservation or no-till systems (Figure 15). The large number of missing answers for the question of what insects the insecticides were applied for indicates that growers probably did not know which insects were a problem. The fact that the majority of insecticide applications were made as "routine applications" confirms this.

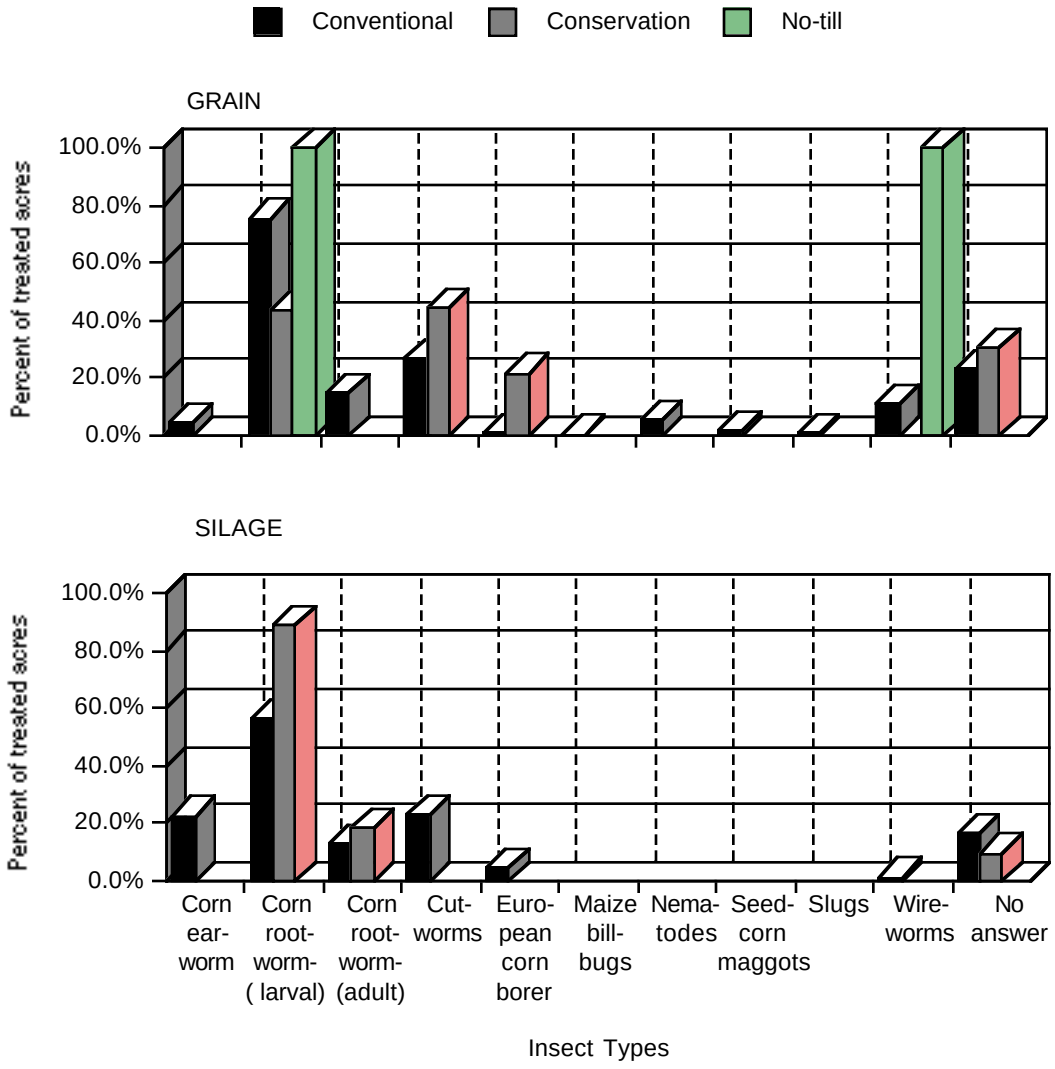


Figure 15: Types of insects for which New York growers treated field corn in 1994 by tillage

SEED TREATMENT

According to the 1994 Cornell Recommends for Integrated Field Crop Management, diseases of corn constitute an important production constraint. They can reduce yield and the quality of grain and silage. Chemical control, though, plays a minor role in the management of corn diseases. With the exception of seed treatment, disease management involves the selection of hybrids with genetic resistance and adoption of sound crop management practices. Growers who pruchase untreated seed are urged to apply a fungicide seed treatment at or before planting to protect from seed decay, seedling blight and damping off caused by fungi on seed or in the soil.

As already discussed in the demographics section of this paper, approximately 85% of the corn planted (both grain and silage) was purchased as pre-treated seed. However, 42.1% of the acreage planted to corn grown for grain was treated with an additional seed treatment (Table 28). The least amount of acreage with a seed treatment applied by the grower was in the Upstate area (35.3%) and the most was in the Hudson River area (92.1%). Less acreage was planted with corn that was treated with a seed treatment by the grower when the corn was grown for silage (37.6%, Table 29). Other than the North Country area where 100% of the acreage was planted with seed treated by the grower, the other areas had treated seed planted on only 35-45% of the acreage.

Table 28: Percent of total acres planted to field corn grown for **grain** that were treated with seed treatments in NYS in 1994 (114 growers)

Area County	# of growers	# of fields	Total acreage	Acres treated number	 % of total
Catskills/Capitol	8	11	418.0	270.0	64.6
Delaware	1	1	10.0	0.0	
Sullivan	6	9	308.0	270.0	
Ulster	1	1	100.0	0.0	
Hudson River	4	6	809.0	745.0	92.1
Columbia	3	3	762.0	745.0	
Dutchess	1	3	47.0	0.0	
Southern Tier	54	110	3,056.8	1,312.9	43.0
Alleghany	1	1	40.0	0.0	
Chautauqua	11	18	395.2	235.2	
Chemung	1	1	100.0	0.0	
Cortland	5	15	421.2	150.0	
Steuben	26	57	1,219.5	574.5	
Tioga	1	1	12.0	0.0	
Tompkins	8	16	836.9	321.2	
Wyoming	1	1	32.0	32.0	
Upstate	48	88	7,700.4	2,718.6	35.3
Cayuga	30	55	5,604.0	2,006.0	
Erie	1	3	20.6	20.6	
Livingston	2	3	239.0	14.0	
Onondaga	7	10	711.0	421.0	
Ontario	1	3	38.0	38.0	
Oswego	2	3	77.0	0.0	
Seneca	3	5	450.0	219.0	
Wayne	1	1	272.0	0.0	
Yates	1	5	288.8	0.0	
Totals	114	215	11,984.2	5,046.5	42.1

Table 29: Percent of total acres planted to field corn grown for **silage** that were treated with seed treatments in NYS in 1994 (104 growers)

Area County	# of growers	# of fields	Total acreage	Acres treated number	 % of total
Catskills/Capitol	19	45	727.5	329.0	45.2
Chenango	1	3	26.0	0.0	
Delaware	9	26	179.0	119.0	
Madison	1	2	32.0	0.0	
Schoharie	1	4	55.0	55.0	
Sullivan	6	9	235.5	155.0	
Ulster	1	1	200.0	0.0	
Hudson River	2	3	50.0	21.0	42.0
Columbia	1	1	21.0	21.0	
Dutchess	1	2	29.0	0.0	
North Country	1	4	50.0	50.0	100.0
Jefferson	1	4	50.0	50.0	
Southern Tier	65	115	3,175.0	1,168.0	36.8
Cattaraugus	1	1	80.0	0.0	
Chautauqua	16	18	652.0	109.0	
Chemung	2	2	85.0	0.0	
Cortland	11	17	791.5	451.0	
Steuben	32	74	1,167.5	544.0	
Tompkins	2	2	57.0	22.0	
Wyoming	1	1	42.0	42.0	
Upstate	17	24	2,204.6	766.6	34.8
Cayuga	9	10	955.0	660.0	
Erie	1	2	19.6	19.6	
Onondaga	4	8	484.0	40.0	
Oswego	1	1	65.0	0.0	
Seneca	1	2	47.0	47.0	
Wayne	1	1	634.0	0.0	
Totals	104	191	6,207.1	2,334.6	37.6

Table 30 summarizes seed treatments used by New York State growers on corn grown for grain in 1994. Forty-seven growers treated their corn seed with a seed treatment. The combination of carboxin, diazinon and lindane (Germate Plus) was used on over half of the treated acres (57.6%), but the greatest amount of active ingredient applied (1,754.9 lbs) was captan. There was a total of 3,830.4 lbs seed treatment active ingredient applied to 5,046.5 acres of corn for grain, making an average of 0.76 lbs ai applied per acre in 1994. The greatest amount of ai applied per acre was in the Hudson River area where 2.2 lbs seed treatment active ingredient was applied per acre of corn grown for gain (Figure 16).

Table 30: Summary of seed treatments used by New York State growers who grew corn for **grain** in 1994 by active ingredient (47 growers)

Active Ingredient Trade name	# of growers	# of fields	Acres treated	% of acres treated	Average seeding rate	Average am't of product used (lb or gal)	Am't of ai applied (lb)
carboxin, diazinon, lindane	**22**	**46**	**2,908.5**	**57.6**			**1,369.3**
Germate Plus (dry)	22	46	2,908.5		27,915.2	3.7	1,369.3
captan, lindane	**5**	**8**	**794.0**	**15.7**			**423.6**
Isotox Seed Treater-F (dry)	5	8	794.0		27,875.0	6.1	423.6
captan	**3**	**3**	**759.0**	**15.0**			**1,754.9**
Captan 300 (liquid)	2	2	749.0		27,800.0	2.4	1,751.1
Captan 30-DD (liquid)	1	1	10.0		10,000.0	1.5	3.8
captan, diazinon, lindane	**6**	**14**	**320.7**	**6.4**			**131.5**
Agrox D-L Plus (dry)	6	14	320.7		28,214.3	3.2	131.5
captan, diazinon	**12**	**21**	**264.3**	**5.2**			**151.1**
Blue Ribbon Protector (dry)	11	17	251.8		28,611.8	3.9	147.9
Agrox 2-Way (dry)	1	4	12.5		24,000.0	2.0	3.2
						Total	**3,830.4**

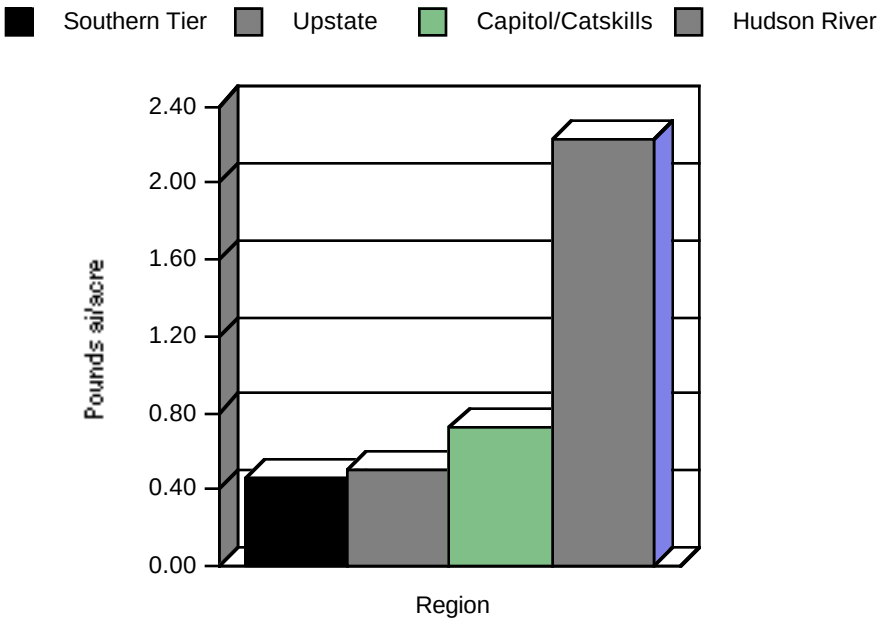


Figure 16: Pounds of seed treatment active ingredient applied per acre to corn grown for grain in New York in 1994 by region

Table 31 shows who applied the seed treatments, the application equipment used, the timing and the basis for application of seed treatments applied to field corn grown for grain in New York in 1994. From our survey, growers indicated that they used a planter box treatment on 95% of the fields and 94% of the acreage was treated at planting. The most common reason a seed treatment was used on corn grown for grain was "routine applicaiton" (68.5% of fields, 70.6% of treated acres).

Table 31: Who applied, application equipment, timing, and basis of application used by New York State growers applying seed treatments to corn grown for **grain** in 1994 (47 growers)

Action	# of fields	% of fields	# of acres	% of treated acres
Who applied				
Grower	87	94.6	4,983.5	98.8
Not specified	5	5.4	63.0	1.2
Application Equipment				
Planter box	92	100.0	5,046.5	100.0
Timing				
At planting	86	93.5	4,778.0	94.7
Before planting	6	6.5	268.5	5.3
Basis for application				
Routine application	63	68.5	3,561.3	70.6
Previous pest problem/field history	24	26.1	1,678.5	33.3
Advice from Cooperative Extension	23	25.0	894.2	17.7
Advice from CMA or consultant	13	14.1	560.7	11.1
Not specified	8	8.7	559.2	11.1
Weather	12	13.0	401.7	8.0
Corn comes up better	3	3.3	400.0	7.9

Table 32 shows a summary of seed treatments used by New York State growers on corn grown for silage in 1994. Thirty-six growers treated their corn seed with a seed treatment. As with corn for grain, the combination of carboxin, diazinon and lindane (Germate Plus) was used on over half of the treated acres (59.5%), but unlike corn for grain, that combination of active ingredients was also the greatest amount of ai applied (778.5 lbs). Captan alone was not applied to corn seed grown for silage. There was a total of 1,297.8 lbs seed treatment active ingredient applied to 2,334.6 acres of corn for silage, making an average of 0.56 lbs ai applied per acre in 1994. The greatest amount of ai applied per acre was in the Catskills/Capitol area where 0.72 lbs ai/acre was applied (Figure 17). This is one quarter pound per acre more than the other four areas.

