DEPARTMENT OF AGRICULTURE

Pesticide Use on Sugarbeets in Minnesota 2021

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Acknowledgements

This report is a result of collaborative efforts between the Minnesota Department of Agriculture (MDA) and Minnesota Sugarbeet Cooperatives. The MDA is very grateful to Southern Minnesota Beet Sugar Cooperative (SMBSC), American Crystal Sugar Company (ACSC) and Minn-Dak Farmers Cooperative (MDFC) for voluntarily providing the sugarbeet pesticide use information. Special thanks go to Joe Hastings (ACSC), Emma Burt (MDFC) and Mark Bloomquist (SMBSC) for coordinating the data compilation and reviewing the report. The MDA is also thankful to Dr. Tom Peters, Associate Professor/Sugarbeet Agronomist, North Dakota State University for providing the avenue to connect with the Minnesota Sugarbeet Cooperatives and reviewing the report. We are also grateful to the sugarbeet growers associated with SMBSC, ACSC and MDFC who were directly or indirectly involved in the data compilation.

Executive Summary

Pesticides are an important tool in managing weeds (herbicides), diseases (fungicides), and insects (insecticides) in sugarbeets. Pesticide use information for corn, soybeans and other important Minnesotan crops has been well documented through the Minnesota Department of Agriculture (MDA) and United States Department of Agriculture's National Agricultural Statistics Service (USDA NASS) collaborative surveys. However, such information has not been available for sugarbeets through the MDA and USDA NASS survey. This survey was designed to collect basic pesticide use information on sugarbeet acres, including the use of pesticide treated seeds, for 2021 growing season. Southern Minnesota Beet Sugar Cooperative (SMBSC), American Crystal Sugar Company (ACSC), and Minn-Dak Farmers Cooperative (MDFC) collaborated for data compilation and provided the MDA a comprehensive pesticide use data set representative of their growers. The data were organized and presented in a form similar to pesticide data collected by the MDA and USDA NASS for other crops in Minnesota. This report represents 425,868 acres of sugarbeets planted in Minnesota by the growers associated with SMBSC, ACSC and MDFC.

This report summarizes herbicide, insecticide and fungicide use[1] on sugarbeet acres in Minnesota for the 2021 growing season. The pesticide use information presented in this report is solely based on the data provided by SMBSC, ACSC and MDFC and does not represent the sugarbeet acres not associated with the cooperatives.

- Sugarbeet growers associated with SMBSC, ACSC and MDFC reported[2] using 12 herbicide active ingredients, 5 insecticide active ingredients and 14 fungicide active ingredients to manage weeds, insects, and diseases excluding seed treatments. Growers used 10 fungicide active ingredients and 2 insecticide active ingredients as seed treatments.
- A total of 4,665,546 pounds of pesticide active ingredients including seed treatments were used on 425,868 acres of reported sugarbeet acres.
- Herbicides were applied to 100% of reported sugarbeet acres. Glyphosate (100%) was applied on the most acres.
- Fungicides were applied to 100% of reported sugarbeet acres. Triphenyltin Hydroxide (97%) was applied on the most acres. This does not include fungicide seed treatments.
- Fungicide treated seeds were used on 100% of reported acres. Thiram (100%) was applied on the most acres as seed treatments.

[1] Insecticide and fungicide seed treatments was included in this report. There was no herbicide included on the sugarbeet seed.

[2] Active ingredients used on very few acres were not reported, generally less than 1,000 acres.

- At least 47% of reported acres didn't receive any insecticide applications. Chlorpyrifos[3] (24%) was applied on the most acres. Neonicotinoid insecticide, imidacloprid, was applied to 4% of reported acres as an in-furrow at-plant application.

- About 70% of reported acres didn't receive any insecticide seed treatments. Insecticide seed treatments included only neonicotinoids, clothianidin and thiamethoxam. Clothianidin (29%) was applied on the most acres as seed treatments.

