2022 Schutter Diagnostic Laboratory Annual Report- Summary

The Schutter Diagnostic Laboratory (SDL) at Montana State University (MSU) is provided as a service to the citizens of Montana for plant pest identification and integrated pest management education. In 2022, the SDL conducted 2,616 plant, plant disease, insect, mushroom, and abiotic diagnoses in 51 of 56 Montana counties and Indian reservations and 4 additional states - North Carolina, North Dakota, Idaho, and Colorado.

- In 2022, SDL diagnoses and associated management recommendations affected a total of 229,000 acres and saved an estimated $2.8 million USD*.
- 97% of survey respondents thought the timeliness of a response/diagnosis was good or excellent**.
- 94% of survey respondents found it easy to submit samples**.
- 65% of survey respondents adapted their pest management decisions based on recommendations provided in the SDL report**.

* Based on the 4-year average of USD saved per acre affected by diagnosis from 2018 to 2021.

**Results of 2022 client surveys, n=156 "Data from "Schutter Diagnostic Lab Surveys" compiled by MSU HELPS Lab, 2022.

Selected Impacts and Outcomes

- Two dead spotted lanternfly (*Lycorma delicatula*) samples were submitted from the Valley County Extension agent from an out-of-state shipment in September of 2022. This demonstrates how easily this invasive pest is transported and the importance of continued monitoring and education about emerging invasive species.
- Disease diagnoses provided by the SDL support ongoing research activities at Montana State University and expand the scope of these studies to also consider the role of pathogen populations and disease pressure.
- The diagnoses of environmental or cultural causes of reduced plant health, where disease or insect problems were initially suspected, saved growers and homeowners money from unnecessary treatments and reduced the potential environmental impact associated with pesticide applications. Noteworthy this season were spring and winter wheat samples suspected of fungal leaf spot disease, which were confirmed to have physiological leaf spot instead.
- We are an important resource for documenting new organisms that occur in our state. For example, we documented the furniture beetle (*Anobium punctatum*) for the first time in Montana from an old beam from a fireplace in Missoula, MT in April 2022.
- Accurate plant identification is critical when assisting clients who suspect poisonous plants are impacting livestock, and we assisted many clients with these types of questions in 2022. For example, the highly poisonous plant poison hemlock (*Conium maculatum*) was the most-submitted species for plant identification in 2022.
- The SDL team was awarded the MSU Extension Director's Team Award in October 2022, highlighting our impact and importance of our services to Extension and the people and places of Montana.

Selected Quotes from Clients in 2022

- “Help from the SDL made it possible for me to continue to grow flowers in my greenhouse and not lose a ton of flowers to unknown disease!”
- “The SDL makes MSU Extension Agents look great. The response is timely, accurate, full of great recommendations for our clients, and resources for further education. You Rock!”
- "Getting information back to producers quickly allows them to make decisions quickly to reduce infestations from insects or chemical applications to slow the spread of undesirable plants or make plans for preventing whatever is happening. Producers also learn either how to identify the problem in the future or get confirmation they know they have correctly identified what they have found.”
- “SDL is a very good option for me to get disease and pest identification. I am a farmer and have a nursery license. Many items come my way most years and we need some assistance in identifying problems.”
- “Best service ever! Quick, knowledgeable staff. Helpful identifying grasses on my five acres and how to control invasive grasses.”
- “As a home gardener, my options for assistance are very limited. Having access to SDL is our only reliable source of verification and they impacted not only my personal garden but prevented significant potential damage to many of the city of Bozeman community garden plots at Westlake (by preventing us from using contaminated manure with pesticide contamination).”
- “I rely heavily on SDL for science-based approach to reducing my carbon footprint and reducing use of chemicals in my yard and garden.”
- “The relief I experienced knowing that my insect was not damaging my home was the best!”
- “[The identification] saved me from worrying that mushrooms growing in my greenhouse may be toxic or harmful to my produce. They were not pathogenic so I can harvest my crop of tomatoes, lettuce, peppers, and cucumbers and eat them safely.”
- “So thankful to know that is it poisonous before our grandson comes over. I almost pulled it out with my hands, but thought it was a pretty plant… Thanks to you two, you could have saved a life or two over here.”
- “I was able to eradicate the noxious weed. Although there was no non-pesticide alternative in my case (other than hand-pulling but the infestation was too large), they were very helpful in explaining how to keep the pesticide use to a minimum.”
- “The Schutter Lab is the secret weapon of MSU. Keep up the strong work.”

