NJ Department of Environmental Protection
Bureau of Quality Assurance and Environmental Monitoring
Pesticide Evaluation and Monitoring Section

AGRICULTURAL PESTICIDE USE IN NEW JERSEY: 2018 SURVEY

Introduction

The Pesticide Evaluation and Monitoring Section (PEMS) began a series of pesticide use surveys in 1985. These surveys address pesticide use by licensed applicators in the state of New Jersey for agriculture, golf courses, termite control, right-of-way, mosquito control, and lawn care. The agricultural use survey is conducted every three years and targets agricultural, nursery and greenhouse use of general and restricted use pesticides. This report focuses on the seventh survey completed in the agricultural use series (2018).

All statewide pesticide use surveys are performed under the authority of the New Jersey Pesticide Control Code (NJPCP), N.J.A.C. 7:30-1 et.seq., requiring licensed applicators to maintain pesticide records for three years and to submit use records to the state when requested. This regulative authority provides an accuracy and level of response that is difficult to duplicate in a voluntary, nationwide survey. In fact, these New Jersey surveys could represent a pesticide usage census rather than a probabilistic survey.

The information collected from the PEMS pesticide use surveys is used by programs within the NJ Department of Environmental Protection along with other state agencies to aid in research, exposure management and monitoring efforts in areas such as ground water protection, farm worker protection and education, and residual pesticide sampling.

Survey Methods

The NJDEP Bureau of Licensing and Registration's records were used to identify 1,734 licensed Private Applicators. A Private Applicator is any person who uses, or supervises the use, of pesticides for the purpose of raising an agricultural commodity. Survey forms, along with instructional letters and return envelopes, were mailed to all 1,734 Private Applicators asking for only 2018 agricultural pesticide use. A total of three mailings were sent during the first four months of 2019.

The survey requested information on each pesticide product used, including trade name, EPA registration number, percent active ingredient, amounts applied, and types of crops treated.

Survey information was entered into a database file. This information file was then merged with a second database that linked trade names with chemical names, and a subprogram converted reported amounts of formulated product to amounts of active ingredient (lbs. a.i.).

Results & Discussion

Once all three mailings were completed, 1,378 out of 1,734 (79%) applicators responded. This response rate is the lowest since the first survey in 2000. Many surveys were returned because applicators are not keeping their mailing address current with the Bureau of Licensing and Registration. PEMS forwarded "returned to sender" surveys to the Bureau of Licensing and Registration for follow-up. PEMS also forwarded a list of non-responders to the Bureau of Compliance for follow-up.

Pesticides used by the agricultural industry in New Jersey for 2018 totaled 971,386 lbs. a.i. Table 1 lists all the compounds reported in the 2018 survey and the amounts (lbs. a.i.) applied. Herbicides comprise 46% of the total pesticide use reported in the New Jersey agricultural industry. Fungicides and insecticides account for 36% and 13% of the total respectively. Rodenticides, growth regulators, fumigants, bactericides and miscellaneous chemicals comprise the remaining 5% of pesticides applied for agricultural pest control.

Total fungicide use decreased by 35% from 2015 reported use. Azoxystrobin, a fungicide used mainly on blueberries and cranberries in New Jersey, decreased from 181,315 lbs. a.i. in 2015 to 7,454 lbs. a.i. in 2018. Total herbicide use increased by 68,273 lbs. a.i., mainly due to the increased use of glyphosate from 2015 to 2018.

Table 1. Pesticide amounts (lbs. a.i.) reported in the New Jersey 2018 Agricultural Pesticide Use Survey.