Table 32: Summary of seed treatments used by New York State growers who grew corn for **silage** in 1994 by active ingredient (36 growers)

Active Ingredient Trade name	# of growers	# of fields	Acres treated	% of acres treated	Average seeding rate	Average am't of product used (lb)	Am't of ai applied (lb)
carboxin, diazinon, lindane	**14**	**25**	**1,388.0**	**59.5**			**778.5**
Germate Plus (dry)	14	25	1,388.0		29,176.0	4.3	778.5
captan, diazinon, lindane	**8**	**24**	**442.0**	**18.9**			**222.1**
Agrox D-L Plus (dry)	8	24	442.0		26,520.8	4.1	222.1
captan, diazinon	**10**	**20**	**284.6**	**12.2**			**184.8**
Blue Ribbon Protector (dry)	10	20	284.6		31,716.2	3.9	184.8
captan, lindane	**4**	**5**	**220.0**	**9.4**			**112.4**
Isotox Seed Treater-F (dry)	4	5	220.0		29,200.0	5.6	112.4
						Total	**1,297.8**

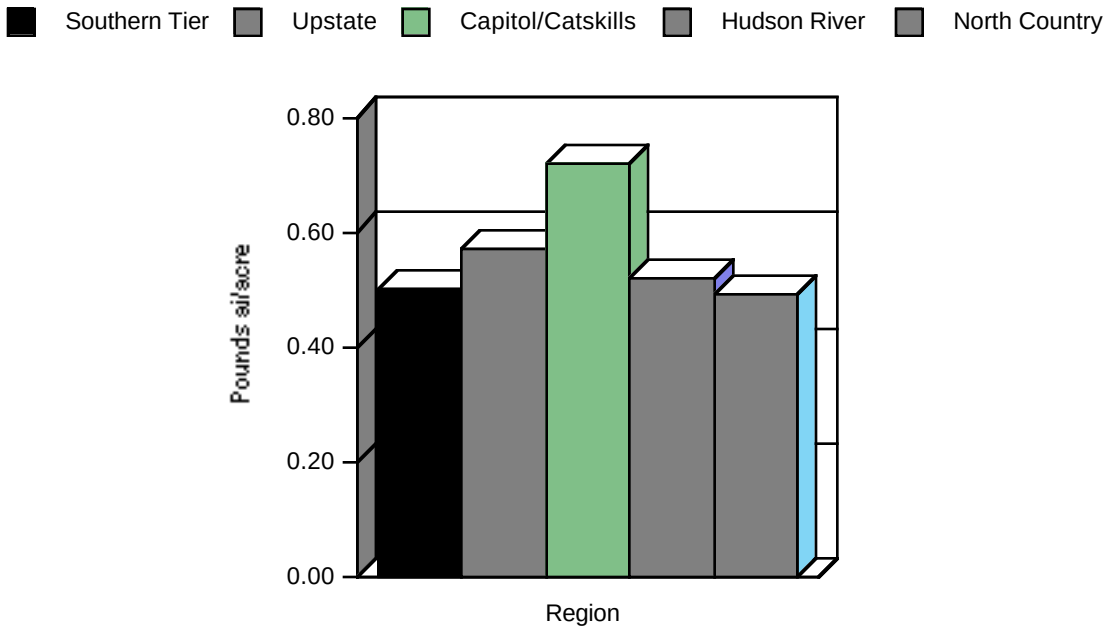


Figure 17: Pounds of seed treatment active ingredient applied per acre to field corn grown for silage in New York in 1994 by region

Table 33 shows who applied the seed treatments, the application equipment used, the timing and the basis for application of seed treatments applied to field corn grown for silage in New York in 1994. One hundred percent of seed treatments were applied by the grower and 100% were applied using a planter box. The seed treatments were applied most often at planting (91.9% of fields and 81.8% of treated acres). The most common reason for a seed treatment was "routine application" (86.5% of fields, 75.7% of acres). Almost half of the treated acreage was treated because of a previous pest problem in that field.

Table 33: Who applied, application equipment, timing, and basis of application used by New York State growers applying seed treatments to corn grown for **silage** in 1994 (36 growers)

Action	# of fields	%of fields	# of acres	% of treated acres
Who applied				
Grower	74	100.0	2,334.6	100.0
Application Equipment				
Planter box	74	100.0	2,334.6	100.0
Timing				
At planting	68	91.9	1,910.6	81.8
Before planting	6	8.1	424.0	18.2
Basis for application				
Routine application	64	86.5	1,767.6	75.7
Previous pest problem/field history	13	17.6	1,117.0	47.8
Advice from CMA or consultant	5	6.8	733.0	31.4
Weather	2	2.7	344.0	14.7
Advice from Cooperative Extension	9	12.2	270.0	11.6
Not specified	3	4.1	20.0	0.9

Table 34 shows a comparison of rotation on the percent of field corn acres treated with seed treatments in New York in 1994. No discernible pattern appears except that one-quarter to one-third of first and second year corn acreage were treated and one-third to one-half of third year and continuous corn acreage were treated for both types of corn. Figure 18 illustrates the amount of seed treatment active ingredient applied to field corn by rotation. Corn for grain grown continuously had more than twice as much active ingredient applied per acre than that grown as first or second year corn. There was little difference due to rotation in corn grown for silage.

Table 34: Comparison of rotation on percent of total acres planted to field corn that were treated with seed treatments in NYS in 1994

Corn type Rotation	# of growers	# of fields	Total acreage	Acres treated number	 percent
Grain					
1st year corn	56	77	4,282.6	1,491.2	34.8
2nd year corn	32	37	1,278.8	297.3	23.2
3rd year corn	26	34	1,383.0	576.0	41.6
Continuous corn	44	65	4,734.8	2,377.0	50.2
No answer	2	2	305.0	305.0	100.0
Silage					
1st year corn	50	69	1,850.1	490.6	26.5
2nd year corn	31	38	990.0	270.0	27.3
3rd year corn	28	34	1,014.0	558.0	55.0
Continuous corn	42	48	2,103.0	766.0	36.4
No answer	1	1	250.0	250.0	100.0

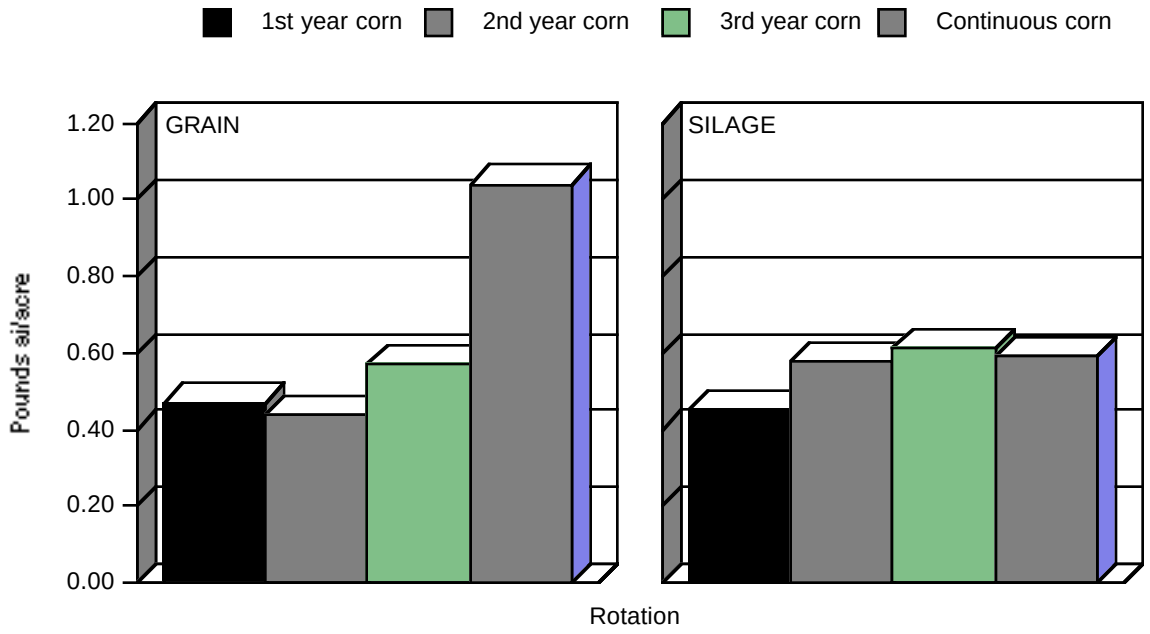


Figure 18: Pounds of seed treatment active ingredient applied per acre to field corn in New York in 1994 by rotation

Table 35 shows a comparison of the type of tillage used on the percent of field corn acreage that was treated with seed treatments. There was little difference between conventional and conservation tillage in corn grown for grain, while almost twice as much seed treatment active ingredient was applied per acre on corn for silage that was grown using conservation tillage versus conventional tillage. The small number of acres grown using a no-till system make comparisons less valid. The amount of seed treatment active ingredient applied per acre on corn in New York in 1994 is illustrated in Figure 19. Corn grown using a conservation tillage system had the most amount of active ingredient applied per acre, when corn was grown for grain.

Table 35: Comparison of tillage on percent of total acres planted to field corn that were treated with seed treatments in NYS in 1994

Corn type Tillage	# of growers	# of fields	Total acreage	Acres treated number	 percent
Grain					
Conventional	90	154	6,404.6	2,675.4	41.8
Conservation	32	54	5,257.1	2,321.6	44.2
No-till	5	5	311.5	49.5	15.9
Silage					
Conventional	81	140	3,823.5	1,126.0	29.4
Conservation	27	44	2,315.6	1,208.6	52.2
No-till	2	4	48.0	0.0	0.0

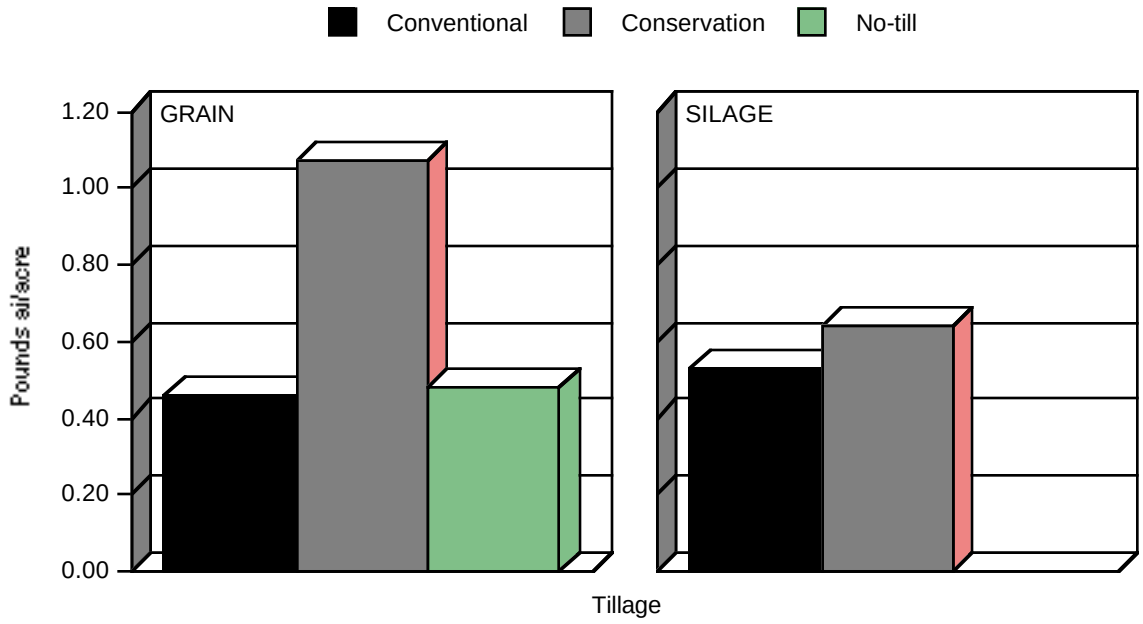


Figure 19: Pounds of seed treatment active ingredient applied per acre to field corn in New York in 1994 by tillage

Table 36 summarizes those pests that growers felt needed to be controlled by the use of a seed treatment on corn grown for grain. Seedcorn maggots were the most important pest indicated by growers. There does not appear to be one dominant pest for corn grown for silage (Table 37).

Table 36: Summary of pests treated for by New York State growers who grew corn for **grain** in 1994 by seed treatment active ingredient (47 growers)

Active Ingredient Pest	# of growers	# of fields	% of fields	Acres treated	% of treated acres
carboxin, diazinon, lindane	**22**	**46**		**2,908.5**	
Seedcorn maggots		35	76.1	2,177.5	74.9
Wireworms		22	47.8	1,042.0	35.8
No answer		4	8.7	501.0	17.2
Nematodes		1	2.2	500.0	17.2
Seedcorn beetles		6	13.0	399.0	13.7
Seed decay		7	15.2	270.0	9.3
Seed rots		3	6.5	314.0	10.8
Damping-off		4	8.7	120.0	4.1
Seedling blights		4	8.7	120.0	4.1
Common smut		5	10.9	63.0	2.2
Slugs and snails		4	8.7	50.0	1.7
Cutworms		1	2.2	25.0	0.9
captan, diazinon	**12**	**21**		**264.3**	
Seedcorn maggots		16	76.2	143.1	54.1
No answer		4	19.0	120.0	45.4
Seed decay		4	19.0	43.0	16.3
Wireworms		2	9.5	20.0	7.6
Nematodes		1	4.8	8.0	3.0
Seed rots		1	4.8	1.2	0.4
captan, diazinon, lindane	**6**	**14**		**320.7**	
Seedcorn maggots		12	85.7	307.7	95.9
Wireworms		9	64.3	281.0	87.6
Seedcorn beetle		1	7.1	97.0	30.2
Damping-off		4	28.6	34.0	10.6
Common smut		3	2.1	26.7	8.3
Corn rootworm (larval)		2	14.3	13.0	4.1
captan, lindane	**5**	**8**		**794.0**	
Seedcorn maggots		8	100.0	794.0	100.0
Seed decay		1	12.5	240.0	30.2
Seedling blights		1	12.5	240.0	30.2
Seed rots		1	12.5	240.0	30.2
Wireworms		2	25.0	47.0	5.9
captan	**3**	**3**		**759.0**	
Damping-off		1	33.0	744.0	98.0
Seed rots		1	33.0	744.0	98.0
Cutworms		1	33.0	10.0	1.3
No answer		1	33.0	5.0	0.7

Table 37: Summary of pests treated for by New York State growers who grew corn for **silage** in 1994 by seed treatment active ingredient (36 growers)

Active Ingredient Pest	# of growers	# of fields	% of fields	Acres treated	% of treated acres
carboxin, diazinon, lindane	**14**	**25**		**1,388.0**	
Seedcorn maggots		19	76.0	922.0	66.4
Wireworms		10	40.0	772.0	55.6
Seedcorn beetles		4	16.0	673.0	48.5
Seed decay		6	24.0	654.0	47.1
Seed rots		4	16.0	438.0	31.6
Common smut		1	4.0	286.0	20.6
Everything		2	8.0	65.0	4.7
No answer		1	4.0	21.0	1.5
captan, diazinon	**10**	**20**		**284.6**	
Wireworms		6	30.0	79.0	27.8
No answer		5	25.0	74.0	26.0
Don't know		3	15.0	73.0	25.7
Seedcorn maggots		7	35.0	62.6	22.0
Seed decay		1	5.0	4.0	1.4
captan, diazinon, lindane	**8**	**24**		**442.0**	
Seedcorn beetle		6	25.0	242.0	54.8
Seed decay		5	20.8	230.0	52.0
Seed rots		5	20.8	230.0	52.0
Wireworms		7	29.2	105.0	23.8
Corn rootworm (larval)		7	29.2	59.0	13.3
European cornborer		5	20.8	48.0	10.9
No answer		5	20.8	48.0	10.9
Seedcorn maggots		2	8.3	50.0	11.3
captan, lindane	**4**	**5**		**220.0**	
Seedcorn maggots		5	100.0	220.0	100.0
Seed decay		1	20.0	70.0	31.8
Seedling blights		1	20.0	70.0	31.8
Seed rots		1	20.0	70.0	31.8
Wireworms		2	40.0	33.0	15.0

Figure 20 illustrates the percent of acreage treated with seed treatments for specific pests by area of the State. For corn grown for grain, seed rots and damping off were a problem in the Hudson River area, while seed corn maggots were a problem in the other areas. For corn grown for silage, the dominant pests in Upstate and the North Country were seedcorn maggots and wireworms, while the other areas did not seem to have a dominant pest.