[3] Following the 2023 Eighth Circuit Court ruling, the Environmental Protection Agency (EPA) reinstated food and feed tolerances for chlorpyrifos. The MDA has conditionally registered chlorpyrifos products for food and feed uses for 2024 only, requiring Water Quality Best Management Practices for chlorpyrifos to be accompanied with the sale of each product.

Background

In 2021, sugarbeet crop was the third most valuable crop in Minnesota after corn and soybeans with a value of 656 million dollars, according to the USDA[4]. This was the highest value of sugarbeet production recorded until this time[4]. In the past 10 years, Minnesota has typically produced between 30 to 35% of all US sugarbeet production (Figure 1)[4]. In each year since 1970, Minnesota was the top sugarbeet producing state. Sugarbeet production in the state is concentrated along the Minnesota River Valley and the Red River Valley (Figure 2)[5].

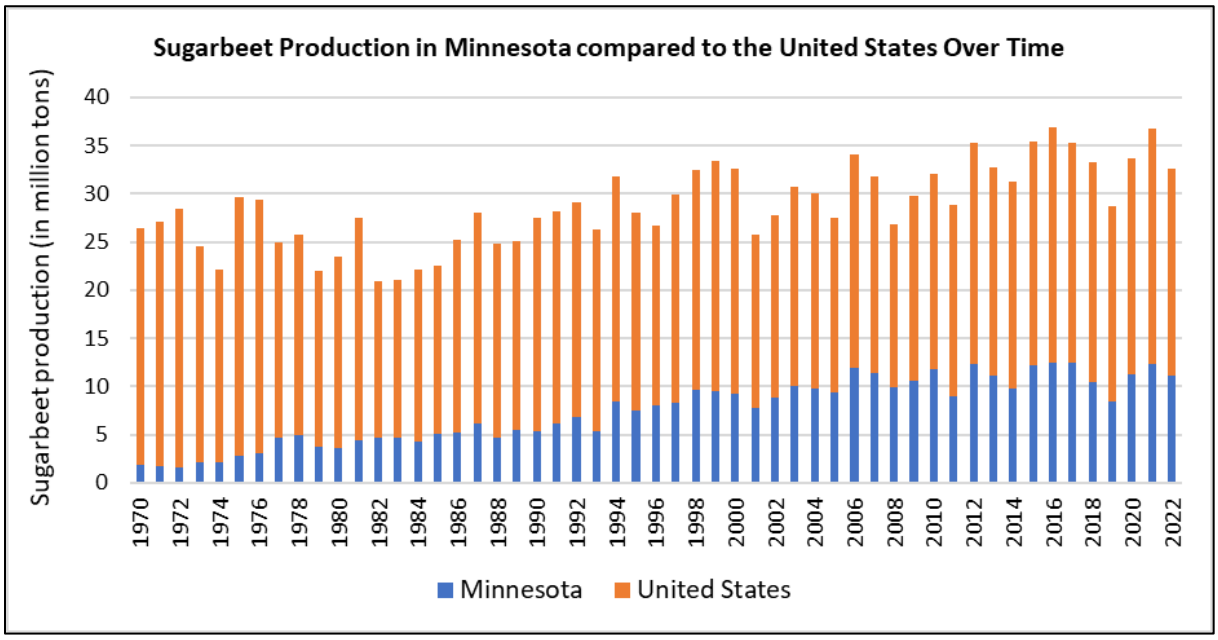

Figure 1. Sugarbeet production in Minnesota from 1970 through 2022 (Source: USDA)

There are three sugarbeet cooperatives in Minnesota: Southern Minnesota Beet Sugar Cooperative (SMBSC), American Crystal Sugar Company (ACSC), and Minn-Dak Farmers Cooperative (MDFC). Each cooperative is owned by growers who are the shareholders of the company with the right and obligation to grow and deliver sugarbeets to be refined into white granulated sugar. Cooperatives provide technical assistance and supply resources to their growers for the proper management of weeds, diseases, and insects. A total of 425,868 acres of sugarbeets were planted in Minnesota in the 2021 growing season by the growers associated with these cooperatives. These planted acres produced 12.2 million tons of sugarbeets resulting in 28.7 tons per acre[6].