MONTANA STATE UNIVERSITY
EXTENSION
Schutter Diagnostic Laboratory

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Introduction

Montana State University (MSU) and MSU Extension provide plant pest identification through the Schutter Diagnostic Laboratory (SDL). The mission of the SDL is to safeguard Montana agriculture, landscapes, and public spaces from plant pests by offering identification services, management advice, and education. Our recommendations are based on integrated pest management (IPM) principles, where IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic and environmental risks. Our mission also includes early detection of new and invasive pests that may pose a risk to Montana and the U.S. to prevent significant limitations to agricultural production and international trade.

In 2022, the SDL conducted a total of 2,616 plant disease, insect/other arthropod, plant, mushroom, herbicide injury, and other abiotic disorders diagnoses through physical, email, and Plant Sample Submission app samples (Table 1).

Table 1. Number of diagnoses by the Schutter Diagnostic Lab in 2022.

Diagnosis Type	**Number of Diagnoses**
Plant Disease	987
Arthropods	720
Plant ID	375
Mushroom ID	48
Herbicide Injury	81
Other Abiotic Disorders	405
Total	**2,616**

We received samples from 51 of 56 counties and reservation offices in Montana and 4 additional states - North Carolina, North Dakota, Idaho, and Colorado. Sixty-three percent of the samples were from Extension, and 37% were from non-extension clientele. Most diagnoses from Extension samples were for Gallatin, Ravalli, Hill, Yellowstone, Judith Basin, and Sanders counties. Ninety percent of Extension samples were from non-commercial clientele while 10% were from commercial sources. For the non-extension samples, 58% were from non-commercial clientele while 42% were from commercial sources. Eighty-one percent of the sample diagnoses were associated with a weed, disease, or pest while 19% of the diagnoses were from abiotic causes (i.e., winter injury, nutrient imbalance, suspected herbicide injury, drought, or cultural problems).

In addition to diagnostic services, SDL diagnosticians provided outreach materials about pests of concern to clients in Montana. For example, the SDL maintains a Facebook page that has over 950 followers. In 2022, we published a total of 34 Facebook posts reaching over 47,000 people, with 70 engaged users per post on average. Our posts usually focus on timely information about plant diseases, insects, and plant identification for our wide range of clientele.

We also send out Urban Alerts (https://mturbanalert.org) and AgAlerts (https://mtagalert.org) that inform our clientele about pertinent issues statewide via text or email. The MSU Urban Alert system (612 subscribers) is intended for Extension agents, landscape professionals, arborists, and anyone concerned with ornamental plants and vegetables. In 2022, we posted 8 urban alerts. The MSU AgAlert system (1,879 subscribers) provides current and research-based information for Montana agricultural clients. There were 12 AgAlerts posted in 2022.

2022 Plant Disease Summary

Diagnostic Staff

Dr. Eva Grimme, Plant Disease Diagnostician & Associate Extension Specialist II
Dr. Uta McKelvy, Assistant Professor Extension Plant Pathology

Other Assistants/Specialists

Dr. Cathy Cripps, Mycologist
Dr. Mareike Johnston, Plant Pathologist
Dr. Mary Burrows, Professor Plant Pathology
Abiya Saeed, Extension Horticulture Specialist
Sarah Eilers, former IPM Manager (January-August 2022)