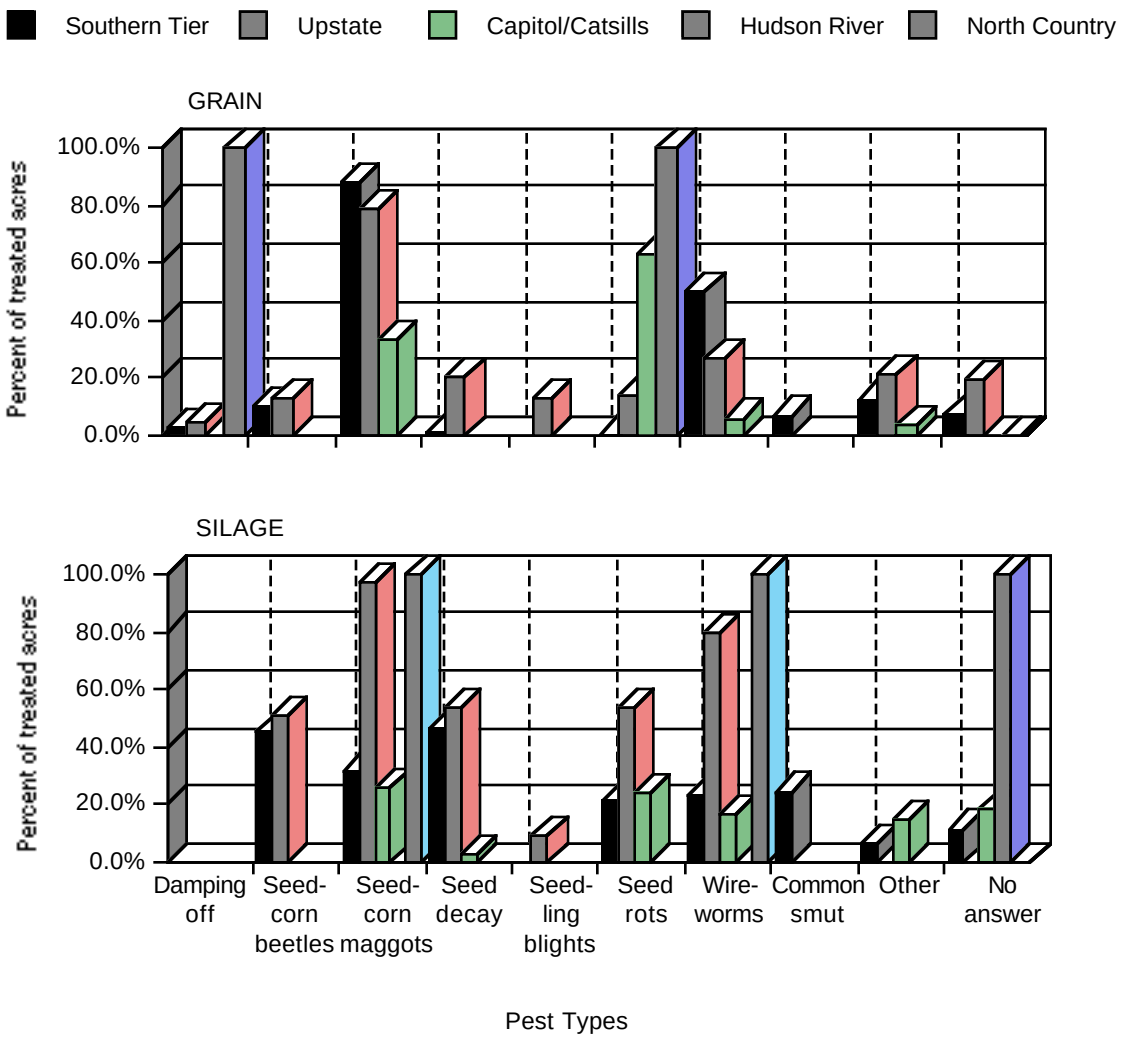


Figure 20: Type of pest for which New York State growers treated corn with seed treatments in 1994 by area

Figures 21 and 22 illustrate the percent of acreage treated with seed treatments for specific pests by rotation and tillage system, respectively. The large number of "no answers" (includes "don't knows"), indicates application of seed treatment without knowing why. The fact that the majority of seed treatments were made as "routine applications" confirms this.

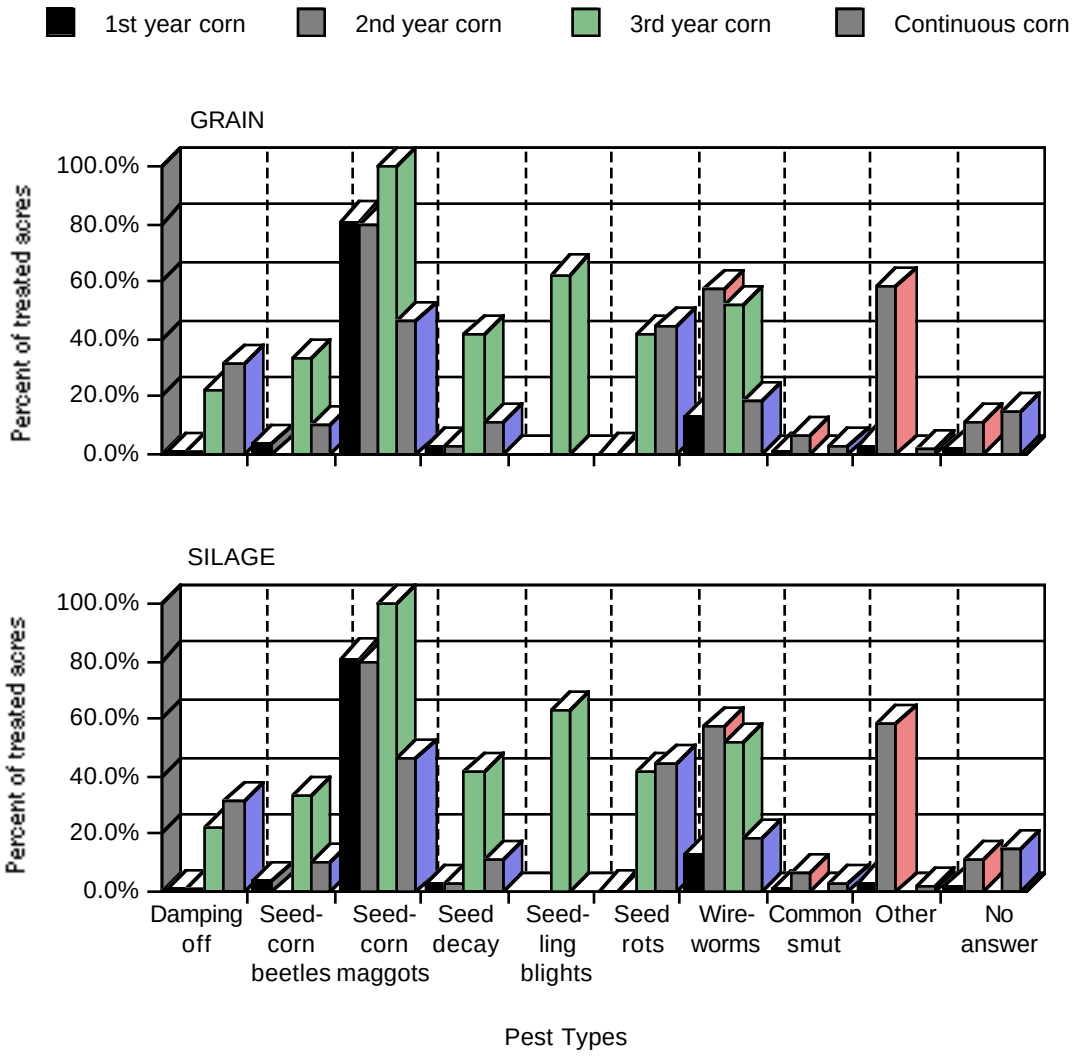


Figure 21: Type of pest for which New York State growers treated corn with seed treatments in 1994 by rotation

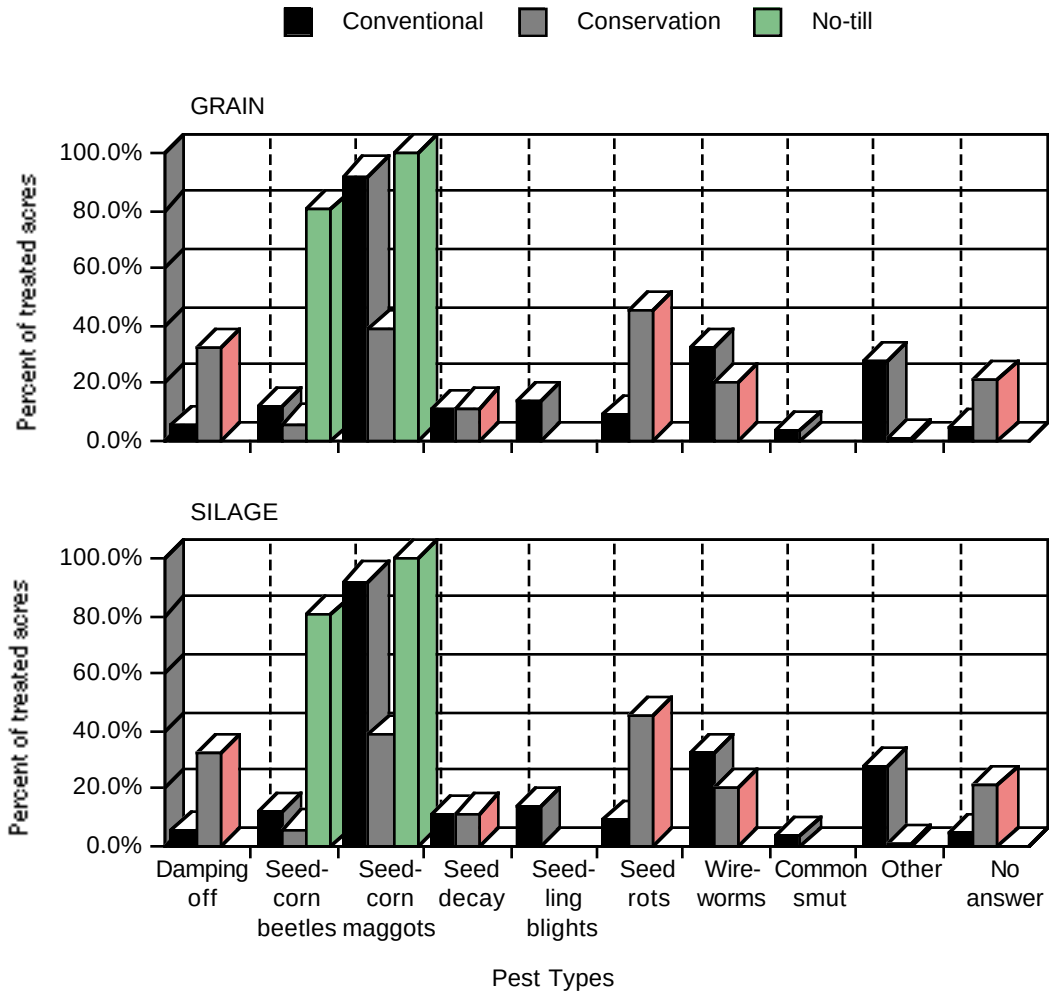


Figure 22: Type of pest for which New York State growers treated corn with seed treatments in 1994 by tillage

BIRD AND OTHER VERTEBRATE PEST CONTROL

Table 38 shows the number of growers who experienced bird or other vertebrate problems with their corn crop in New York in 1994. The majority of growers did not experience bird or other vertebrate problems, but of the two, other vertebrates were more of a problem (46.1%) than birds (32.9%). Of the 91 growers who experienced bird and/or other vertebrate problems in 1994, 85 (93.4%) did not use chemicals to control the problem (Table 39). The other six used Avitrol for birds, and Havoc or Starlicide for other vertebrates.

Table 38: Bird and other vertebrate problems indicated by New York field corn growers in 1994 (167 growers)

Pest Problem?	# of growers	% of growers	Pest Problem?	# of growers	% of growers
Birds			Vertebrates		
No	103	61.7	No	79	47.3
Yes	55	32.9	Yes	77	46.1
No answer	9	5.4	No answer	11	6.6

Table 39: Chemical control of birds or other vertebrates by New York field corn growers in 1994 (91 growers with bird and/or vertebrate problems)

Chemical	Pest controlled	# of growers	% of growers with bird or other vertebrate problems
No chemicals used		85	93.4
Avitrol	Birds	3	3.3
Havoc	Other vertebrates	2	2.2
Starlicide	Other vertebrates	1	1.1

Non-chemical control was used for control of birds and/or other vertebrates more often than chemical control (Table 40). Fifty-two (57.1%) of the growers who had bird and/or other vertebrate problems did not use any non-chemical control. The most common non-chemical method used was shooting, used by 38.5% of growers experiencing problems.

Table 40: Non-chemical control of birds or other vertebrates by New York field corn growers in 1994 (91 growers with bird and/or vertebrate problems)

Non-chemical method	Pest controlled	# of growers	% of growers with bird or vertebrate problems
No control used		52	57.1
Shooting	Vertebrates only	17	18.7
	Birds and vertebrates	13	14.3
	Birds only	5	5.5
Frightening devices	Birds only	4	4.4
	Vertebrates only	2	2.2
	Birds and vertebrates	1	1.1
Shelter/nest removal	Birds and vertebrates	3	3.3
	Birds only	2	2.2
Electronic, sonic or vibrational devices	Birds only	1	1.1
Trapping	Vertebrates only	3	3.3
	Birds and vertebrates	1	1.1
Exclusion from structures	Birds only	2	2.2
	Birds and vertebrates	1	1.1
Woodchuck bombs	Vertebrates only	2	2.2
Sanitation	Birds and vertebrates	1	1.1
Peanut butter on electric fence	Vertebrates only	1	1.1

EQUIPMENT CALIBRATION, STORAGE AND DISPOSAL OF PESTICIDES AND

MISCELLANEOUS INFORMATION

According to the New York State Pesticide Applicators Training Manual (PAT manual), calibration of equipment is the first step in controlling pesticide applications. Calibration should occur often to ensure the proper amount of chemical is being applied. Table 41 shows the frequency of calibration of pesticide application equipment by New York field corn growers. One hundred and forty-four growers answered this question by indicating "once a season" as their most common response.

Table 41: Calibration frequency of pesticide application equipment by New York field corn growers (144 growers)

Calibration frequency	# of responses	% of growers
Once a season	79	56.4
Two to three times a season	28	20.0
Before each application	14	10.0
Every two to three years	11	7.9
At the time of equipment purchase	7	5.0
Other 1/	4	2.9
Never	2	1.4

1/ Other includes: "when we have equipment trouble", "I monitor acres/tankful", "I do not use equipment", "once in 15 years"

Storage of pesticides should occur, if possible, in a separate building designated only for pesticides. If this is not possible, then a wing or corner on the first floor of a building should be used (PAT manual, 1990). The area where pesticides are stored should be locked or secured in some way. Pesticides should be stored in their original containers with the labels intact. Herbicides should be stored separately from other pesticides and non-pesticide materials, as some can vaporize and get into other material nearby, thus causing contamination. Three quarters of New York State growers in this survey indicated that they stored pesticides "only in original containers" (Table 42). Fifty-eight percent stored them in a "pesticide only" location with two-thirds of them locked. Only 10% stored them with non-pesticide materials.