[4] https://www.nass.usda.gov/Data_and_Statistics/index.php

[5] https://croplandcros.scinet.usda.gov/

[6] Based on reported planted acres, not harvested acres

Several weeds, insects and diseases are commonly reported on sugarbeet acres in Minnesota[7]. Example grass and broadleaf weeds include waterhemp, pigweed, kochia, lambsquarter, wild oat, cocklebur, ragweed, thistle, barnyard grass, buffalo bur, foxtail, and nightshade. Sugarbeet root maggot, wireworms, cutworms, springtails and lygus bugs are major insect pests that attack sugarbeets. Diseases such as aphanomyces damping-off, rhizoctonia damping-off, fusarium yellows/yellowing, rhizomania (crazy root), cercospora leaf spot, bacterial leaf spot, and alternaria leaf spot are commonly reported on sugarbeets.

Sugarbeet farming requires intensive management practices that include proper pesticide use for managing a range of pests. Pesticides are an important tool to protect sugarbeets from weeds, diseases, and insects. Pesticide use information for other major Minnesotan crops has been well documented through the Minnesota Department of Agriculture (MDA) and United States Department of Agriculture's National Agricultural Statistics Service (USDA NASS) collaborative surveys. However, such information has not been available for sugarbeets through the MDA and USDA NASS survey. The MDA has been gathering and providing pesticide information for corn, soybeans, wheat, and alfalfa to the public for nearly 20 years in partnership with the USDA NASS (reports are available at Agricultural Pesticide Sales and Use Reports - Statewide | Minnesota Department of Agriculture).

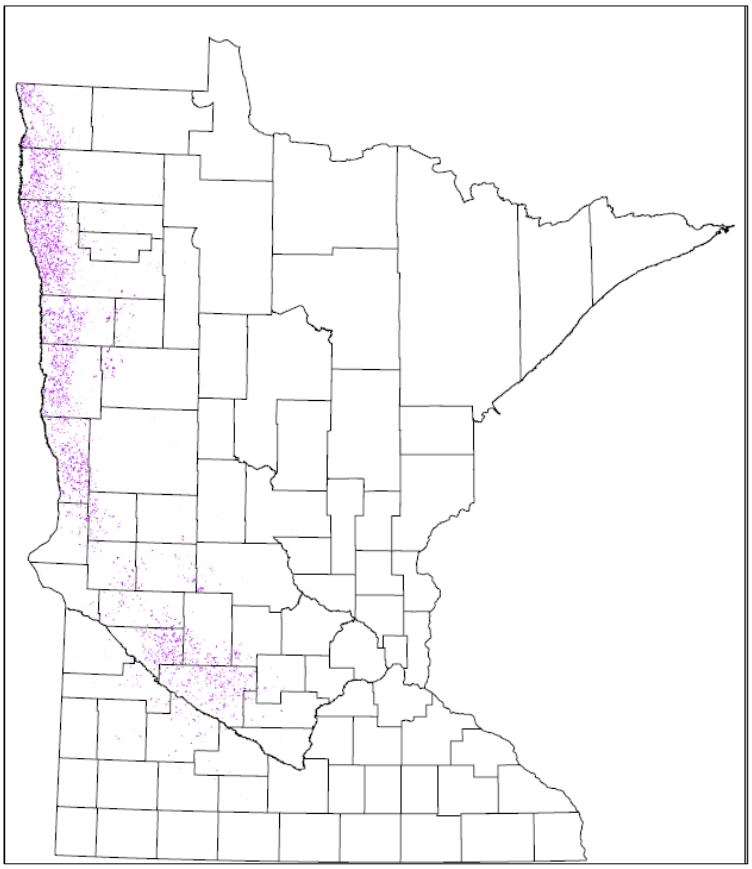

Figure 2. A map showing sugarbeet production areas in Minnesota (Source: USDA)