Impacts & Outcomes

- The team of the Schutter Diagnostic Lab (SDL) strives to provide accurate and timely plant disease diagnoses and is often involved in the detection of new pathogens. Noteworthy samples arriving in the SDL in 2022 included an increase in winter and spring wheat samples suspected of Wheat streak mosaic virus infection. We also identified the stem and bulb nematode on alfalfa plants from Colorado.
- The accurate and timely diagnosis of plant diseases is key to applying successful management strategies. The SDL team is focusing on integrated pest management strategies to address plant problems. Through collaboration of the SDL team with MSU Extension specialists, best management strategies are developed to effectively address plant health issues.
- Numerous samples were submitted in 2022 that were suspected to be a disease problem. In many cases, environmental or cultural factors were causing the plant stress, resulting in reduced plant health. Therefore, chemical interventions to treat a pathogen-related plant problem were not required. Noteworthy this season were spring and winter wheat samples suspected of fungal leaf spot disease, which were confirmed to have physiological leaf spot instead.
- In 2022, plant disease diagnoses for agricultural crops impacted a total of 229,090 acres (based on SDL Survey responses, N=42).
- The SDL is testing mint mother stock and in-vitro plants for Verticillium dahlia for the third year. The absence of Verticillium is essential for mint growers to ensure that only healthy plant materials are distributed to customers. In 2022, we tested in-vitro samples of 7 lines. We will continue to support Montana's mint producers by providing this testing service.
- The SDL diagnosed 40 field samples of spring wheat and barley from a crop rotation study conducted at the Montana Agricultural Experiment Station in Moccasin for soilborne diseases. The primary objective of this crop matrix study is to evaluate the effects of diversifying wheat-based cropping systems with broadleaf crops, such as pea, lentil, and canola, on small grain crop performance. By providing plant disease diagnoses, the SDL is expanding the scope of this particular study to also consider the impact of diversified crop rotation on disease pressure and pathogen populations. We will continue to support this multi-year study for a third year in 2023.

Sample Summary

In 2022, the SDL completed 987 plant disease diagnoses (agricultural and horticultural samples). Samples were mainly submitted by extension personnel (50.4%) with 46.1% from non-commercial and 4.3% from commercial entities. Commercial entities outside of MSU accounted for 24.9% of the samples. The number of non-extension, non-commercial samples accounted for 48.6%. Based on 156 survey responses (2022 SDL

survey), samples were submitted by homeowners/gardeners (29.4%), agribusiness (8.4%), growers/farmers (6.3%), researcher/specialists (5.6%), arborists (4.9%), crop consultants (3.5%), and regulatory agents (2.1%).

Deciduous and evergreen woody ornamentals accounted for 41.2% of the horticulture diagnoses made by the SDL in 2022. Sample hosts of this category included Colorado blue spruce, blue spruce, pine trees, fir, lilac, juniper, poplar, apple, crabapple, pear, oak, arborvitae, and maple trees.

Fruit and vegetable samples (apple, pear, cherry, raspberry, tomato, garlic, herbs) accounted for 15.7%, perennial & annual plants for 4.5%, and turf samples accounted for 4.3% of the horticulture diagnoses.

Small grain crops accounted for 56.8% of all agricultural crop samples in 2022 (133 samples processed; 46 spring wheat, 38 barley, 34 winter wheat, further durum wheat, millet, Triticale, oats, corn, and non-specified wheat). Pulse crops (19.7%) constituted the second-largest group of crop samples (46 samples processed; 22 lentil, 16 chickpea, 8 dry field pea), followed by alfalfa (15 samples). Other crops submitted for disease diagnosis in 2022 included potato, garlic, asparagus, fava beans, sugarcane, soybean, canola, bindweed, bush bean, orchard grass, tent grass and other forage grasses.

Trends from 2022: Agriculture

Agricultural crops accounted for 389 plant disease diagnoses in 2022. Of the 389 diagnoses for agricultural crops, 341 diagnoses identified diseases problems (88%) and 47 diagnoses identified abiotic disorders (12%). Drought conditions continued to persist across most of the state in 2022, resulting in relatively low disease pressure.

Samples were received from 32 of 56 Montana counties, with Gallatin, Judith Basin, Hill, and Daniels counties contributing more than 60 % of agricultural crop samples. We received samples from two other states, Colorado, and North Carolina. Two plant disease diagnosis requests were received via the sample submission app; submission of a physical sample was requested in both cases.