Table 42: Pesticide storage practices used by New York field corn growers and their employees (145 growers)

Storage practice	# of responses	% of growers
Stored only in original containers	114	78.6
Stored in unlocked "pesticide only" location	50	34.5
Locked up in separate "pesticide only" location	34	23.4
Stored with non-pesticide materials	15	10.3
Other 1/	9	6.2

1/ Other includes: "stored up high on shelf", "do not store"-2, "do not carryover"-4, "labeled building", "unlocked out of reach of children"

Disposal is a two-fold problem: unwanted or unused pesticides, and empty pesticide containers. According to the PAT manual, disposal of unwanted/unused pesticides can be done in several ways: (a) factory-sealed pesticides may be returned to the

manufacturer, (b) excess pesticide mixture can be sprayed on another labeled site where the same pest problem is, or (c) they can be picked up at "Pesticide Clean Up Days." Sixty percent of New York growers answered the question "carryover unused pesticides to the next season", 22.9% "return them to the manufacturer", and 22.9% "do not have any" (Table 43).

Table 43: How unwanted or unused pesticides are disposed of by New York field corn growers and their employees (144 growers)

Method of disposal	# of responses	% of growers
Carryover to next season	86	61.1
Return to pesticide manufacturer/dealer	33	22.9
Do not have unused/unwanted pesticides	33	22.9
Spray on noncrop land areas	14	9.7
Landfill	6	4.2
Bury	4	2.8
Give to other growers	3	2.1

Empty pesticide containers are never completely "empty." They still contain small amounts of pesticide even after rinsing (PAT manual, 1990). Containers should be separated into "burnable," "non-burnable" and those that contain mercury, lead, cadmium, or inorganic pesticides. The PAT manual gives these rules:

1. When disposing of containers that held liquid formulations:
   - triple-rinse the container immediately after emptying
   - puncture the top and bottom of the container to prevent reuse, crush flat
   - deposit the container in a licensed sanitary landfill
2. When using containers holding dry formulations:
   - completely empty the contents of the container into the tank
   - open both ends of the container to help remove any remaining pesticide and to prevent reuse of container
   - deposit the container in a licensed sanitary landfill
3. Burnable containers can only be burned with state approval and permission on the label. Never burn containers that held 2,4-D type weed killers as the smoke from such a fire could cause serious damage to plants and trees.
4. Non-burnable containers may be returned to the manufacturer for reuse.
5. Burial is the least preferred option for pesticide waste disposal. It is no longer listed on the label as an option, and is only legal if specifically allowed by state or local laws.

New York growers disposed of empty pesticide containers in all of the above ways (Table 44). The most common method (54.5%) was by burning. Three of the six growers who used 2,4-D weed killers used this method. One-third disposed of empty containers in a landfill after triple-rinsing.

Table 44: How empty pesticide containers are disposed of by New York field corn growers and their employees (143 growers)

Method of disposal	# of responses	% of growers
Burn	78	54.5
Landfill after triple-rinsing	45	31.5
Recycle after triple-rinsing	19	13.3
Bury	18	12.6
Return to pesticide manufacturer/dealer	16	11.2
Other 1/	3	2.1

1/ Other includes: "long term storage", "none", "burn after triple-rinse"

In order to purchase restricted-use pesticides, the purchaser must be a certified pesticide applicator. Many of the herbicides used by field corn growers are restricted-use pesticides, including all of the triazine herbicides. Eighty-two percent of the growers surveyed indicated they were certified pesticide applicators (Table 45).

Table 45: Certification of field corn growers and their employees (167 growers)

Certified pesticide applicator?	# of growers	% of growers
Yes	137	82.0
No	8	4.8
No answer	22	13.2

Table 46 shows what the cost per acre for chemical pest control was in 1994. The average cost was approximately $12.65/acre. The fact that 13 growers indicated they spent nothing on chemical pest control indicates that growers are confused as to what "chemical pest control" means. Only one grower used absolutely no pesticides at all, so that grower should have been the only one to answer "$0". Many growers indicated that they "do not use pesticides, only herbicides." This is a common misconception. Many people think that pesticides refer only to insecticides.

Table 46: Cost of chemical pest control per acre of field corn for New York State growers in 1994 (131 growers)

Cost per acre	# of growers	% of growers
$0	13	9.9
less than $10	12	9.2
$11-25	59	45.0
$26-50	35	26.7
$51-75	7	5.3
over $150	5	3.8

Average cost = 2.3 +/- 1.4 (approximately $12.65/acre)

Table 47 shows who recommends, or what assists New York growers in deciding which pesticide(s) to use on their field corn. The three most common responses were "farm supply dealer" (49.0%), "past success with product" (47.6%), and "Cooperative Extension agent/specialist" (44.1%).

Table 47: Who recommends, or what assists New York field corn growers and their employees in deciding which pesticide(s) to use on their field corn (145 growers)

Who	# of responses	% of growers
Farm supply dealer	71	49.0
Past success with product	69	47.6
Cooperative Extension agent/specialist	64	44.1
Chemical salesperson	52	35.9
Another farmer/grower	33	22.8
Private consultant	15	10.3
Other 1/	7	4.8
Magazine, radio or TV advertisement	4	2.8

1/ Other includes: "scouting last year's pests", "college agronomist", "own research", "price", "advice from custom applicator", "Cornell Recommends" -2

As previously mentioned, groundwater contamination is a big concern, especially with the triazine herbicides being used so predominantly by field corn growers. According to Hirschi, et. al., 1993, determining your soil's potential for leaching, your pesticide's potential for leaching, and the soil-pesticide interaction rating are three ways farmers can protect their groundwater. One way to do these three things is to use the National Pesticide/Soils Database and User Decision Support System for Risk Assessment of Ground and Surface Water Contamination (NPURG). NPURG is a computerized information delivery system which can be used to analyze the potential for pesticides to move below the root zone and beyond the edge of a field. NPURG generates farm-specific printouts of the relative rankings of leaching and surface runoff potentials for each pesticide/soil combination. Table 48 indicates that only one-quarter of the growers surveyed are aware of NPURG or other soil/pesticide interaction programs, and only eight percent are working with the Soil Conservation Service on such a program.

Table 48: Number of New York field corn growers that are aware of NPURG, or soil/pesticide interaction programs and are working with the Soil Conservation Service on soil/pesticide interaction programs (167 growers)

Program Answer	# of growers	% of growers
Aware of NPURG		
no	80	47.9
yes	41	24.6
not sure	17	10.2
no answer	29	17.4
Working with SCS		
no	74	44.3
yes	14	8.4
not sure	7	4.2
no answer	72	43.1

It is recommended, for maximum corn production and sustained soil productivity, corn should be rotated out of a field after three years (Cornell Field Crops and Soils Handbook). Table 49 indicates that the average number of years any one field on New York farms remains in field corn is 3.2 +/- 1.4.

Table 49: Average length of time (in years) any one field on New York farms remains in field corn (148 growers)

Number of years	# of growers	% of growers
1	12	8.1
2	32	21.6
3	53	35.8
4	24	16.2
5	13	8.8
6	13	8.8
7	1	0.7

Average number of years = 3.2 +/- 1.4

ALTERNATIVE PEST CONTROL METHODS

There are many non-chemical pest control methods available to field corn growers. Cultural methods suggested for control of weeds as recommended in the Cornell Field Crops and Soils Handbook, and the "Long Range Plan for New York State Integrated Pest Management Program" are as follows:

- Selection of a hybrid that is adapted to local growing conditions
- Timely planting and proper fitting for tilled situations, or proper adjustment of no-till planters.
- Cultivation when time and labor are available
- Use of cover crops, interseeding or mulches

Only 64 growers (38.3%) surveyed indicated that they used some non-chemical method to control weeds in 1994 (Table 50). Crop rotation was stated as the non-chemical method used most often to control weeds. It was used on 5,704.3 acres (31.4 % of total acreage surveyed). Eight of the growers estimated an average yield gain of 14.7% by rotating crops. According to the "Long Range Plan," crop rotation may shift the weed spectrum in a given field, but it cannot be relied upon for economical weed control in that field. The methods recommended above were used by New York field corn growers as follows:

- Hybrid selection: Not given as a choice on the survey
- Timely planting: 6.0% of growers, 10.5% of acreage, average estimated yield gain of 20%
- Cultivation: 16.2% of growers, 20.9% of acreage, average estimated yield gain of 9.0%
- Cover crops: 10.8% of growers, 12.1 % of acreage, average estimated yield gain of 6.4%

Table 50: Non-chemical control of weeds utilized by New York field corn growers in 1994 (64 growers using some non-chemical method)

Non-chemical method	# of growers	# of acres	Most common weeds targeted	# of growers estimating gain or loss	# of acres on which estimated	Avg. estimated % yield gain or loss
Crop rotation	46	5,704.3	Annual broadleaves	8	705.0	14.7
Cultivation	27	3,806.5	Weeds in general	7	1,231.5	9.0
Cover crops	18	2,198.5	Weeds in general	4	1,077.0	6.4
Timely planting	10	1,905.0	Weeds in general	1	400.0	20.0
Improved drainage	4	250.0	Weeds in general	1	40.0	1.0
Early harvest	3	295.0	Annual broadleaves	1	45.0	20.0
Resistant varieties	1	93.0	Weeds in general	--	--	--
Crop residue removal	1	65.0	Weeds in general	--	--	--
Mowing	1	20.0	Weeds in general	--	--	--

The recommended cultural methods for the control of insects are as follows:

- Crop rotation: especially important in the control of corn rootworm
- Timely planting
- Timely harvest

Only 27 (16.2%) growers indicated they used some form of non-chemical control for insects (Table 51). The most common method was crop rotation (12% of growers, 10.0% of total acreage surveyed) which is the method that is most recommended, and can virtually eliminate the incidence of corn rootworm in field corn. Eight growers estimated an average yield gain of 9.1% through the use of crop rotation as an insect control technique. The other two recommended methods, timely planting and timely harvest were used by 1.2% and 3.6% of growers on 0.4% and 0.03% of surveyed acreage, respectively.

Table 51: Non-chemical control of insects utilized by New York field corn growers in 1994 (27 growers using some non-chemical method)

Non-chemical method	# of growers	# of acres	Most common insects targeted	# of growers estimating gain or loss	# of acres on which estimated	Avg. estimated % yield gain or loss
Crop rotation	20	1,747.8	Corn rootworm	8	856.0	9.1
Resistant varieties	4	1,549.0	Insects in general	2	63.0	6.2
Timely planting	2	75.0	Insects in general	1	25.0	20.0
Early harvest	6	6.0	Insects in general	--	--	--
Biocontrols/predators/parasites	1	3.0	Corn earworm & European corn borer	1	3.0	10.0

The recommended cultural methods for control of diseases of field corn are as follows:

- Selection of disease-resistant varieties
- Crop rotation
- Improved drainage
- Crop residue removal/full incorporation

- Timely planting
- Early harvest
- Dense plant population

Only 19 (11.4%) growers indicated they used some non-chemical method to control diseases in 1994 (Table 52). As with insect control, the method used on the greatest number of acres (13.7%) by the growers surveyed, was also the one most highly recommended: resistant varieties. The rest of the recommended methods were used as follows:

- Crop rotation: 4.2% of growers, 0.04% of total acreage, average estimated gain of 3.3%
- Improved drainage: 4.8% of growers, 9.4% of total acreage, no estimated gain or loss
- Crop residue removal: not used
- Timely planting: 0.6% of growers, 2.6% of total acrage, no estimated gain or loss
- Early harvest: 1.2% of growers, 1.1% of total acreage, average estimated gain of 10%.
- Dense population: this was not asked as a control method, but the growers that indicated they used cultural methods to control diseases did not use this one, as their average seeding rate was 27,000 versus 27,700 seed per acre for the rest of the growers.

Table 52: Non-chemical control of diseases utilized by New York field corn growers in 1994 (19 growers using some non-chemical method)

Non-chemical method	# of growers	# of acres	Most common diseases targeted	# of growers estimating gain or loss	# of acres on which estimated	Avg. estimated % yield gain or loss
Resistant varieties	7	2,493.9	Diseases in general	1	250.0	5.0
Improved drainage	8	1,701.0	Diseases in general	--	--	--
Timely planting	1	480.0	Diseases in general	--	--	--
Early harvest	2	200.0	Downy mildew	1	50.0	10.0
Crop rotation	7	7.0	Diseases in general	3	3.0	3.3

PESTICIDE APPLICATIONS MADE BY COMMERCIAL APPLICATORS

Table 53 summarizes the herbicides applied by commercial pesticide applicators to New York State field corn in 1994 by active ingredient. As with herbicides applied by growers, pendimethalin (Prowl) was applied to the greatest number of acres, and was the greatest amount of active ingredient applied as well. There was a total of 201,983.7 lbs herbicide active ingredient applied to 127,401.9 acres of corn, making an average of 1.6 lbs ai/acre applied by commercial applicators in 1994. This is considerably less than what was applied by growers themselves (2.6 lbs/acre less than corn grown for grain, and 2.3 lbs/acre less than corn grown for silage).

Table 53: Summary of herbicides applied by commercial pesticide applicators to New York State field corn in 1994 by active ingredient (9 commercial applicators)

Active Ingredient Trade name	# of applications	Average am't of prod. used (lb or gal)	Acres treated	Am't of ai applied (lb)
pendimethalin	**45**		**39,150.0**	**51,719.1**
Prowl 3.3EC (liquid)	39	0.40	38,881.5	51,316.3
Prowl (liquid)	6	0.38	268.5	402.8
atrazine	**97**		**33,997.2**	**43,035.6**
AAtrex 4L (liquid)	91	0.33	23,964.2	31,297.0
AAtrex Nine-O (dry)	6	1.30	10,033.0	11,738.6
atrazine & metolachlor	**34**		**19,698.0**	**41,595.0**
Bicep Lite	4	0.75	11,092.0	41,595.0
Bicep (liquid)	30	0.65	8,606.0	33,692.5
metolachlor	**31**		**9,875.2**	**19,070.2**
Dual 8E (liquid)	31	0.24	9,875.2	19,070.2
cyanazine	**17**		**6,529.5**	**15,613.7**
Bladex 90DF (dry)	15	2.27	5,833.5	11,942.3
Bladex 4L (liquid)	2	1.32	696.0	3,671.4
metolachlor & cyanazine	**14**		**4,914.0**	**18,252.0**
Cycle (liquid)	14	0.93	4,914.0	18,252.0
dicamba	**47**		**4,783.5**	**915.4**
Banvel	47	0.05	4,783.5	915.4
alachlor	**19**		**2,145.0**	**4,380.3**
Partner (dry)	3	3.67	1,589.0	3,787.1
Lasso (liquid)	16	0.27	556.0	593.2
glyphosate	**23**		**1,763.0**	**2,419.3**
Roundup (liquid)	20	0.35	1,720.0	2,386.5
Ranger (liquid)	3	0.38	43.0	32.8
dicamba & atrazine	**6**		**1,270.0**	**1,566.3**
Marksman (liquid)	6	0.39	1,270.0	1,566.3
primisulfuron methyl	**12**		**853.0**	**29.9**
Beacon (liquid)	12	0.05	853.0	29.9
nicosulfuron	**6**		**688.0**	**22.6**
Accent	6	0.04	688.0	22.6
alachlor & atrazine	**20**		**656.5**	**2,379.8**
Bullet (liquid)	20	0.91	656.5	2,379.8
bromoxynil	**6**		**627.5**	**237.9**
Buctril (liquid)	6	0.19	627.5	237.9
2,4-D	**9**		**289.5**	**550.1**
Amine-4 (liquid)	9	0.50	289.5	550.1
bentazon & atrazine	**2**		**141.0**	**175.5**
Laddok (liquid)	2	0.38	141.0	175.5
bentazon	**2**		**21.0**	**21.0**
Basagran (liquid)	2	0.25	21.0	21.0
Totals	**390**		**127,401.9**	**201,983.7**

The application equipment used, and timing and method of application used by commercial applicators to apply herbicides to field corn in New York in 1994 are shown in Table 54. All of the applications were made as broadcast applications with a boom sprayer. These were applied as preemergence sprays on two-thirds of the acres treated and as postemergent sprays on one-quarter.