[7] Sugarbeet production guide (https://www.ndsu.edu/agriculture/sites/default/files/2023-01/a1698-23.pdf)

Survey Objective, Data Collection and Limitations

This survey was designed to collect basic information on herbicide, fungicide and insecticide use including the use of fungicide and insecticide treated seeds in sugarbeet industry for 2021 growing season. The survey is a result of collaborative efforts between the MDA and Minnesota sugarbeet cooperatives and is the first statewide report of pesticide use on sugarbeet acres in Minnesota from the MDA. The information presented in this report is based on reported planted acres, not harvested acres.

SMBSC, ACSC and MDFC collaborated to provide combined data set in the provided formats. The data represent collective and representative information of sugarbeet growers associated with SMBSC, ACSC and MDFC. The collected data were organized and presented in a form similar to pesticide data collected by the MDA and USDA NASS for other major crops in Minnesota. The provided data were presented as such without weighing them unlike the way the pesticide use data were presented in the MDA's other pesticide use reports (https://www.mda.state.mn.us/agricultural-pesticide-sales-use-reports-statewide).

It is not possible to determine which sugarbeet acres received two or more products of different active ingredients though the individual applications and rates were captured based on the provided information. For example, sugarbeet acres that received s-metolachlor applications were captured but it was not possible to report acres that received both s-metolachlor and ethofumesate. Sugarbeet acres treated with an herbicide that contains more than one active ingredient were presented as such without separating them by individual active ingredient.

The pesticide use information presented in this report is solely based on the data provided by SMBSC, ACSC and MDFC and does not represent the sugarbeet acres not associated with the cooperatives.

Data Interpretation and Findings

Pesticide Application Overview

Growers associated with SMBSC, ACSC and MDFC planted 425,868 acres of sugarbeets in the 2021 growing season. Growers reported 31 pesticide active ingredients excluding seed treatments (12 herbicide active ingredients, five insecticide active ingredients and 14 fungicide active ingredients) to manage weeds, insects, and diseases (Table 1 - 5). Growers reported 10 fungicide active ingredients and two insecticide active ingredients for seed treatments (Table 8 and 10).

Table 1. Herbicide active ingredients used on sugarbeet acres in 2021

Active Ingredient (Herbicide)	Sites of action group	Example products*
Acetochlor	15	Warrant
Aciflourfen	14	Ultra-Blazer
Clethodim	1	Select
Clopyralid	4	Stinger
Desmedipham + Phenmedipham	5 + 5	Betamix
Desmedipham + Phenmedipham + Ethofumesate	5 + 5 + 16	Progress
Dimethenamid-p	15	Outlook
Ethofumesate	16	Nortron
Glyphosate	9	Glyphosate
Quizalofop	1	Assure II
S-metolachlor	15	Dual Magnum
Triflusulfuron	2	Upbeet

*Reference to commercial products or trade names is made with the understanding that no discrimination is intended, and no endorsement is implied. The example pesticide products mentioned in the table do not necessarily represent the products used by sugarbeet growers associated with SMBSC, ACSC and MDFC.

Table 2. Fungicide active ingredients used on sugarbeet acres in 2021

Active Ingredient (Fungicide)	Modes of action group	Example products*
Azoxystrobin	11	Quadris
Bixafen	7	Lucento
Copper	M1	Copper
Difenoconazole	3	Inspire
Flutriafol	3	Lucento
Fluxapyroxad	7	Priaxor
Mancozeb	M3	Maneb
Mefentrifluconazole	3	Provysol
Propiconazole	3	Inspire
Prothioconazole	3	Proline
Pyraclostrobin	11	Headline
Tetraconazole	3	Eminent
Thiophanate Methyl	1	Topsin M
Triphenyltin Hydroxide	30	Tin

*Reference to commercial products or trade names is made with the understanding that no discrimination is intended, and no endorsement is implied. The example pesticide products mentioned in the table do not necessarily represent the products used by sugarbeet growers associated with SMBSC, ACSC and MDFC.