Sixty-six percent of diagnoses that identified a disease problem in 2022 were associated with fungal and fungal-like pathogens. Root and crown rots were prevalent disease issues on agronomic crops in 2022, accounting for 50% of all disease diagnoses. Root rots associated with *Fusarium* sp. were very common (19%) affecting alfalfa, barley, chickpea, dry field pea, lentil, soybean, durum wheat, triticale, spring, and winter wheat. *Rhizoctonia* sp. (6%) caused root diseases in barley, forage grasses, lentil, millet, spring, and winter wheat. *Cochliobolus sativus* caused common root rot (6%) on barley and spring wheat. More than one root rot-causing organism was frequently detected on crop samples (root rot complex; 7%).

Fungal foliar diseases accounted for 10% of all crop disease diagnoses in 2022. Alfalfa samples were diagnosed for spring black stem (*Phoma medicaginis*) and Stemphylium leaf spot (*Stemphylium* sp.). Net blotch (*Dechlsera teres*) and spot blotch (*Bipolaris sorokiniana*) were common foliar diseases on barley. Ascochyta blight on chickpea (*Ascochyta rabiei*) was the only fungal foliar disease identified on submitted pulse crop samples in 2022.

Four percent of disease diagnoses were associated with viral pathogens. We observed an increase of winter and spring wheat samples with symptoms of Wheat streak mosaic virus infection on which the wheat curl mite vector (*Aceria tosischella*) was confirmed. In addition, we detected Bean common mosaic virus, a seedborne virus, in a bush bean sample grown for seed increase.

Three percent of disease diagnoses were associated with bacterial pathogens. *Xanthomonas* sp. caused bacterial leaf spot on alfalfa, bacterial leaf streak on barley, spring and winter wheat; *Pseudomonas* sp. caused bacterial leaf blight on barley, field pea, and winter wheat.

Noteworthy samples received in the SDL in 2022 included alfalfa plants from Colorado infested with the stem and bulb nematode, *Ditylenchus dipsaci*. We also observed an increase in spring and winter wheat samples confirmed for physiological leaf spot, which are genotype-specific responses to environmental conditions. Physiological leaf spot expression is assumed to be associated with chloride deficiency.

The impact of an extended cold and wet spring followed by hot and dry summer months, causing widespread severe drought conditions in 2022, are reflected in abiotic disorder diagnoses. Freeze/frost/cold damage, nutrient imbalances, cultural/environmental problems, and drought stress damage accounted for 25, 25, 19, and 4% of abiotic disorder diagnoses, respectively.

Trends from 2022: Horticulture

Horticultural samples accounted for 561 diagnoses (samples submitted through the Plant Diagnostic Information System [PDIS]) and 85 plant disease diagnoses for electronically submitted samples (i.e., photos in emails and through the sample submission app).

The continuing drought conditions during 2022 and the unusually hot temperatures in July and August 2022 caused heat and drought stress on most plants in the urban landscape. Plants showed symptoms of dieback, discoloration, nutrient deficiency, and stunted growth.

Fungal diseases were predominant during 2022. Evergreen samples, especially Colorado blue spruce and blue spruce, were submitted with signs of Rhizosphaera needle cast disease (41) and/or sudden needle drop (34). Pine trees were mainly affected by Dothistroma needle blight (23). Cytospora canker was diagnosed on spruce and Colorado blue spruce trees (11), fruit trees (2), poplar trees (7), willow tree (1), and fir (1). Oak leaf blister disease was confirmed on five oak tree samples. Powdery mildew infection was confirmed on 14 samples, including cherry trees, lilac, grape, pea shrub, peony, squash, and tomato.

Twenty-four plant samples, including apple, crabapple, and pear, were submitted to the SDL with suspected fire blight infection. Samples were tested with rapid disease diagnostic kits, confirming positive results on six apple tree samples, four pear tree samples, and four crabapple samples.

Root rots caused by *Rhizoctonia* sp., *Fusarium* spp., and *Pythium* sp. were confirmed on 36 samples (6.4%). A variety of samples, including cucumber, garden beans, petunia, begonia, and turfgrass were diagnosed with Pythium root rot. Rhizoctonia root rot and brown patch was confirmed on 15 turfgrass samples and one zinnia. Fusarium root rot was diagnosed on turfgrass, squash, raspberry, cucumber, lisianthus, and sunflower.