Table 54: Application equipment, timing, and method of application used by commercial pesticide applicators applying herbicides to New York State field corn grown in 1994

Action	# of acres	% of acres
Application Equipment		
Boom sprayer	127,401.9	100.0
Timing		
Preemergence	84,066.0	66.0
Postemergence	32,270.4	25.3
Preplant incorporated	9,594.0	7.5
Preplant surface	844.0	0.7
Before tillage	624.0	0.5
After harvest	3.5	0.003
Method		
Broadcast	127,401.9	100.0

Table 55 summarizes the weeds for which commercial applicators treated New York State field corn with one or more active ingredient in 1994. Annual broadleaves and grasses were the most targeted weed for most active ingredients. The triazine resistant strains of weeds were treated almost exclusively with pendimethalin. Commercial applicators were much more specific as to which weed(s) were targeted by a certain pesticide than were growers, but the incidence of "don't know" as a target pest is a little disconcerting since it is very important to identify the problem weeds prior to spraying.

Table 55: Summary of weeds treated for by commercial pesticide applicators on field corn in 1994 by active ingredient

Active Ingredient Weed	Acres treated	% of acres	Active Ingredient Weed	Acres treated	% of acres
pendimethalin	**39,150.0**		**dicamba**	**4,783.5**	
Annual grassess	34,441.0	88.0	Annual broadleaves	4,497.5	94.0
Triazine resistant strains	33,784.0	86.3	*Velvetleaf*	*4,051.0*	
Annual broadleaves	6,356.0	16.2	*Wild mustards*	*75.0*	
Quackgrass	1,090.0	2.8	*Ragweed*	*65.0*	
Sedges	459.0	1.2	Triaz. resist. lambsquart.	1,668.0	34.9
Bindweeds	353.0	0.9	Perennial grasses	480.5	10.0
Don't know	52.5	0.1	*Quackgrass*	*425.5*	
atrazine	**33,997.2**		*Johnsongrass*	*25.0*	
Annual broadleaves	33,647.7	98.9	Perennial broadleaves	255.0	5.3
Lambsquarters	*17,733.0*		*Bindweeds*	*154.0*	
Ragweed	*4,954.0*		*Horsenettle*	*80.0*	
Redroot pigweed	*4,937.0*		Don't know	60.0	1.3
Wild mustards	*75.0*		Yellow nutsedge	34.0	0.7
Perennial grasses	6,440.5	18.9	Triaz. resist. ragweed	29.0	0.6
Quackgrass	*6,109.5*		Annual grasses	10.0	0.2
Johnsongrass	*229.0*		**alachlor**	**2,145.0**	
Perennial broadleaves	760.5	2.2	Yellow nutsedge	873.0	40.6
Bindweeds	*639.5*		Annual broadleaves	391.5	18.2
Horsenettle	*95.0*		Foxtails	861.0	40.1
Annual grasses	719.0	2.1	Quackgrass	332.0	15.5
Triazine resistant lambsquarters	76.0	0.2	Bindweeds	29.0	1.4
Don't know	60.0	0.2	**glyphosate**	**1,763.0**	
Yellow nutsedge	34.0	0.1	Quackgrass	1,670.0	94.7
Triazine resistant ragweed	29.0	0.1	Annual broadleaves	138.0	7.8
			Don't know	93.0	5.3

(continued)

Table 55: Weeds, commercial pesticide applicators (continued)

Active Ingredient Weed	Acres treated	% of acres	Active Ingredient Weed	Acres treated	% of acres
atrazine & metolachlor	**19,698.0**		**dicamba & atrazine**	**1,270.0**	
Annual broadleaves	19,566.0	99.3	Annual broadleaves	880.0	69.3
Annual grasses	18,625.0	94.6	*Velvetleaf*	*344.0*	
Yellow nutsedge	18,375.0	93.3	*Ragweed*	*26.0*	
Quackgrass	1,031.0	5.2	Yellow nutsedge	740.0	58.3
Bindweeds	409.0	2.1	Annual grasses	480.0	37.8
Johnsongrass	42.0	0.2	Bindweeds	30.0	2.4
metolachlor	**9,875.2**		Quackgrass	30.0	2.4
Yellow nutsedge	9,165.0	92.8	**primisulfuron methyl**	**853.0**	
Annual broadleaves	661.5	6.7	Quackgrass	788.0	92.4
Quackgrass	585.0	5.9	Annual broadleaves	129.0	15.1
Bindweeds	136.5	1.4	Bindweeds	24.0	2.8
Annual grasses	9.2	0.9	Triazine resistant strains	5.0	0.5
cyanazine	**6,529.5**		Sedges	5.0	0.5
Fall panicum	6,301.0	96.5	**nicosulfuron**	**688.0**	
Annual broadleaves	5,251.0	80.4	Annual grasses	524.0	76.2
Quackgrass	170.0	2.6	Quackgrass	338.0	49.1
Bindweeds	108.5	1.7	Annual broadleaves	350.0	50.9
metolachlor & cyanazine	**4,914.0**		Sedges	350.0	50.9
Annual broadleaves	4,813.0	97.9	**alachlor & atrazine**	**656.5**	
Annual grasses	4,517.0	91.9	Annual broadleaves	515.5	78.5
Yellow nutsedge	4,517.0	91.9	Quackgrass	449.5	68.5
Quackgrass	299.0	6.1	Bindweeds	82.0	12.5
Bindweeds	102.0	2.1	Annual grasses	73.0	11.1
Don't know	68.0	1.4	**bentazon & atrazine**	**141.0**	
bromoxynil	**627.5**		Yellow nutsedge	141.0	100.0
Velvetleaf	255.5	40.7	**bentazon**	**21.0**	
Johnsongrass	10.5	1.7	Annual broadleaves	21.0	100.0
Triazine resistant lambsquarters	372.0	59.3	Quackgrass	20.0	95.2
2,4-D	**289.5**		Triaz. resist. lambsquart.	20.0	95.2
Quackgrass	208.5	72.0			
Annual broadleaves	171.0	59.1			
Don't know	81.0	28.0			

A summary of insecticides applied by commercial pesticide applicators to New York State field corn in 1994 is found in Table 56. These differ greatly from those used by the grower. Terbufos (Counter) and fonofos (Dyfonate) were applied to the greatest number of acres by commercial applicators, but were applied to less than one-third of the acreage treated by growers. A total of 604.2 lbs insecticide active ingredient was applied to 537.5 acres of field corn for an average of 1.1 lbs ai/acre. In contrast to herbicides, commercial applicators applied 0.2 lbs more insecticide active ingredient per acre to corn than growers did to corn grown for grain, and 0.4 lbs/acre more than growers did to corn grown for silage.

Table 56: Summary of insecticides applied by commercial pesticide applicators to New York State field corn in 1994 by active ingredient

Active Ingredient Trade name	# of applications	Average am't of prod. used (lb or gal)	Acres treated	Am't of ai applied (lb)
terbufos	**2**		**272.0**	**338.3**
Counter 15G (dry)	1	8.20	250.0	307.5
Counter 20CR (dry)	1	7.00	22.0	30.8
fonofos	**3**		**126.0**	**184.2**
Dyfonate 20-G (dry)	2	7.00	123.0	172.2
Dyfonate 4-EC (liquid)	1	1.00	3.0	12.0
methyl parathion	**1**		**72.0**	**72.0**
Penncap-M (liquid)	1	0.50	72.0	72.0
permethrin	**2**		**37.5**	**5.2**
Ambush 25W (dry)	2	0.55	37.5	5.2
tefluthrin	**1**		**30.0**	**4.5**
Force 3G (dry)	1	5.00	30.0	4.5
Totals	**9**		**537.5**	**604.2**

Most of the insecticides were applied at planting (92.5%) using the planter (92.5%, Table 57). The method of application used was split between "in furrow" (46.5%), and banded applications (46.5%). All but two of the insecticide applications made by commercial applicators to field corn in 1994 were made for the control of corn rootworms (Table 58).

Table 57: Application equipment, timing, and method of application used by commercial pesticide applicators who applied insecticides to New York State field corn grown in 1994

Action	# of acres	% of acres
Application Equipment		
Planter	497.0	92.5
Boom sprayer	40.5	7.5
Timing		
At planting	497.0	92.5
Postemergence	25.5	4.7
Preemergence	12.0	2.2
Preplant surface	3.0	0.6
Method		
In furrow	250.0	46.5
Banded	247.0	46.0
Broadcast	40.5	7.5

Table 58: Summary of insects treated for by commercial pesticide applicators on field corn in 1994 by active ingredient

Active Ingredient Insect	# of applications	% of applications	Acres treated	% of acres
terbufos	**2**		**272.0**	
Corn rootworm (larval)	2	100.0	272.0	100.0
Corn rootworm (adult)	1	50.0	30.8	11.3
fonofos	**3**		**126.0**	
Corn rootworm (larval)	3	100.0	126.0	100.0
Corn rootworm (adult)	2	66.7	123.0	97.6
methyl parathion	**1**		**72.0**	
Corn rootworm (larval)	1	100.0	72.0	100.0
Corn rootworm (adult)	1	100.0	72.0	100.0
permethrin	**2**		**37.5**	
Cutworms	1	50.0	12.0	32.0
Leafhopper	1	50.0	25.5	68.0
tefluthrin	**1**		**30.0**	
Corn rootworm (larval)	1	100.0	30.0	100.0
Corn rootworm (adult)	1	100.0	30.0	100.0

COMMENTS AND CONCERNS OF NEW YORK STATE GROWERS

The following are comments written by growers on their surveys. They fall into one of three categories: public perception, control of pests, or pesticide regulations.

Public Perception

- "The public needs to be educated that they don't have to be afraid of a corn field. People assume a corn field is a hazardous waste area. Landlords and neighbors think we are all poisoning the land and that farmers are indiscriminate polluters."
- " Corn is a great crop to grow - easily mechanized - good feed for cattle, high energy source. On the other hand, it is very expensive to grow. The use of chemicals is an absolute must, but growing concerns with the environment has made non farmers and consumer groups wary. We need a higher level of education to these groups to help alleviate their fears."
- "Don't forget we as farmers have families. We are concerned about health issues as we are more exposed to chemicals than the consumer is. Our wives and families buy all the groceries at the same stores other people do. We want and deseve good information on which we base our decisions."
- "We need all the products and tools we can get in order to ultimately use less total pesticide. I get very tired of some environmental groups thinking farmers spray pesticides on crops just because they have nothing else to do, or worse yet, don't know any better. We don't put $4,000 or more in a sprayer and then go apply it unless it is absolutely necessary."

Regulations/Certification/Pesticide Use

- "I don't feel we farmers are being treated fairly in regards to the use of pesticides. We now must take tests in order to purchase and use chemicals and then go to some of the 'foolish' meetings in order to get 'points' to get our recertification. The meetings I have attended give me the impression people feel we are not applying the chemicals properly or do not give a hoot about the environment. If they only knew how much we have invested in these chemicals and machinery. We farmers have enough common sense to know not to spray when it's windy, not near open ditches, streams and ponds, and certainly not near the neighbor's houses where we rent land."
- "I personally feel that there is too much blame on the farmers who try to do everything they can do to be safe with their own, and everyone else's lives. I do not like how the average person can go to a department store and buy a pesticide with no training, apply it by dumping it, instead of spraying. Then they blame other people for the problems of the environment. We, the farmers, do not have the money to throw around and waste with not having the training to apply it correctly."
- "More restrictions should be implemented to household and lawn care products. They pose serious environmental problems."
- "I would like to see New York State have quicker approval of newly released pesticides - ones that the EPA and other states have already approved. Each additional agency that requires approval before use only drives the corn growers' cost up for the pesticides, and for crop production, such that NYS, which is a marginal corn production area, will eventually have fewer and fewer farmers producing. I am very concerned about the re-evaluation of atrazine. If it is not reapproved, there will be no replacement for this broad spectrum and economical herbicide."
- "New York State corn producers have to be competitive with Midwest corn growers who have a much wider spectrum of chemical controls that are priced more competitively. Chemical companies don't register in NY because of delays in registration. Atrazine products and others are more cost effective than many alternatives."
- "To grow food and crops we need the option of chemicals that are safe for all users and the environment. When we lose good products that do a good job, it will cost everybody lots of money. We must read and apply according to the label to protect the environment, people and products."
- "In New York State, farmers are dying of taxes and other expenses. Other states bordering New York have more access to less costly pesticides. Atrazine is one of the few chemicals we can use to control small problems with lower cost per acre."
- "With the demise of atrazine formulations, the growing of corn will be very expensive."
- "We need access to newer, safer chemicals. I would not remove older ones from the market, however. We need to be able to rotate chemicals in order to avoid resistance problems."

- "Our main concern in using pesticides in growing crops are the threats of fines and liabilities. Even though we use practical precautions, we are aware things possibly can go wrong. We are very mindful of the effects to persons and the environment, and do our utmost to be careful. It seems that the control agency could be more understanding and helpful in the products they license for the public to use. After all, they and the government make the decision to put these pesticides on the market. By their very act of licensing they are the ones who introduce hazardous material into the environment."
- "Accept Pennsylvania training for recertification for license."
- "I feel I have a serious deer problem. I lose between 5-10% of my corn crop to deer and raccoon (mostly deer). I would like farmers who grow more than 40 acres of corn to take two deer per year without a permit, or be able to apply for a 5 year permit to remove two deer per year."
- "I feel a landowner should have the right to kill deer for his own use when there is deer damage."

Control Measures and Problems

- "I believe that maintaining short rotations is the most economical and environmentally advantageous way to produce field corn. The most successful way we have had has been to use atrazine as the sole herbicide. Since atrazine rates have been cut we have had to use other (more expensive and more dangerous) herbicides to get control. Keeping fields in corn for only two years prevents weeds from becoming established which might in longer production plans. Also, insect and disease problems are minimized in short rotations not to mention the decreased need for commercial fertilizers."
- "Crop rotation remains the best control." (Four growers wrote this.)
- "Mowing is used to control weeds. Also use cover cropping. We are reluctant to use spray of any kind due to environmental and health concerns."
- "We tried some red clover for cover crop on about 100 acres in 1994. Applied at cultivation. It didn't work. The corn shaded out the clover."
- "Increase of stalk disease making grain corn hard to harvest."
- "I am very interested in band applications of herbicides over the row at planting to control in-row weeds, with cultivation to control between row weeds. I would like to see more information on equipment set-up, operation and related information."

COMPARISONS AND CONCLUSIONS

According to "Pest and Pesticide Use Assessment in Dairy Cattle/Field and Forage Production Systems in the Northeast, 1986, 66.7% of New York corn was produced using a conventional tillage system, 17.4% no-till, and 16.4% reduced tillage. In an unpublished 1990 survey, conventional tillage was used on 87.9% of the acreage, 6.0% was no-till and 4.0% was reduced tillage. This survey (1994) shows a much different

pattern. Fifty-six percent of total acreage surveyed used a conventional tillage system, 42% used reduced (conservation) tillage, and only 2% used no-till systems. This pattern is reflective of atmosphere/public concern/specialists' recommendations over the past ten years on herbicide use, water quality, and soil erosion.