Table 3. Fungicide active ingredients used for seed treatment on sugarbeet acres in 2021

Active Ingredient (Fungicide Seed Treatment)	Modes of action group	Example products*
Fludioxonil	12	Maxim 4
Fluxapyroxad	7	Systiva
Hymexazol	32	Tachigaren
Mefenoxam	4	Apron XL
Metalaxyl	4	Allegiance
Metconazole	3	Metlock
Penthiopyrad	7	Kabina
Sedaxane	7	Vibrance
Thiram	M3	Thiram
Tolclofos-methyl	14	Rizolex

*Reference to commercial products or trade names is made with the understanding that no discrimination is intended, and no endorsement is implied. The example pesticide products mentioned in the table do not necessarily represent the products used by sugarbeet growers associated with SMBSC, ACSC and MDFC.

Table 4. Insecticide active ingredients used on sugarbeet acres in 2021

Active Ingredient (Insecticide)	Mode of action group	Example products*
Chlorpyrifos	1B	Lorsban
Esfenvalerate	3A	Asana XL
Imidacloprid	4A	Midac FC
Terbufos	1B	Counter
Zeta-cypermethrin	3A	Mustang max

*Reference to commercial products or trade names is made with the understanding that no discrimination is intended, and no endorsement is implied. The example pesticide products mentioned in the table do not necessarily represent the products used by sugarbeet growers associated with SMBSC, ACSC and MDFC.

Table 5. Insecticide active ingredients used for seed treatment on sugarbeet acres in 2021

Active Ingredient (Insecticide Seed Treatment)	Mode of action group	Example products*
Clothianidin	4A	Poncho Beta
Thiamethoxam	4A	Cruiser

*Reference to commercial products or trade names is made with the understanding that no discrimination is intended, and no endorsement is implied. The example pesticide products mentioned in the table do not necessarily represent the products used by sugarbeet growers associated with SMBSC, ACSC and MDFC.

Herbicide Application

A summary of herbicide applications on reported sugarbeet acres is presented in Table 6. Herbicides were applied to 100% of reported sugarbeet acres in 2021 growing season[8]. Glyphosate (100%) was applied on the most acres. Glyphosate and s-metolachlor contributed the most pounds of active ingredient applied per year for reported planted acres.

Table 6. Herbicide application details by active ingredient (a.i.) for sugarbeets

Agricultural Chemical (a.i.)	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre* (a.i.)	Average Rate Per Crop Year *Pounds per Acre* (a.i.)	Total Applied Per Crop Year *Total Pounds* (a.i.)
Acetochlor	6.46	1.00	0.94	0.94	25,805
Aciflourfen	8.68	1.00	0.25	0.25	9,243
Clethodim	11.29	1.00	0.07	0.07	3,280
Clopyralid	51.95	1.53	0.07	0.11	23,801
Desmedipham + Phenmedipham	3.82	1.00	0.24	0.24	3,970
Desmedipham + Phenmedipham + Ethofumesate	0.14	1.00	0.34	0.34	202
Dimethenamid-p	24.57	1.19	0.56	0.67	70,047
Ethofumesate Post-emergence*	45.34	1.68	0.13	0.21	40,549
Ethofumesate PPI and Pre-emergence**	31.21	1.00	1.65	1.65	219,285
Glyphosate	100.00	2.08	0.98	2.05	871,966
Quizalofop	2.49	1.00	0.05	0.05	511
S-metolachlor Post-emergence *	46.34	1.30	0.96	1.24	245,009
S-metolachlor PPI and Pre-emergence **	25.26	1.00	0.72	0.72	77,064
Triflusulfuron	0.24	1.00	0.03	0.03	31

*Post includes herbicides that are applied post-emergence.