HERBICIDES	lbs. a.i.	HERBICIDES	lbs. a.i.
2,4-D	14,468	Carfentrazone-ethyl	22
2,4-DB*	22	Chlorimuron-ethyl	131
2,4-DP	4	Chlorthal-dimethyl	13,159
Acetochlor	6,856	Clethodim	1,332
Acifluorfen	86	Clomazone	1,773
Alachlor	50	Clopyralid	763
Aminopyralid*	183	Cloransulam-methyl	165
Atrazine	40,626	Cycloate	1,329
Bensulide	6,791	Dicamba	5,471
Bentazon	951	Dichlobenil	313
Benzamide	28	Dimethenamid	1,224
Bicyclopyrone	374	Diquat	676
Bromoxynil	2	Dithiopyr	350
Carbofluorfen	111	Diuron	4,642

Table 1. (cont.)

HERBICIDES	lbs. a.i.
EPTC	339
Ethalfluralin	1,786
Ethofumesate	111
Fenoxaprop-ethyl	210
Florasulam*	5
Fluazifop-butyl	53
Flumiclorac-pentyl	2
Flumioxazin	876
Fluroxpyr	49
Fluthiacet-methyl	73
Fomesafen sodium	650
Glufosinate-ammonium	9,957
Glyphosate	193,961
Halauxifen-methyl*	7
Halosulfuron-methyl	365
Hexazinone	73
Imazamox	1
Imazethapyr	138
Imazosulfuron	88
Indaziflam	283
Isoxaben	881
Isoxaflutole	160
Lactofen	49
Linuron	2,255
MCPA*	22
Mecoprop	376
Mesotrione	3,155
Methyl octanoate*	135
Metolachlor	50,198
Metribuzin	3,304
Metsulfuron-methyl	1
Napropamide	7,989
Nicosulfuron	9
Norflurazon	10,547
Oryzalin	11,017
Oxadiazon	99
Oxyfluorfen	1,000
Paraquat	17,825
Pelargonic acid	68
Pendimethalin	15,313
Phenmedipham	961
Prodiamine	1,411
Prometon	29
Prometryn	215
Pronamide	983
Prosulfuron*	1
Pyroxasulfone	2,669
Pyroxsulam	3
Quinclorac	46
Rimsulfuron	216
Saflufenacil	179
Sethoxydim	382
Sodium chlorate*	43
Siduron	2
Simazine	5,151
Sulfentrazone	1,139
Tebuthiuron*	1
Tembotrione	72
Terbacil	1,339
Thiencarbazone-methyl	46
Thifensulfuron	141
Topramezone	7
Tribenuron	65
Tripclopyr	103
Trifluralin	824
HERBICIDES TOTAL	**451,360**

Table 1. (cont.)

INSECTICIDES	lbs. a.i.	INSECTICIDES	lbs. a.i.
Abamectin	46	Flonicamid	22
Acephate	4,044	Flubendiamide	65
Acequinocyl	5	Flupyradifurone	927
Acetamiprid	764	Fluvalinate	11
Azadirachtin	15	Formethanate HCL*	11
Azinphos-methyl	15	Hexythiazox	2,815
Bacillus spp.	5,061	Imidacloprid	1,670
Bifenazate	286	Indoxacarb	463
Bifenthrin	2,085	Isaria fumosorosea	1
Borate*	61	Lambda-cyhalothrin	1,502
Burkholderia spp.*	1,358	Malathion	1,714
Carbaryl	11,718	Metarhizium anisopliae*	1
Chlorantraniliprole	709	Methiocarb	46
Chlorfenapyr	9	Methomyl	6,373
Chlorpyrifos	6,543	Methoxyfenozide	497
Chromobacterium subtsugae*	166	Oxydemeton-methyl*	1
Clofentezine	21	Novaluron	35
Chenopodium ambrosioides*	145	Oil	54,777
Chlothianidin	306	Oxamyl	1,267
Cyantraniliprole	244	Permethrin	1,377
Cyclaniliprole*	15	Phorate	46
Cyflumetofen*	59	Phosmet	8,406
Cyfluthrin	930	Pymetrozine	95
Cypermethrin	538	Pyrethrins	15
Diazinon	4,220	Pyridaben	12
Dimethoate	692	Pyridalyl	569
Dinotefuran	286	Pyrifluqunazon*	17
Emamectin	3	Soap	522
Endosulfan	11	Spinetoram	722
Etoxazole	14	Spinosad	235
Fenazaquin*	2	Spirodiclofen	21
Fenbutatin oxide	2	Spiromesifen	230
Fenpropathrin	531	Spirotetramat	79
Fenpyroximate	133	Tefluthrin	8
Fenvalerate	467	Terbufos	183
Fipronil	61	Thiacloprid	2

Table 1. (cont.)