This pattern also explains the difference in herbicide usage from 1986, 1990 and 1994 by New York growers illustrated in Table 59. For almost all of the herbicides listed, the percent of acreage treated was the least in 1990 (when most of the corn acreage was produced using conventional tillage), followed by 1986, and the most acreage was treated in 1995. However, the amount (lbs) of active ingredient applied per acre has decreased since 1986.

Table 59: Comparison of herbicide usage by field corn growers in New York State in 1986, 1990 and 1994

	1986		1990		1994	
Active ingredient	% of acreage	lbs ai per acre	% of acreage	lbs ai per acre	% of acreage	lbs ai per acre
atrazine	41.0	2.0	28.0	3.0	38.7	1.6
cyanazine	14.5	2.5	10.8	4.8	9.9	3.0
metolachlor	13.9	2.5	10.2	1.7	18.8	2.1
pendimethalin	7.6	2.0	17.9	2.0	52.0	1.7
glyphosate	6.8	1.5	1.8	1.7	13.5	0.8
dicamba	5.3	0.3	5.6	0.5	17.6	0.9

Since 1986, corn rootworm has been cited as the insect for which most insecticides are used. However, the actual insecticides, amounts used and acreage treated has changed (Table 60). In 1986, the insecticide used on the most acreage was chlorpyrifos, followed by terbufos. In 1990, it was carbofuan followed by terbufos, and in 1994, tefluthrin (which was not used at all in 1986 or 1990) was used on almost half of the treated acreage. Rates have also changed, but not greatly, except in the case of fonofos which was being applied at the rate of 4.0 lbs/acre in 1990 versus 1.0 lb/acre in both 1986 and 1994.

Table 60: Comparison of insecticide usage by field corn growers in New York State in 1986, 1990 and 1994

	1986		1990		1994	
Active ingredient	% of acreage	lbs ai per acre	% of acreage	lbs ai per acre	% of acreage	lbs ai per acre
chlorpyrifos	34.8	1.0	16.1	1.8	23.9	1.5
terbufos	24.3	1.0	26.5	1.3	22.5	1.6
carbofuran	15.9	1.0	26.9	1.4	9.4	0.5
fonofos	9.9	1.0	22.3	4.0	1.6	1.0
tefluthin	0.0		0.0		41.5	0.2

In comparison to other corn producing states, herbicide applications in New York State appear to cover more acreage, and applicators apply more pounds of active ingredient per acre (Table 61). Also, applicators in some states appear to be utilizing herbicides that are not being used at all in New York.

Table 61: Comparison of herbicide usage by field corn growers in New York State to field corn growers in Illinois, Missouri and North Dakota

	New York		Illinois[a/]		Missouri[b/]		North Dakota[c/]
Active ingredient	% of acreage	lbs ai per acre	% of acreage	lbs ai per acre	% of acreage	lbs ai per acre	% of acreage
pendimethalin	52.0	1.7	2.0	1.0	0.0		2.5
atrazine	38.7	1.6	83.0	1.2	28.0	1.5	1.9
metolachlor	18.8	2.1	34.0	1.9	3.1	1.8	7.8
dicamba	17.6	0.9	17.0	0.4	0.9	0.3	21.0
glyphosate	13.5	0.8	1.0	0.9	0.8	0.6	1.0
cyanazine	9.9	3.0	25.0	2.2	2.9	1.6	11.3

[a/] Pesticide Use Associated with Soil Type and Crop Management within the State of Illinois for 1992

[b/] Becker, et. al., 1992

[c/] Pesticide Use and Pest Management Practices for Major Crops in North Dakota 1992

In comparison to United States pesticide use on corn, New York, in this survey, applied only 0.3% of the total herbicides (213,195,408 lbs ai, Gianessi and Anderson, 1995) applied to corn, and only 0.03% of the total insecticides (26,418,410 lbs ai).

Growers seem to be genuinely interested in following correct procedures. Storage of pesticides is being done correctly in "pesticide only" locations, locked and in original containers. Most growers either carryover unused pesticides, or return them to the manufacturer. Disposal of containers is being done properly, and application equipment is being calibrated at least "once a season."

Use of alternative methods to control pests appears to be much less in 1994 than it was in New York in 1990. For example, the unpublished data from 1990 indicated that 90.2% of growers used crop rotation to control pests, while only 30% used it in 1994. However, this may be due to how the question was asked. In 1990, growers were only asked if they used certain non-chemical methods, while in this survey, they needed to indicate what pest they used the method for, and how many acres were treated in this manner.

According to Specker, et. al., 1986, weeds caused 2 percent yield losses to corn in the Northeast. If atrazine were no longer available for use, the yield losses due to weeds would increase to 13 percent. If no triazines were available, losses would increase to about 28 percent, and if all herbicides were no longer available, weed losses would increase tremendously to about 61%. In this survey, that appears to be the case for corn grown for grain, although not as severe (Table 62). There is actually an increase in yield on corn for silage when triazines were not used, but that may be reflective of the low number of fields where this occurrred (13 fields).

Table 62: Comparison of average yield and herbicide use in field corn grown in New York State in 1994

Herbicide use	Silage		Grain	
	Average yield (tons)	% difference	Average yield (bu)	% difference
All herbicides available	16.8		131.8	
No atrazine	16.5	-1.8	120.4	-8.6
No triazines	17.4	+3.5	100.6	-23.7
No herbicides	8.2	-51.2	----	--

If no insecticides were available in the aforementioned 1986 survey, there would be a one to three percent yield loss due to various insects. In this survey, average yield for corn grown for silage with insecticides was 19.2 tons, versus 15.7 tons for silage corn grown without insecticides. That is an 18.2% loss without insecticides. For corn grown for grain, the loss was much less: 5.2% loss for grain corn grown without insecticides.

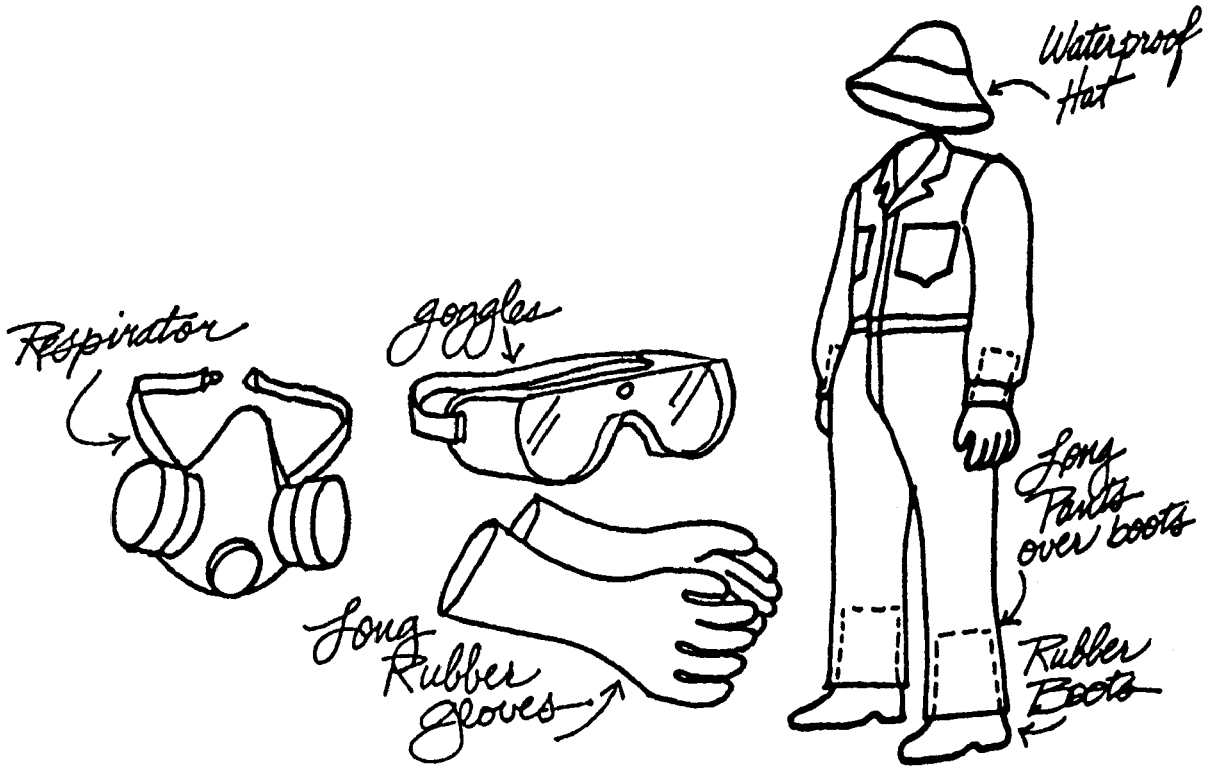
In a comparison of effect of use of insecticides on yield in various rotations, the least amount of loss is found in first year corn (Table 63). It is interesting to find that the greatest loss occurs in second year corn, and there is even a gain in yield on third year corn for grain that did not have insecticides applied.

Table 63: Comparison of insecticide usage and rotation on field corn yield in New York State in 1994

Rotation Insecticide usage	Silage		Grain	
	Average yield (tons)	% difference	Average yield (bu)	% difference
First year corn				
Insecticides used	17.0		134.4	
No insecticides used	15.8	-7.1	127.7	-3.5
Second year corn				
Insecticides used	18.9		142.5	
No insecticides used	15.5	-18.0	120.6	-15.4
Third year corn				
Insecticides used	17.8		122.9	
No insecticides used	16.0	-10.1	132.2	+7.2
Continuous corn				
Insecticides used	17.1		136.6	
No insecticides used	15.6	-8.8	126.9	-7.2

Part II

USE AND CARE OF PERSONAL PROTECTIVE EQUIPMENT



USE OF WORK CLOTHING AND PERSONAL PROTECTIVE EQUIPMENT (PPE)

Two hundred and thirteen growers completed the survey on clothing and equipment. At least three-quarters of the corn producers "nearly always" wore an undershirt/T-shirt, undershorts/long johns, jeans/work trousers, a baseball style cap, socks and leather shoes (Table 64). Exposure to pesticides through the skin decreases with more layers of clothing. Most growers wore undershirts and undershorts. Just under half reported "nearly always" wearing a long-sleeved shirt, while 38.5% wore one "occasionally depending on the weather," and 9.9% indicated it "depended on the pesticide" that they were using. Work coats or jackets were worn "occasionally depending on the weather" (66.2%), while close to one-third of the growers wore some type of coverall (overalls, woven coveralls or insulated coveralls) "depending on the weather."

Table 64: Frequency of use of work clothes by New York field corn growers when working with pesticides (213 growers)

Type of clothing	Nearly always wear % of growers	Wear occasionally: weather dependent % of growers	Wear occasionally: pesticide dependent % of growers	Rarely or never wear % of growers
Undershirt/T-shirt	80.3	11.3	0.9	7.0
Undershorts/long johns	73.7	8.5	1.4	13.1
Jeans/Work trousers	97.2	0.5	0.5	1.9
Overalls	12.7	28.6	8.5	41.3
Long sleeved shirt	47.9	38.5	9.9	1.4
Short sleeved shirt	21.1	32.9	7.5	29.1
Baseball style cap	76.1	13.1	1.4	11.7
Socks	99.5	0.0	0.0	0.0
Leather shoes	87.3	6.6	1.4	2.8
Canvas shoes	1.4	4.2	1.4	81.7
Woven coveralls	14.6	27.2	5.6	44.6
Insulated coveralls	0.9	28.6	1.9	58.9
Work coat or jacket	11.7	66.2	5.2	11.7
Cotton/canvas gloves	11.3	35.2	9.4	33.3
Leather gloves	17.4	26.8	7.5	40.4

Leather shoes were "nearly always" worn by 87.3% of growers. Although leather may resist dust penetration, dust can sift into the inside, spray can be absorbed, and decontamination is a problem. The same is true of leather gloves, which were worn "nearly always" by 17.4% of growers, but "rarely or never" worn by 40.4%. Baseball-style caps (worn "nearly always" by 76.1% of growers) may keep the sun out of the eyes and allow ventilation, but they do not provide a good barrier to pesticides. In addition, contaminated caps can be a source of continued exposure as they are worn for many occasions, but rarely washed.

Exposure studies have shown hands to be the area of greatest exposure (Lavy, et. al., 1983). The use of chemical-resistant gloves will reduce this exposure. Fifty-four percent of growers reported "nearly always" wearing chemical-resistant gloves, and 29.6% wore them "occasionally depending on the pesticide" (Table 65). Of the growers who wore chemical-resistant gloves "depending on the weather," "rarely or never," or

indicated they were "unnecessary for the kinds of pesticides they applied," 63.0% used AAtrex, 22.2% used Dual, 18.5% used Bicep and/or Roundup, 14.8% used Lorsban, 11.1% used Force, Bladex and/or MCPA Amine, 7.4% used Beacon and/or 2,4-D, and 3.7% used Captan 300, Bullet, Accent and/or Cycle. These pesticides specifically state on the label to wear chemically resistant gloves.

Table 65: Frequency of use of personal protective equipment by New York field corn growers when working with pesticides (213 growers)

Type of clothing	Nearly always wear	Wear occasionally: weather dependent	Wear occasionally: pesticide dependent	Rarely or never wear	Unnecessary for the types of pesticides I apply
	% of growers	% of growers	% of growers	% of growers	% of growers
Chemical-resistant gloves	54.0	2.3	29.6	9.4	3.3
Rubber boots	30.0	26.3	22.1	14.6	4.2
Woven coveralls over work clothes	15.0	25.8	8.0	37.6	6.1
Nonwoven coveralls	7.5	4.7	13.6	54.9	10.8
Chemical-resistant coveralls	8.5	2.8	14.1	54.4	13.6
Chemical-resistant apron	5.2	1.9	14.6	58.2	13.6
Wide brimmed plastic/rubber hat	3.8	1.9	5.2	67.6	14.**6**
Hard hat	1.9	2.3	3.8	66.2	18.8
Dust/mist respirator	15.5	4.2	29.6	33.8	11.7
Half-face chem cartridge respirator	14.1	4.2	16.4	43.2	16.0
Full-face chem cartridge respirator	4.2	0.5	2.8	62.0	22.5
Powered air-purifying resp (PARC)	0.0	0.9	1.9	59.6	25.8
Goggles	22.1	2.3	26.8	3.3	6.6
Safety glasses	19.7	3.8	20.2	39.9	6.1
Face shield	5.6	2.8	14.6	56.8	11.5
Regular eyeglasses	0.5				

Chemical cartridge (half-face, full-face or PARC), or dust/mist respirators were "nearly always" worn by 33.8% of the growers, and goggles, safety glasses, or a face shield were "nearly always" worn by 47.4% of growers. Seventy-five percent of growers reporting pesticide use, used chemicals requiring a dust/mist or chemical cartridge respirator, and goggles, safety glasses or a face shield. Of these growers, 80.9% either "nearly always" wore or wore "occasionally depending on the pesticide" some type of respirator, and 100% wore some type of eye protection "nearly always" or "depending on the pesticide."

Rubber boots were "nearly always" worn by 30.0% of growers, and another 30.0% wore them "depending on the pesticide." Eighty-seven percent of growers used a pesticide requiring rubber boots on the label. Almost half of them indicated they "rarely or never" wore rubber boots, wore them "dependent on the weather," or indicated they were "unnecessary for the types of pesticides they applied." Coveralls of any type were generally not worn.

The material of outer clothing worn most often by corn growers was cotton/polyester blend (38.1%), followed by cotton (32.4%, Table 66). Many growers indicated they did not use limited-use or disposable garments because Tyvek is unbearable in hot weather.