**PPI (Preplant Incorporated) and pre-emergence includes herbicides that are applied prior to planting and that are incorporated into the soil or applied pre-emergence.

[8] There was no herbicide seed treatment on sugarbeets.

Fungicide Application

A summary of fungicide applications on sugarbeet acres is presented in Table 7. Fungicides were applied to 100%[9] of reported sugarbeet acres in 2021 growing season excluding seed treatments. Triphenyltin hydroxide (97%) was applied on the most acres. Mancozeb and triphenyltin hydroxide contributed the most pounds of active ingredient applied per year for reported acres excluding seed treatments.

Table 7. Fungicide application details by active ingredient (a.i.) for sugarbeets

Agricultural Chemical (a.i.)	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre* (a.i.)	Average Rate Per Crop Year *Pounds per Acre* (a.i.)	Total Applied Per Crop Year *Total Pounds* (a.i.)
Azoxystrobin at Plant*	39.28	1.00	0.15	0.15	25,875
Azoxystrobin Post**	13.99	1.00	0.24	0.24	14,522
Bixafen	3.86	1.00	0.07	0.07	1,088
Copper	25.50	1.12	0.57	0.64	69,017
Difenconazole	36.50	1.00	0.11	0.11	17,684
Flutriafol	3.93	1.00	0.11	0.11	1,882
Fluxapyroxad	4.78	1.00	0.07	0.07	1,481
Mancozeb	92.98	3.30	1.60	5.28	2,090,654
Mefentrifluconazole	37.71	1.01	0.10	0.11	16,932
Propiconazole	36.50	1.00	0.11	0.11	17,684
Prothioconazole	83.47	1.00	0.18	0.18	63,315
Pyraclostrobin at Plant*	0.17	1.00	0.15	0.15	105
Pyraclostrobin Post**	46.74	1.00	0.15	0.15	29,097
Tetraconazole	8.03	1.00	0.18	0.18	6,075
Thiophanate Methyl	31.58	1.00	0.35	0.35	47,281
Triphenyltin Hydroxide	97.16	2.00	0.25	0.52	216,866

*At Plant includes fungicides applied at planting.

**Post includes fungicides applied after planting.

[9] Verified by the Coops

Fungicide Seed Treatment

A summary of fungicide seed treatments on reported sugarbeets acres is presented in Table 8. Fungicide treated seeds were used on 100% of reported acres. A total of 10 different fungicide active ingredients were reported for seed treatments. Thiram (100%) was applied on the most acres as seed treatments. Hymexazol and penthiopyrad contributed the most pounds of active ingredient applied per year for reported acre as seed treatments.

Table 8. Fungicide seed treatment details by active ingredient (a.i.) for sugarbeets

Agricultural Chemical (a.i.)	Planted Acres Treated *Percent*	Average Rate Per Application *Pounds per Acre* (a.i.)	Average Rate Per Crop Year *Pounds per Acre* (a.i.)	Total Applied Per Crop Year *Total Pounds* (a.i.)
Fludioxonil	0.10	0.0001	0.0001	<1
Fluxapyroxad	17.98	0.0067	0.0067	514
Hymexazol	91.41	0.0320	0.0300	12,199
Mefenoxam	1.19	0.0002	0.0002	<1
Metalaxyl	98.81	0.0002	0.0002	86
Metconazole	3.02	0.0003	0.0003	4
Penthiopyrad	59.55	0.0188	0.0188	4,774
Sedaxane	33.43	0.0020	0.0020	287
Thiram	99.90	0.0034	0.0034	1,427
Tolclofos-methyl	3.02	0.0007	0.0007	9

Insecticide Application

A summary of insecticide applications on reported sugarbeet acres is presented in Table 9. Chlorpyrifos[10] (24%) was applied on the most acres and also contributed the most pounds of active ingredient applied per year for reported acres excluding seed treatments.