INSECTICIDES	lbs. a.i.
Thiamethoxam	906
Tolfenpyrad*	54
Trichlorfon	299
INSECTICIDES TOTAL	**127,561**

GROWTH REGULATORS	lbs. a.i.
Aminoethoxyvinylglycine	45
Ancymidol	1
Benzyladenine	9
Chlormequat chloride	183
Cyromazine	228
Cytokinin	2
Daminozide	918
Diflubenzuron	1
Dikegulac sodium	23
Ethephon	656
Gibberellin	23
Indole-3-butyric acid	12
Kinoprene	3,057
NAA	13
Paclobutrazol	17
Prohexidone calcium	14
Pyriproxyfen	63
Trinexapac-ethyl	221
GROWTH REGULATORS TOTAL	**5,486**

MISCELLANEOUS^	lbs. a.i.
Capsaicin	4
Chitosan*	3
Ferric sodium*	7
Fluensulfone*	84
Garlic oil	10
Iron phosphate	16
Kaolin	1,729
Lime sulfur*	2,997
Metaldehyde	78
Methyl anthranilate	85
Neem oil	30
Octadecadienol	588
Paecilomyces spp.*	30
Piperonyl butoxide	90
Soybean oil	25
MISCELLANEOUS TOTAL	**5,776**

FUMIGANTS	lbs. a.i.
Aluminum phosphide*	8
Metam-sodium	20,341
FUMIGANTS TOTAL	**20,349**

Table 1. (cont.)

FUNGICIDES	lbs. a.i.	FUNGICIDES	lbs. a.i.
Acibenzolar-methyl	26	Flutolanil	24
Ametoctradin	349	Flutriafol	201
Azoxystrobin	7,454	Fluxapyroxad	449
Benomyl*	2	Fosetyl-al	557
Benzovindiflupyr	142	Gliocladium virens	131
Boscalid	1,950	Iprodione	3,209
Buprofezin	239	Isofetamid*	26
Calcium polysulfide	908	Kresoxim-methyl	75
Captan	53,140	Laminaran	13
Carbamate	449	Mancozeb	41,798
Carbonic acid	26	Mandipropamide	532
Chlorothalonil	65,786	Maneb	243
Coniothyrium mintans	15	Mefenoxam	338
Copper salts	32,470	Metalaxyl	1,628
Cyazofamid	880	Metconazole	1,049
Cyflufenamid	64	Metiram	14
Cymoxanil	445	Metrafenone	117
Cyproconazole	52	Myclobutanil	1,028
Cyprodinil	2,295	Oxathiapiprolin*	211
Difenoconazole	578	Penthiopyrad	418
Dimethomorph	293	Penflufen*	16
Dodine	160	Phosphite	1,558
Ethaboxam*	70	Phosphoric acid	227
Etridiazole	125	Picoxystrobin	152
Famoxadone	444	Piperalin	7
Fenamidone	7	Polyoxin D zinc	30
Fenarimol	1	Potassium salts*	20,201
Fenbuconazole	1,698	Propamacarb HCL	5,119
Fenhexamid	339	Propiconazole	2,075
Ferbam	1,675	Prothioconazole*	435
Fluazinam	60	Pyraclostrobin	2,593
Fludioxonil	386	Pyrimethanil	148
Fluopicolide	314	Pyriofenone*	17
Fluopyram	123	Quinoxyfen	165
Fluoxastrobin	3	Quintozene	274
Flutianil*	5	Reynoutria sachalinensis	185

Table 1. (cont.)