2022 Insect Diagnostics Summary

Diagnostic Staff

Laurie Kerzicnik, Associate Extension Specialist II, Urban and Horticultural Arthropod Diagnostician
Marni Rolston, Research Associate, Crop Arthropod Diagnostician

Other Assistants/Specialists

Dr. Michael Ivie, Systematic Entomologist, Montana State University
Dr. Justin Runyon, Entomologist, USDA Forest Service
Dr. Casey Delphia, Research Associate/Entomologist, Montana State University

Impacts & Outcomes

- Two invasive spotted lanternflies, *Lycorma delicatula*, were found dead in a shipment received in Glasgow, MT on September 23, 2022 from Pennsylvania.
- The furniture beetle, *Anobium punctatum*, was documented for the first time in Montana from an old beam from a fireplace in Missoula, MT on April 13, 2022.
- Hundreds of parthenice tiger moth caterpillars, *Apantesis parthenice,* were found on western stoneseed, *Lithospermum ruderale*, plants in Hobson, MT (Judith Basin Co.) in June of 2022.
- Swallow bugs and bat bugs were diagnosed from homes in West Yellowstone and Deer Lodge, MT, which ruled out bed bugs and any costly insecticide treatments associated with them.
- Clover root curculio, *Sitona hispidulus*, was diagnosed in Teton and Broadwater counties, helping producers understand and better manage their under-performing alfalfa crops.
- In Frenchtown, MT, hundreds of dirt-colored seed bugs (*Rhyparochromus vulgaris*) were found overwintering in hay bales purchased from St. Ignatius, MT. Proper diagnosis of this non-pest insect reduced concerns about potential pasture damage.
- Black grass bugs (*Labops hesperius*) were diagnosed on pasture grass in Phillips and Gallatin counties after most damage had occurred, so costly control strategies were not implemented. Future cost-effective management options were offered.

Insect Identification Activities and Trends

In 2022, there were 720 arthropod diagnoses; 656 were urban samples and 64 were agricultural samples. Of the urban samples, approximately 396 non-commercial samples were submitted via the Plant Diagnostics Information System (PDIS), 245 were diagnosed via email, and 15 were diagnosed through the sample submission app. For the agricultural arthropod samples, 43 commercial samples were submitted via PDIS,17 were diagnosed via email, and 4 were diagnosed through the sample submission app. For all arthropod identifications, 84% were urban/horticulture samples while 16% were field crop samples (from PDIS only). For all insect diagnoses, 64% were submitted from extension agents and 36% were submitted directly from non-extension sources such as homeowners, growers, consultants, arborists, and others. Concerning the extension samples, 87% of the diagnoses were for non-commercial clientele while 13% were for commercial clients. For the non-extension diagnoses, 55% were for non-commercial clientele while 45% were for commercial clients. Samples were submitted from 47 counties and reservation offices in Montana, and one sample was submitted from North Dakota.

Urban/Household Samples

Woody ornamentals represented the greatest number of urban insect diagnoses (49%). The greatest number of woody ornamental insect samples came from apple, arborvitae, ash, aspen, cherry, cotoneaster,

cottonwood, elm, juniper, oak, pear, pine, poplar, rose, spruce, and willow. The most common pests associated with these woody ornamentals are shown in Table A1.

For households (20% of all non-commercial diagnoses), spiders (13%-mostly hobo spiders and wolf spiders), ants (11%-field ants, pavement ants, carpenter ants, odorous house ants, and thief ants), carpet beetles (10%), seed bugs (10%-dirt-colored seed bugs and western conifer seed bugs), flies (8%-cluster flies, dark-winged fungus gnats, and non-biting midges), bed bugs and bat bugs (6%), root weevils (6%), German cockroaches (5%), and several others (springtails, spider beetles, clover mites, Indian meal moths, and western yellowjackets) were represented. All diagnoses were followed with reports, which allowed for the sharing of the arthropod's ecology, the benefits it might provide to the ecosystem, and any clarifications of common misinformation or misconceptions, particularly for the hobo spider and the brown recluse.