Table 66: Material of outer clothing worn most often by New York field corn growers when handling pesticides (210 growers)

Material	# of records	% of growers
Cotton/polyester blend	80	38.1
Cotton	68	32.4
Limited-use or disposable	30	14.3
Water-proof rubber/plastic	23	11.0
Don't know	9	4.3

The labels of some of the pesticides used by corn growers state that certain PPE must be worn when mixing or loading the concentrated product. Table 67 shows what PPE field corn growers and their employees wore when mixing and/or loading pesticides. AAtrex and Bladex are pesticides used in this survey that had PPE listed on the label for mixing or loading. Figure 23 shows what protective equipment should be worn by growers mixing AAtrex and/or Bladex, and what percent of those growers indicated wearing that equipment. Three-quarters or more of the growers wore the chemical-resistant gloves and protective eyewear required, and a little more than half wore the rubber boots. The chemical-resistant apron was required only for Bladex, but a greater percentage of growers used an apron for AAtrex than for Bladex.

Table 67: Personal protective equipment worn by field corn growers when mixing and/or loading pesticides (201 growers)

Protective equipment	# of responses	% o growers
Chemical-resistant gloves	161	80.0
Rubber boots	111	55.2
Goggles	90	44.8
Woven coveralls over work clothes	55	27.4
Safety glasses	55	27.4
Half-face chemical cartridge respirator	52	25.9
Dust/mist respirator	51	25.4
Chemical-resistant coveralls/rain gear	37	18.4
Chemical-resistant apron	32	15.9
Non-woven (limited-use) coveralls	26	12.9
Face shield	23	11.4
Wide-brimmed plastic/rubber hat	18	9.0
Full-face chemical cartridge respirator	11	5.5
Do not mix/load pesticides	11	5.5
Hard hat	7	3.5
None	2	1.0
Powered air-purifying respirator	1	0.5
Regular eyeglasses	1	0.5

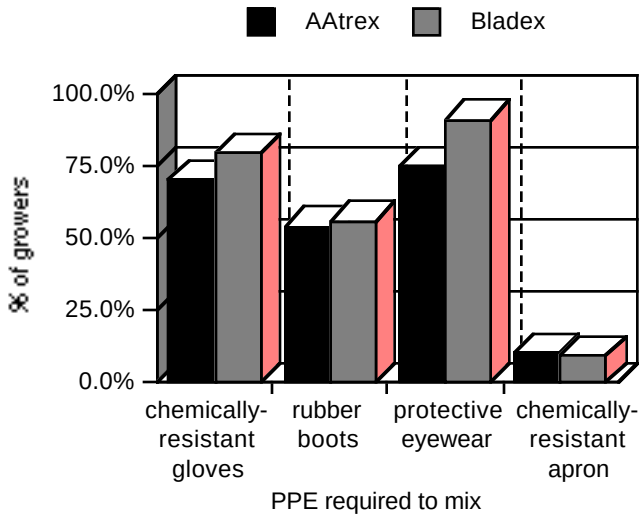


Figure 23: Percent of field corn growers wearing PPE required by label to mix AAtrex or Bladex

LAUNDERING PROCEDURES

Proper management of clothing worn while working with pesticides can help to minimize pesticide exposure. According to the Department of Textiles and Apparel at Cornell University, the following rules should be used when washing clothing worn while applying pesticides:

- All clothing worn while handling or applying pesticides is contaminated
- Wash hands immediately after handling contaminated clothing; wear chemical-resistant gloves when **highly** contaminated
- Wash clothing daily
- Wash separately from family wash
- Hang garments outdoors to dry
- Prerinse or presoak
- Pretreat heavily soiled garments with detergent or a pre-wash product
- Wash only a few items at a time
- Use highest water level
- Use hot water
- Use longest wash time
- Use heavy-duty detergent
- Line dry to avoid contaminating dryer
- After washing - run machine through a complete cycle with detergent
- Rewash contaminated garments two or three times before reuse for more complete pesticide removal

Figure 24 shows the number of hours field corn growers wore refurbishable work clothing before laundering. Almost half of the growers washed their work clothing every 8 to 11 hours. The minimum number of hours was one, and the maximum was 112,

with an average of 11.4 hours. However, 84.6% of growers said they washed their clothing between 4 and 16 hours, which indicates they are laundering daily as recommended.

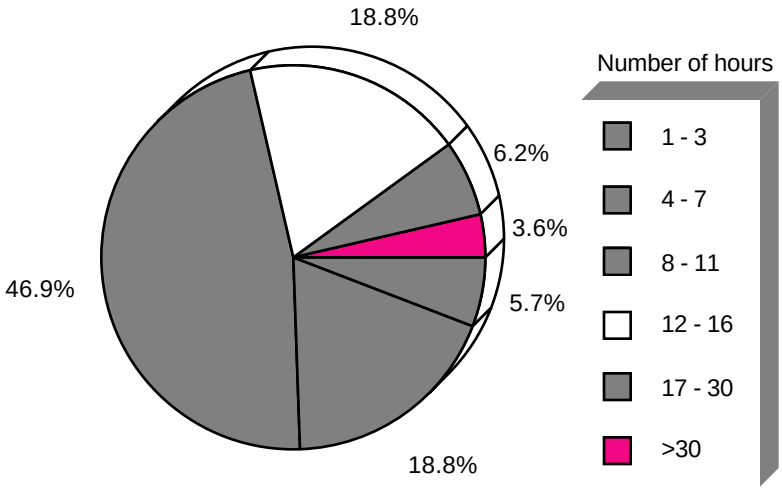


Figure 24: Number of hours refurbishable clothing is worn by New York field corn growers before laundering

Eighty-six percent of growers used the family washer, but washed contaminated clothing separately from family laundry (Table 68). Table 69 shows the steps taken to launder clothes worn when working with pesticides. Forty-five percent presoaked or prerinsed before washing, 71.8% washed in hot or warm water, and 61.5% line-dried their clothing outdoors. A very commendable 36.6% cleaned their washer after laundering to avoid contaminating family clothing. Only 2.6% washed more than once to remove more pesticide before drying. Between nine and 18% of growers did not answer one or more of these questions. It is impossible to know whether they did not answer because they did not do that procedure, or because they did not know whether or not it was done.

Table 68: Facilities used by New York field corn growers to launder clothing worn when handling pesticides (208 growers)

Facilities	# of responses	% of growers
Family washer, but in a SEPARATE load from family clothes	178	85.6
Family washer WITH family clothes	16	7.7
Commercial laundry service	8	3.9
Grower's special facilities reserved for pesticide-soiled clothing	7	3.4
Don't know	3	1.4
Coin operated laundry	2	1.0

Table 69: Steps used by New York field corn growers to launder clothes worn when handling pesticides (213 growers)

Step	Yes	No	Don't know
	% of growers	% of growers	% of growers
Presoak or rinse before washing with detergent	45.1	28.2	9.9
Wash in hot or warm water rather than cold	71.8	8.9	10.3
Wash more than once before drying	2.6	49.8	6.6
Line-dry outdoors	61.5	17.4	6.1
Clean washer after laundering	36.6	38.5	11.7

REPLACEMENT OF WORK CLOTHING AND PPE

Replacement of work clothing occurred most often when the clothing wore out (76.0%, Table 70). Many growers gave more than one answer to this question. These were either "when it wears out" combined with another answer such as "seasonally," "annually" or "2 times a year," or "if contaminated by a pesticide spill" combined with another answer. However, the most common combination (15.9% of growers) was "when it wears out" and "if contaminated by a pesticide spill."

Table 70: Frequency of replacement of work clothing by New York field corn growers (208 growers)

Frequency	# of responses	% of growers
When it wears out	158	76.0
If contaminated by pesticide spill	63	30.3
Seasonally	17	8.2
Annually	15	7.2
Two times a year	7	3.4
After every use	1	0.5
Three times a year	1	0.5
Every two years	1	0.5
Not applicable	1	0.5

Of the 91 growers who indicated they used disposable garments, one-third discarded them after 8 to 11 hours of use (Figure 25). The minimum number of hours that disposable garments were worn before being discarded was one hour and the maximum was 100 hours. Although the average number of hours was 9.1, the mode (the answer with the greatest number of responses) was 8 hours.

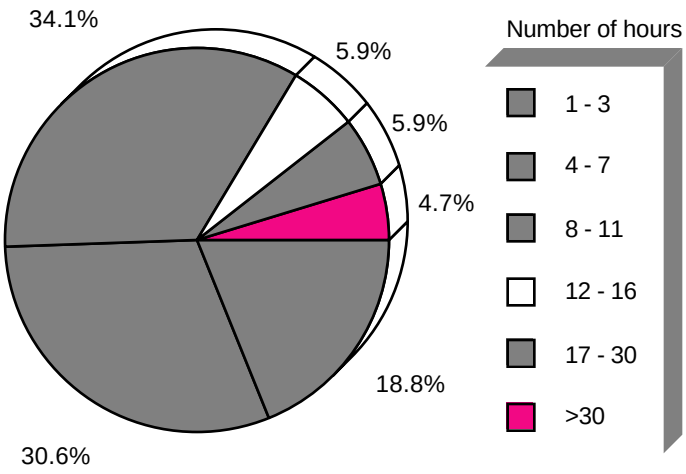


Figure 25: Number of hours limited-use or disposable garments are worn by New York field corn growers before they are discarded

According to the EPA, the U.S. Department of Agriculture - Extension Service (USDA-ES) and PPE manufacturers, workers should dispose of most nonwoven (limited-use or disposable) coveralls after one workday's exposure (8 hours). This is what New York field corn growers appear to do. However, the instructions for some coated nonwoven suits may permit reuse if each period of use is short, if the inside of the garment is not contaminated, and if they do not get much pesticide on them. Growers may be misinterpreting these instructions to justify overuse of a coverall as the following comments indicate: "I wear them until they are visibly dirty," "it depends on exposure," "during loading for about a week," and "I will reuse them if I can tolerate the inside smell."

Over half of the growers who wore disposable garments burned them (Table 71). Close to one-third sent them to the landfill. Only 8.8% render them unusable before discarding them.

Table 71: How limited-use or disposable garments are discarded by New York field corn growers (91 growers)

Method of disposal	# of responses	% of growers
Burn	53	58.2
Landfill	28	30.8
Bury	8	8.8
Render unusable	8	8.8
Don't know	5	5.5

Chemical-resistant (reusable) gloves should be inspected before use for signs of wear or abrasion (EPA, USDA-ES pamphlets). If they show any sign of wear, they should be discarded. Even if there are no signs of wear, reusable chemical-resistant gloves should be replaced regularly since residues that cannot be detected may remain

in the material even after washing and adequate airing. A good rule of thumb is to dispose of gloves that have been worn for about one week of work. Because hand protection is the most important concern for pesticide handlers, glove replacement is a high priority. Close to 50% of the growers replaced chemical-resistant gloves "when a leak was detecTable" and/or "seasonally" (Table 72). Only 5.4% of growers indicated that they replaced gloves weekly.

Table 72: Frequency of replacement of chemical-resistant gloves by New York field corn growers (204 growers)

Frequency	# of responses	% of growers
When a leak is detecTable	96	47.1
Seasonally	92	45.1
Do not wear chemical-resistant gloves	30	14.7
Weekly	11	5.4
After every use	4	2.0
Monthly	3	1.5
Daily	2	1.0
Two to three times per week	1	0.5
Haven't yet	1	0.5

According to the EPA, USDA-ES pamphlets, replacement of respirator cartridges should occur:

- at the first indication of odor, taste, or irritation
- when the respirator manufacturer or pesticide label requires, or
- at the end of each day's work period, if no other instructions or indications of service life are available.

Table 73 shows how often respirator cartridges were replaced by New York field corn growers. Half of the growers did not wear cartridge respirators. Only one-quarter of the growers who wore respirators indicated replacement "when odors were detecTable," and only 10% replaced them daily, although 3 growers implied replacement at least that frequently: "check daily to see if need replacement," "after every use," and "every time I mix."

Table 73: Frequency of replacement of respirator cartridges by New York field corn growers (98 growers)

Frequency	# of responses	% of growers
Seasonally	51	52.0
When odors are detecTable	26	26.5
Weekly	11	11.2
Daily	10	10.2
Check daily to see if need replacement	1	1.0
After every use	1	1.0
Two to three times per week	1	1.0
Every time I mix	1	1.0
Haven't yet	1	1.0

MAINTENANCE AND STORAGE OF PPE

According to the EPA, USDA-ES pamphlets, proper maintenance of eyewear and respirators means to hand-wash goggles, face shields, safety glasses, and reusable respirator facepieces with mild detergent and warm water after each day of use. Then, rinse thoroughly and wipe dry or hang in a clean area to air dry. Respirators and eyewear should be stored where they are protected from dust, extreme sunlight, excessive moisture, pesticides and other chemicals. A zip-closable sturdy plastic bag works well for storage. Prior to reuse they should be test-fitted to make sure they fit correctly.

Table 74 indicates how New York field corn growers maintain chemical cartridge respirators and eyewear between uses. Only 120 growers answered this question because of the choices that were given for answers. Seventy-six growers checked "do not wear cartridge respirators," and that was all they checked. However, approximately 40% of those growers wore some sort of eye protection as indicated by previous questions. Of those who did answer the question, at least one-third followed the washing procedures outlined by EPA, USDA-ES: hand wash, rinse, wipe or hang dry. Close to one-third stored them in a zip-closable plastic bag, and close to one-quarter "test fit prior to wearing."

Table 74: How New York field corn growers maintain chemical cartridge respirators and eyewear between uses (120 growers)

Maintainance Step	# of responses	% of growers
Rinse with clear water	58	48.3
Hand-wash parts separately with detergent	53	44.2
Hang (air) dry	43	35.8
Wipe dry	41	34.2
Store in zip-closable plastic bag	36	30.0
Store in original box	31	25.8
Wipe parts clean with towel or rag	28	23.3
Test fit prior to wearing	28	23.3
Hang outside or in barn until needed	19	15.8
Store in office building	1	0.8
Replace with new	1	0.8

PPE was stored "in pesticide storage area" by 39.7% of New York growers (Table 75). As stated previously, this is not a good idea, nor is it good to store PPE in a vehicle where it will be exposed to sunlight, heat, etc., or near a shower where it will be exposed to moisture.

Table 75: Where New York field corn growers store protective equipment between uses (191 growers)

Storage area	# of responses	% of growers
In pesticide storage area	74	38.7
At home	39	20.4
In vehicle	21	11.0
In dressing/changing area with no shower	18	9.4
With other clothing items at work	18	9.4
Farm shop/garage/barn away from pesticides	16	8.4
In dressing/changing area with a shower	12	6.3
Dispose of immediately and buy new as necessary	2	1.0
Do not wear any	2	1.0
Protective equipment storage	1	0.5

LABEL REQUIREMENTS FOR CLOTHING AND PPE AND USE OF ENCLOSED VEHICLES

Growers were asked if they wore the minimum protective equipment as required on the pesticide label. Figure 41 illustrates the results. Fifty percent indicated they wore "more than minimum requirements," or "minimum requirements." The other half "mostly wore minimum requirements," "often did not," or "did not know."