FUNGICIDES	lbs. a.i.
Sulfur	65,174
Tebuconazole	574
Tetrachloroisophthalonitrile*	967
Tetraconazole*	2
Thiabendazole	14
Thiophanate-methyl	5,356
Thiram	437
Triadimefon	33
Trichoderma spp.*	6
Trifloxystrobin	918
Triflumizole	82
Triticonazole*	22
Ziram	19,829
Zoxamide	122
FUNGICIDES TOTAL	**351,772**

*Indicates a compound not reported in the 2015 survey.
^Miscellaneous compounds include pheromones, synthetic alternatives (naturally occurring elements/compounds), synergists, and disinfectants.

Table 2 lists the highest use compounds in the three main agricultural use pesticide categories (lbs. a.i.) as listed in Table 1. The most highly reported pesticide used in agricultural pest control was the herbicide glyphosate. This herbicide accounted for approximately 20% of the total pesticides applied for agricultural pest control in New Jersey in 2018. Glyphosate is a broad spectrum, systemic herbicide. It is most widely used to control annual broad-leaf weeds that compete with crops. According to the 2018 survey data, 61% of the glyphosate used in New Jersey is applied to soybeans. The second most heavily used agricultural pest control chemical is the fungicide chlorothalonil (7% of NJ total). Chlorothalonil is a broad-spectrum, non-systemic fungicide used to control fungi in a wide variety of agricultural commodities including vegetables, turf, tree fruit and ornamentals. In New Jersey in 2018, 32% of reported chlorothalonil use was on cranberries.

Table 2. Highest use compounds in the New Jersey 2018 Agricultural Pesticide Use Survey.

Compound	Total (lbs. a.i.)	% of Category	% of Total Usage
HERBICIDES: 451,360 lbs. a.i.			
Glyphosate	193,961	43	20
Metolachlor	50,198	11	5
Atrazine	40,626	9	4
INSECTICIDES: 127,561 lbs. a.i.			
Oil	54,777	43	6
Carbaryl	11,718	9	1
Phosmet	8,406	7	1
FUNGICIDES: 351,772 lbs. a.i.			
Chlorothalonil	65,786	19	7
Sulfur	65,174	19	7
Captan	53,140	15	5
FUMIGANTS: 20,349 lbs. a.i.			
Metam-sodium	20,341	100	2

Table 3 shows the reported amount (lbs. a.i.) applied to each type of crop in New Jersey in 2018. Soybeans received 17% of the total amount of pesticides applied. Four commodities—soybeans, field corn, peaches and blueberries—received just over half (487,712 lbs. a.i.) of the total amount of agricultural pesticides used in 2018. The remaining 483,675 lbs. a.i. were distributed over 28 different types of commodities.

Table 3. Use totals by type of crop in the New Jersey 2018 Agricultural Use Survey.

Crop	Amount (lbs. a.i.)	% of Total Use
Soybeans	161,379	17
Field Corn	140,314	14
Peaches	102,614	11
Blueberries	83,405	9
Ornamentals	72,925	8
Apples	65,186	7

Crop	Amount (lbs. a.i.)	% of Total Use
Other	49,866	5
Cranberries	42,967	4
Peppers	32,563	3
Tomatoes	28,236	3
Grapes	27,234	3
Potatoes (White and Sweet)	20,928	2
Cucumbers	20,793	2
Sweet Corn	14,378	1
Other Tree Fruit	13,495	1
Asparagus	12,496	1
Eggplant	12,216	1
Alfalfa/Other Hay	11,281	1
Leafy Greens	10,880	1
Sod	9,142	1
Small Grains	6,497	1
Cabbage	6,448	1
Lettuce	4,854	<1
Spinach	4,733	<1
Other Leafy Vegetables	4,112	<1
Chinese Vegetable Varieties	3,553	<1
Strawberries/Brambles	3,077	<1
Other Beans/Peas	2,401	<1
Broccoli	1,710	<1
Cauliflower	957	<1
Other Cole Crops	564	<1
Brussel Sprouts	181	<1
Livestock/Poultry	1	<1