Vegetables consisted of seven percent of all non-commercial diagnoses. The main vegetable hosts included beans, peppers, potatoes, rhubarb, squash, Swiss chard, and tomatoes. Some of the common pests on these hosts included aphids, beet leafminers, flea beetles, grasshoppers, two-spotted spider mites, root maggots, and thrips. In the greenhouse, aphids, thrips, and two-spotted spider mites were commonly reported. Tarsonemid mites were diagnosed on a commercial begonia greenhouse sample.

Other arthropod identification requests for outside the home/in the yard included banded Argiope spiders, Carolina wolf spiders, cat-faced spiders, Eastern cicada-killer wasps, bumble flower beetles, black flies, blister beetles, cicadas, prionus borers, flea beetles, garden millipedes, Urocerus horntails, Jerusalem crickets, leafhoppers, giant water bugs, seed bugs, western flower thrips, root weevils, western yellowjackets, boxelder bugs, and sculptured pine borers. In 2022, there was a heavy infestation of miller moths within homes in several areas in Gallatin, Stillwater, Yellowstone, and Missoula Counties.

Additionally, we continue to monitor and educate about potential invasive species entering the state. Two dead spotted lanternfly, *Lycorma delicatula*, samples were reported from the Valley County Extension agent from a shipment in September of 2022. This demonstrates how easily this pest is transported. Two suspected emerald ash borer samples were reported from Hardin and Livingston, MT, which stresses the importance and impact of education and outreach for invasive insects throughout the state.

Field Crop Samples

Sixty-four samples that were categorized as potential arthropods of agricultural importance were submitted to the Schutter Diagnostic Lab in 2022. Most of the agricultural samples received were from alfalfa (13) and wheat (11). However, samples were also received from pasture/grasslands (11), legumes (5), greenhouses (4), corn (2) and canola, triticale, garlic, Faba bean, kochia, radish, locoweed, knapweed, barley, plum, sunflower seeds, aster, and dahlia (one sample each).

Insects diagnosed from alfalfa fields included clover root curculio, wireworm larvae, dirt-colored seed bugs, collembola, Western yellow-striped armyworm, alfalfa plant bugs, meadow plant bugs, Noctuid moths and black blister beetles. Insects diagnosed from wheat included wheat stem sawfly, Hessian fly, wheat curl mite, grasshopper eggs, wheat head armyworm, wheat stem maggot, cereal leaf beetle, Russian wheat aphid, bird cherry oat aphid, mealybugs, and thrips.

Other crop arthropods submitted to the Schutter Lab included Banks grass mites in corn, pea leaf weevils in Faba beans, black grass bugs in pastureland, flea beetles in radish, treehoppers in white locoweed and spotted knapweed, tarnished plant bugs in cropland, false chinch bugs in a dryland hay field and stink bugs in chickpea.

Several samples of non-damaging/beneficial arthropods were also submitted from agricultural lands, including a few species of parasitic wasps, a carabid beetle, and a burying beetle.

Lastly, a few specimens of filth flies (horn fly and blow fly larvae) that were collected from cow manure were submitted and identified.

2022 Weeds Lab Summary – Plant ID, Mushroom ID, and Herbicide Injury

Diagnostic Staff

Noelle Orloff- Associate Extension Specialist II

Other Assistants/Specialists

Dr. Jane Mangold
Dr. Tim Seipel

Other Cooperators

Dr. Cathy Cripps, Mushroom identification
Dr. Matt Lavin, Plant identification

Impacts and Outcomes

- Accurate plant identification is critical in situations involving poisonous plants. Our most submitted species for plant identification in 2022 was poison hemlock, a species that can cause serious issues for livestock. We also confirmed poisonous plants such as white bryony in home landscape settings where one client commented, "So thankful to know it is poisonous before our grandson comes over."
- Our plant identification services help land managers cope with the issue of noxious weeds. We identified several samples that were confirmed to be state- or county-listed noxious weeds, as well as correcting several misidentifications of noxious weed look-a-likes. Our services save land managers time and money and protect native plant communities.