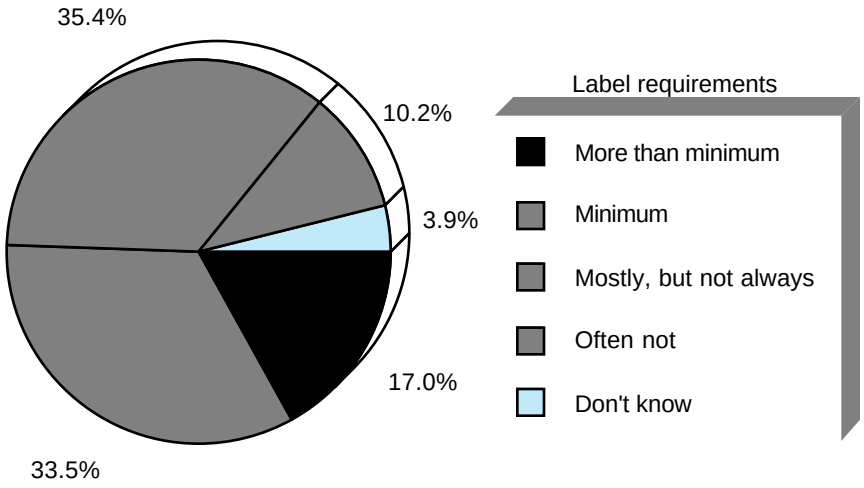


Figure 26: Frequency with which New York field corn growers meet the minimum protective equipment requirements on the pesticide label

The primary reason growers gave for not wearing the minimum requirements stated on the label was that "protective equipment is too hot" (35.8%, Table 76). "Apathy" was indicated by several answers: "no good reason," "don't pay enough attention to it," "not always sure what's required," "do what we've always done," "don't take time for proper equipment," "tend to ignore label with herbicides," "too lazy," "inconvenience," and "time/troublesome."

Table 76: Why New York field corn growers do not meet the minimum protective equipment requirements on the pesticide label (109 growers)

Reason	# of responses	% of growers
Protective equipment is too hot	39	35.8
No answer	25	22.9
Protective equipment is too expensive	20	18.3
Protective equipment restricts movement	19	17.4
Apathy	14	12.8
Minimum requirements are too strict	12	11.0
Protective equipment is not available where I/my employees live	4	3.7
Cab tractor	1	0.9
Limited use of chemicals requiring PPE	1	0.9
Goggles restrict vision	1	0.9
PPE causes more problems than the chemicals	1	0.9

Research has shown that dermal exposure to the applicator in an enclosed tractor cab during ground boom application is one-sixth the exposure to the applicator conducting similar operations with an open tractor cab (Lunchick, et. al., 1988). Forty growers (19.5%) made "essentially all" of their pesticide applications from an enclosed cab (Table 77). Although only one grower indicated that a "cab tractor" was the reason for not wearing minimum requirements, 21.6% of those who did not meet the requirements made "essentially all" of their applications from enclosed cabs.

Table 77: Proportion of applications that New York field corn growers make from an enclosed vehicle (205 growers)

Frequency	# of records	% of growers
None	142	69.3
Less than one-third	10	4.9
One-third to two-thirds	3	1.5
More than two-thirds	10	4.9
Essentially all	40	19.5

EDUCATIONAL RESOURCES AND APPLICATOR TRAINING

When asked what three resources field corn growers would most likely use to learn about protective equipment, they chose "pesticide applicator's training manual" (70.0%), "fact sheets" (48.8%), and "kit of sample protective equipment" (37.9%, Table 78).

Table 78: Resources New York field corn growers would be most likely to use to learn about protective equipment (203 growers)

Resource	# of responses	% of growers
Pesticide applicator's training manual	142	70.0
Fact sheets	99	48.8
Kit of sample protective equipment	77	37.9
Exhibit	63	31.0
Videotape	56	27.6
Media (TV, radio, newspaper)	23	11.3
Telephone hot line	17	8.4
Slide set	10	4.9
Computer program	5	2.5

Table 79 shows what educational formats are preferred for pesticide applicator training by field corn growers. Two-thirds of the growers preferred a "training session." Ninety percent of the field corn growers surveyed indicated that the "Extension Service" sponsors the applicator certification and continuing education programs they attend (Table 80).

Table 79: Educational formats preferred for pesticide applicator training by field corn growers and their employees (205 growers)

Format	# of responses	% of growers
Training session	132	64.4
Self study	66	32.2
Study group	54	26.3
Satellite downlink	10	4.8
Conference	10	4.8

Table 80: Who sponsors the applicator certification and continuing education programs attended by field corn growers (207 growers)

Sponsor	# of responses	% of growers
Extension service	190	91.8
Chemical company/dealer	109	52.7
Seed company/dealer	52	25.1
Employer	24	11.6
Equipment dealer	9	4.3
NYS Department of Environmental Conservation	2	1.0

SHORT- AND LONG- TERM HEALTH PROBLEMS ASSOCIATED WITH EXPOSURE TO PESTICIDES

There are many short-term or acute symptoms associated with exposure to pesticides. Figure 27 illustrates the number of times field corn growers experienced

those symptoms in 1994, that they felt were related to working with pesticides. The most common complaint was skin irritation, felt once by 9.6% of growers, two to three times by 4.8%, and 5 times or more by 1.0%. Headaches were experienced by 31 (14.9%) growers: once - 8.2%, 2 to 3 times - 5.3%, 4 to 5 times - 0.5%, and 5 or more times - 1.0%.

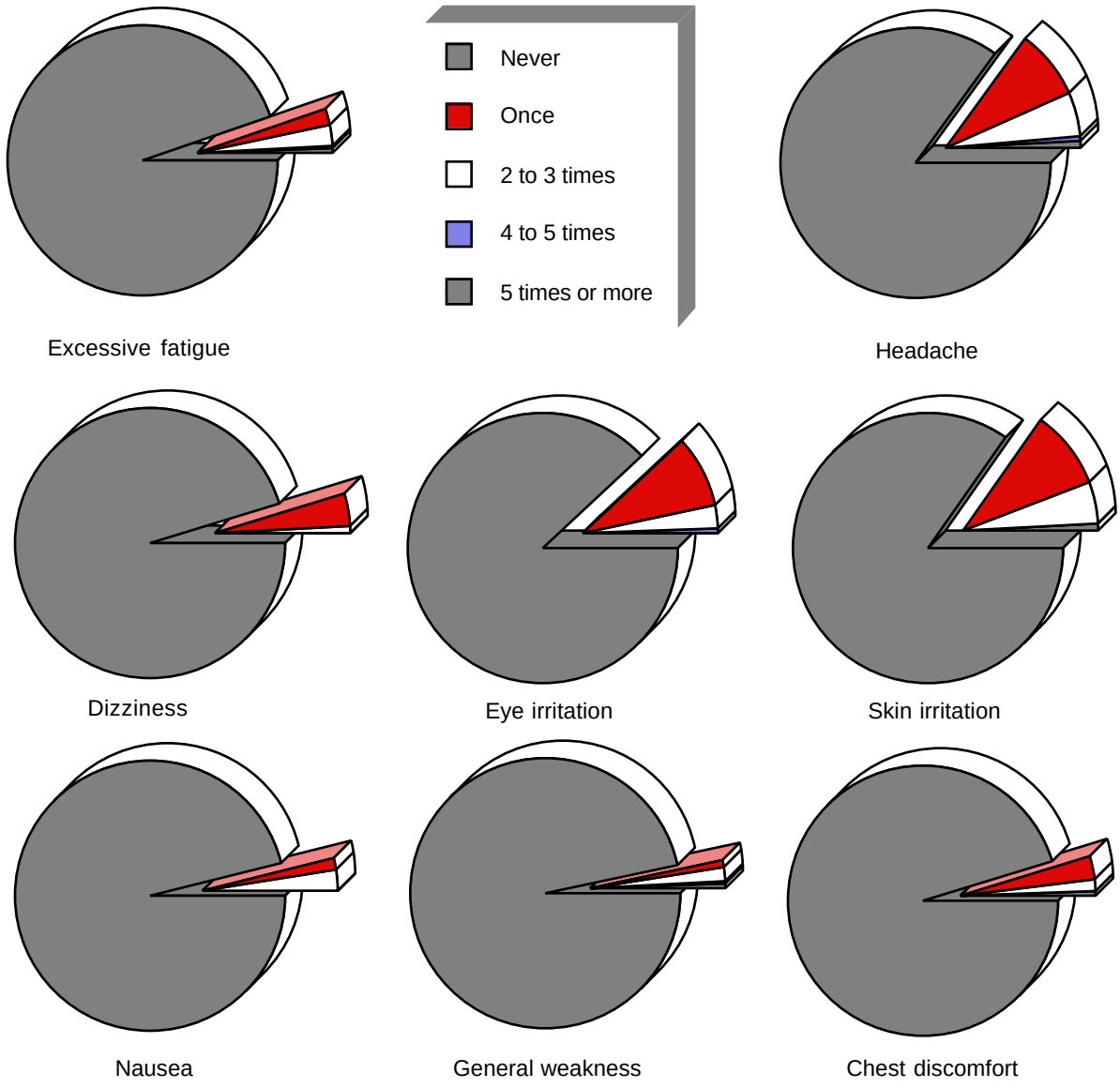


Figure 27: Number of times acute or short-term symptoms associated with exposure to pesticides were felt by New York field corn growers in 1994

Symptoms not illustrated in Figure 27 were diarrhea which was felt by two growers no more than three times, and loss of appetite, experienced by one grower once. Of the ten symptoms, medical help was sought by growers for only two. Table 81 shows that those symptoms were fatigue and eye irritation. In both cases, only one grower sought the help of a physician.

Table 81: Was medical attention sought for symptoms felt by New York field corn growers in the past crop year (76 growers)

Symptom	Medical help Sought: Yes (% of growers experiencing symptoms)	Medical help Sought: No (% of growers experiencing symptoms)
Fatigue (n=11)	9.1	90.9
Eye irritation (n=25)	4.0	96.0

When asked if any particular chemical caused these acute or short-term symptoms, 18.4% of growers who had experienced at least one symptom, one or more times, said "yes, a particular pesticide caused this" (Table 82). Four of the ten materials listed were not used on field corn in 1994. Four of the growers (28.5%) who indicated a particular chemical, named Prowl.

Table 82: New York field corn growers that felt a particular chemical pesticide caused acute or short term exposure symptoms (76 growers)

Caused by a particular brand?	# of responses	% of growers	Trade name	# of growers	Why
no	62	81.6			
yes	14	18.4			
			Prowl	4	It is very hard to wash off, it just lingers, it will make your teeth and gums sore
					To me this is a nasty product, turns everything yellow, including equipment and clothing. If you get a drop on your skin, it is there for a while
					The smell
					Don't know why
			Counter	2	Wind carried odor toward tractor at planting time
					Got some in eye
			Monitor	1	Highly toxic material is sometimes used during the hottest time of the year and PPE can cause discomfort, so I removed some while spraying in the cab, but it still causes discomfort
			Bladex	1	A gust of wind caught the mist
			Butyrac	1	I sprayed it at a high temperature
			Eptam	1	Smell caused headaches
			Force	1	Its the only one we use and apply ourselves
			Disyston	1	No answer
			2,4-D	1	No answer
			Rootworm materials	1	No answer

When asked about chronic or long-term health problems, four growers gave the following answers:

- "Just the stress that goes with the territory. We have to apply to survive, but these chemicals are dangerous just by the implications of this survey."
- "Possible chest problems from applying anhydrous ammonia on farm."
- "Hands shake, more noticeable."
- "Very low sperm count."

CONCLUSIONS AND COMPARISONS

New York State field corn growers appear to wear PPE when working with pesticides. However, many seem to be apathetic and even angry about having to wear the PPE. The following comments were written on the surveys, and the reasons why growers don't wear required PPE given earlier indicated many felt this way:

- "Please try to keep all the 'do-gooders' off our backs. We don't need laws passed so we have to wear a moon suit to go spray. We are smart enough not to get chemicals all over ourselves."
- "The new WPS standards should be made voluntary as far as wearing protective equipment. Employers should be required to educate employees as far as use of the equipment and the dangers of exposure to chemicals, and also to notify workers of applications, but if the employer or the educated employee does not want to use protective equiment, they shouldn't have to. Employers should also have to provide protective equipment to any employee who wants it."
- "Protective clothing for farmers is an item of concern. While needed in most cases, the cost of such items often serves as a deterrent to their use. Farmers are in a price cost squeeze that has gone beyond the realm of most people's understanding."
- "Cost and availability of safety garments are a problem. All pesticide sales agents should be required to sell the protective gear as hard as they sell the product. Chemical companies should promote sales of PPE at fair prices to the farmer. This could be in lieu of all the hats and pens they hand out."
- "I would like to see more infomation on protective equipment. Maybe it's available, I haven't seen it."

Comparisons to other surveys are difficult due to the different climates, pesticides, crops, equipment, regional attitudes, etc., but some relationships between these data and those of a 1992 Iowa State University study (Stone, 1992), where Iowa commercial applicators (for corn and soybeans) were surveyed, as well as a 1993 New York State grape growers survey (Partridge, et. al., 1993) may be useful. Table 83 shows a comparison of certain clothing and protective equipment "nearly always" worn by respondents of the previously mentioned surveys.

Table 83: Comparison of clothing and PPE "nearly always" worn by NY corn growers in 1994, NY grape growers in 1993 and Iowa commercial applicators in 1992

Clothing or PPE	NY corn %	NY grape %	Iowa %
Long-sleeved shirt	47.9	55.4	22.0
Undershirt	80.3	75.7	33.0
Chemical-resistant gloves	54.0	61.5	81.0
Rubber boots	30.0	28.4	20.0
Chemical cartridge respirator	18.3	18.9	5.0
Dust mask	15.5	45.9	6.0
Goggles/face shield	27.7	19.6	26.0

The percent of New York corn growers who "nearly always" wore a long-sleeved shirt and an undershirt was 2.2, and 2.4 times that of Iowa agricultural applicators, but approximately the same as that of New York grape growers. The use of chemical cartridge respirators and dust masks was more prevalent among New York growers, but chemical-resistant gloves were "nearly always" worn by 27% more Iowa applicators. The three-fold difference in dust mask use between corn and grape growers is most likely due to the greater use of dust formulations by grape growers. Dust/mist masks were not recommended when the Iowa survey was completed.

New York corn growers, in general, seem to be following correct laundering procedures: daily washing, separate from family clothes, prerinsing, washing in hot water, and line-drying. The Iowa study and the grape growers survey showed approximately the same results.

Disposable garments are being worn too long by approximeately one-sixth of New York corn growers surveyed in 1994 before they are discarded, compared to one-third of New York grape growers surveyed in 1993. Replacement of gloves and respirator cartridges is not always being done as recommended. Although reusable PPE is being stored by 38.7% of New York corn growers in a pesticide storage area, and 11% of growers in their vehicles (Table 84), maintenance of chemical respirators and eyewear between uses (prior to storage) is being done correctly.

Table 84: Comparison of storage of PPE by NY corn growers in 1994, NY grape growers in 1993 and Iowa commercial applicators in 1992

Storage practice	NY corn %	NY grape %	Iowa %
In pesticide storage area	38.7	23.5	38.0
In vehicle	11.0	3.4	40.0

Label compliance was reported at the same frequency in both New York surveys and in Iowa, but as mentioned previously, New York corn growers are angry about the rules regarding compliance. New York field corn growers demonstrated an interest in learning about protective equipment through resources such as training manuals and fact sheets. They attend programs sponsored by Extension, and prefer a training session format.

All short-term symptoms associated with exposure to pesticides were experienced at least once by at least one field corn grower in New York in 1994. They were experienced with approximately the same frequency by New York grape growers in 1993. In both cases, very few respondents sought medical help for the symptoms

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