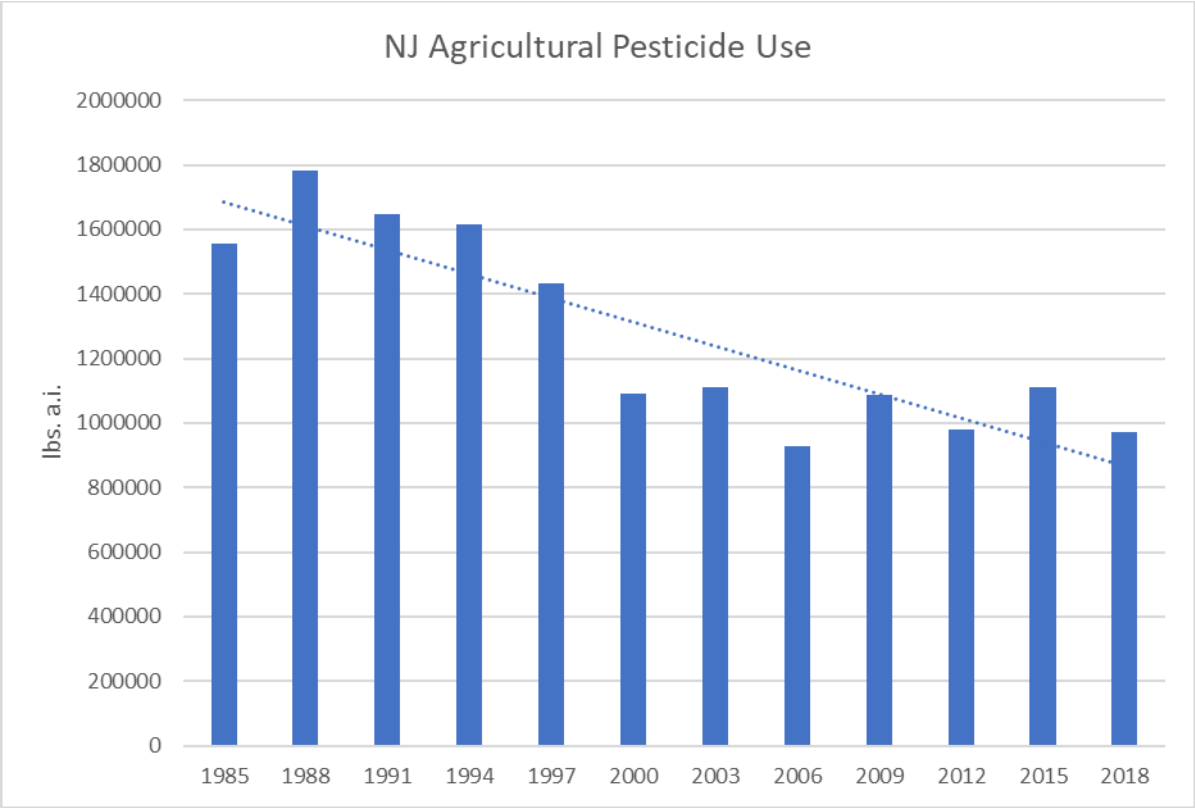
Table 4 shows agricultural pesticide use by county. Salem and Cumberland counties had the highest overall use with 179,492 and 177,970 lbs. a.i. reported in 2018 respectively. These two counties account for 36% of the statewide use. Agricultural pesticide use in Burlington county decreased by more than 50% from 2015 (289,416 to 134,989 lbs. a.i.). Reported agricultural use in Camden county more than doubled from 2015 (6,172 to 15,582 lbs. a.i.). Twenty of New Jersey's twenty-one counties reported agricultural pesticide use (Hudson county being the exception).