Table 9. Insecticide application details by active ingredient (a.i.) for sugarbeets

Agricultural Chemical (a.i.)	Planted Acres Treated *Percent*	Average Applications *Number*	Average Rate Per Application *Pounds per Acre* (a.i.)	Average Rate Per Crop Year *Pounds per Acre* (a.i.)	Total Applied Per Crop Year *Total Pounds* (a.i.)
Chlorpyrifos at Plant*	0.33	1.00	1.50	1.50	2,115
Chlorpyrifos Post**	23.63	1.00	1.00	1.00	100,649
Esfenvalerate	6.27	1.00	0.05	0.05	1,323
Imidacloprid	4.50	1.00	0.18	0.18	3,458
Terbufos	10.18	1.00	1.50	1.50	65,042
Zeta-cypermethrin	8.00	1.00	0.03	0.03	852

*At Plant includes insecticides applied at planting.

**Post includes insecticides applied after planting.

[10] Following the 2023 Eighth Circuit Court ruling, the Environmental Protection Agency (EPA) reinstated food and feed tolerances for chlorpyrifos. The MDA has conditionally registered chlorpyrifos products for food and feed uses for 2024 only, requiring Water Quality Best Management Practices for chlorpyrifos to be accompanied with the sale of each product.

Insecticide Seed Treatment

A summary of insecticide seed treatments on reported sugarbeet acres is presented in Table 10. Only about 30% of reported acres received insecticide seed treatments. Neonicotinoids were the only insecticides reported for seed treatments. Clothianidin (29%) was applied on the most acres and also contributed the most pounds of active ingredient applied per year for reported acres as seed treatments.

Table 10. Insecticide seed treatment details by active ingredients (a.i.) for sugarbeets

Agricultural Chemical (a.i.)	Planted Acres Treated *Percent*	Average Rate Per Application Pounds per Acre (a.i.)	Average Rate Per Crop Year Pounds per Acre (a.i.)	Total Applied Per Crop Year Total Pounds (a.i.)
Clothianidin	29.40	0.09	0.09	8,232
Thiamethoxam	0.98	0.08	0.08	333

Potential Implications

This survey is a result of collaborative efforts between the MDA and Minnesota sugarbeet cooperatives and is the first statewide report of pesticide use on sugarbeet acres from the MDA. In the past, similar information has been collected for corn, soybean, wheat, and other crops through the cooperative efforts between the MDA and USDA NASS.

The survey results will help the MDA understand current pesticide use practices in sugarbeets. It is important that the MDA, as a state regulatory agency, stays updated with pesticide use practices in crop industries and assists them to deal with potential regulatory changes.

The MDA is responsible for the development and promotion of pesticide best management practices (BMPs). The BMPs include both legal requirements and voluntary practices that are designed to prevent and minimize the degradation of Minnesota's water resources. This survey indicates that sugarbeet growers followed BMPs related to the rate and frequency of pesticide applications. It also showcases the good pesticide record keeping practices followed by sugarbeet farmers and cooperatives.

In 2021, sugarbeet growers used 1,590,762 pounds of herbicides, 2,892,780 pounds of fungicides and 182,004 pounds of insecticides including fungicide and insecticide seed treatments, which represent 34, 62 and 4 percent of the total pesticides used on sugarbeet acres. Sugarbeet growers applied 42 different pesticide active ingredients in varying quantities based on total pounds of active ingredient applied per crop year. The amount of pesticide used does not necessarily correlate with its environmental risks, which depend on many factors such as chemical behavior and toxicity of the pesticides, and environmental factors. For instance, glyphosate sticks to soil and does not move around much; while acetochlor, with low soil adsorption and high solubility, can be easily washed away by rain, depending on field conditions. In 2021, a total of 25,805 pounds of acetochlor and 871,966 pounds of glyphosate were used on sugarbeet acres. Glyphosate has consistently been sold in higher quantities than acetochlor in Minnesota since 2000. However, the MDA water monitoring results show multiple instances of the state water quality standard violations due to acetochlor, while no such violations were linked to glyphosate.