Table 4. Total pesticide amounts (lbs a.i.) by county in the New Jersey 2018 Agricultural Use Survey.

County	Amount (lbs. a.i.)	% of Total
Salem	179,492	18
Cumberland	177,970	18
Burlington	134,989	14
Gloucester	126,385	13
Atlantic	91,111	9
Warren	71,109	7
Hunterdon	45,776	5
Monmouth	35,996	4
Mercer	18,570	2
Morris	17,872	2
Camden	15,582	2
Ocean	13,486	1
Sussex	11,256	1
Middlesex	9,645	1
Somerset	9,479	1
Cape May	8,479	1
Passaic	2,848	<1
Bergen	1,295	<1
Essex	38	<1
Union	10	<1

Figure 1 shows the total lbs. a.i. used in New Jersey for each agricultural use survey conducted. The reported pesticide usage for agricultural pest control has remained consistent between 2000 and 2018, with only a 16% change between the peak reported use in 2003 and lowest reported use in 2006.

Figure 1. Total lbs. a.i. used in New Jersey for each agricultural use survey conducted (1985-2018). The trend line indicates a steady decrease in reported pesticide use since the surveys began.



Summary & Conclusions

The herbicide glyphosate accounted for approximately 20% of the total pesticides applied for agricultural pest control in New Jersey in 2018. Between 2015 and 2018, there was a 29% increase in reported glyphosate use in New Jersey agriculture. Since the first survey in 1985, there has been a 97% increase in reported glyphosate use from 6,001 lbs. a.i. to 193,961 lbs. a.i.. Glyphosate is the most heavily used herbicide world-wide. However, its effectiveness and ease of application have led to overuse and many weed varieties have developed glyphosate resistance. Farmers now need to apply more glyphosate to reach the same levels of effectiveness. Glyphosate-resistant weeds is likely one explanation for the increase in reported use.

The number of licensed Private Applicators in New Jersey has decreased by approximately 45% from 3,317 in 1985 to 1,734 in 2018. It is interesting to note that while the number of licensed Private Applicators has decreased by almost half since 1985, according to the Census of Agriculture, the number of farms in New Jersey was higher in 2017 (9,883 farms) than it was in 1987 (9,032 farms). However, while the number of farms is higher, the average size of each farm

has decreased from 99 acres in 1987 to 74 acres in 2017. Fewer Private Applicators may be attributed to less acres being farmed overall. PEMS will reach out to the Department of Agriculture for clarification.

The response rate has also decreased from a peak response rate of 96% in 1988 to an all-time low of 79% in 2018. When you combine the low response rate and decrease in licensed Private Applicators, 2018 saw the lowest number of individual survey responses since the Private Applicator survey began in 1985. There were 3,007 survey responses in 1988, while there were only 1,378 responses in 2018. With the number of Private Applicators consistently decreasing year after year, PEMS will also reach out to the Department of Agriculture for suggestions on how to increase the survey response rate to ensure the accuracy of the pesticide use data that is collected.

Pesticides used by the agricultural industry in New Jersey for 2018 totaled 971,386 lbs. a.i. As the trend line in Figure 1 shows, there has been a steady decrease in reported agricultural pesticide use since the surveys began in 1985. However, as discussed previously, the number of licensed Private Applicators, survey response rate and number of acres being farmed in New Jersey have also decreased in the same time period. Therefore, it is hard to identify with any certainty which of these factors may be related to the steady decrease in reported pesticide use. It is likely that fewer licensed applicators are applying fewer pesticides to fewer acres, but the lower survey response rate makes that unclear.

In the future, PEMS will look for ways to streamline the survey data submission. Private Applicator survey data is quite cumbersome to report and streamlining the process might increase survey response rate.