Plant Identification Activities and Trends

In 2022, the SDL processed 220 physical specimens for plant identification, and 155 electronic samples (i.e. photos in emails, texts, and through our sample submission app). Most samples came from noncommercial sources such as government personnel, homeowners, and small acreage landowners. These samples accounted for 82% of sample submissions. Samples from commercial clients such as farmers, ranchers, consultants, nurseries, and representatives from agribusinesses accounted for 18% of all submissions. About 48% of samples were from Extension offices submitting samples on behalf of their clients.

Plant identification samples submitted represented 255 unique species. Forty-five percent of samples were exotic plants. The most submitted exotic species were poison hemlock (*Conium maculatum*, 7), cheatgrass (*Bromus tectorum*, 6), and quackgrass (*Elymus repens*, 5). Thirty-three percent of samples were Montana native plants. The most common native species submitted were false buffalograss (*Munroa squarrosa*, 3), horned sea blite (*Suaeda calceoliformis*, 3), and Western aster (*Symphyotrichum ascendens*, 3).

Seven confirmed specimens of state-listed noxious weeds or regulated plants were submitted representing four unique species (Table 1). The SDL provides a valuable resource where land managers can get accurate information about suspected problematic plants such as noxious weeds.

Table 1. State listed noxious weeds and regulated plants submitted to the SDL in 2022.

Species	**County**	**Priority**
Ventenata	Ravalli	2A
Yellowflag iris	Gallatin	2A
Spotted knapweed	Teton	2B
Cheatgrass	Chouteau, Gallatin, Ravalli	3

Mushroom Identification Activities

In addition to plants, we also identify mushroom specimens. In 2022, Dr. Cathy Cripps assisted the SDL by identifying 48 mushroom samples. These specimens were of 33 different species. All mushroom samples were from noncommercial sources, and were found mainly in lawns, gardens, or natural areas. Clients interested in mushroom identification are most often concerned with edibility or toxicity of mushrooms, and proper identification is vital for these types of questions.

Herbicide Injury Activities and Trends

We assessed 72 physical samples for potential herbicide injury along with 9 electronically submitted samples. We suspected herbicide injury to be affecting samples in 77% of these cases. Clients in several cases involving damage to property were referred to the Montana Department of Agriculture field offices for assistance with further investigation.

Most herbicide injury cases were from ornamental or vegetable garden settings, where we assessed 61 samples for herbicide injury symptoms. Of these, seventeen woody ornamental samples showed symptoms consistent with synthetic auxin herbicide injury. These symptoms may have arisen due to herbicide drift or root uptake resulting from lawn applications. Twenty-two vegetable samples from home gardens also showed symptoms consistent with synthetic auxin herbicide injury, an increase of 83% compared with 2021. Based on site histories it is likely most of these occurred because of herbicide carryover in garden amendments or newly purchased topsoil. Other issues we encountered in residential landscapes included woody plants showing glyphosate injury symptoms (seven cases). In thirteen potential herbicide injury cases we determined that plant symptoms were likely due to other environmental factors.

Of the 20 commercial agricultural samples we assessed for herbicide injury, there were several different suspected causes of injury with no clear pattern. We recorded several cases where symptoms were consistent with herbicide injury from in-crop or pre-plant applications of herbicide that resulted from situations such as interactions between weather events and herbicide applications. For example, we observed symptoms of photosynthesis inhibitory injury, contact herbicide injury, and synthetic auxin herbicide injury from in-crop applications. There were a range of other issues suspected on one or two samples including herbicide drift, synthetic auxin carryover in potatoes, ALS inhibitor carryover in pulse crops, and tank contamination. Finally, we assessed six crop samples where symptoms were explained by other environmental factors or plant disease rather than herbicides.

Table A1. Common insects and diseases associated with urban/ornamental plant hosts submitted to the Schutter Diagnostic Lab in 2022.

Host Tree	Common Insects/Arthropods	Common Diseases
Apple	Blister mites, codling moth, tortricid leafrollers	Fire blight, Cytospora canker
Arborvitae	False spider mites, spruce spider mites	Kabatina tip blight
Ash	Brownheaded ash sawfly, leafcurl ash aphids, ash plant bugs, western ash bark beetles	Fungal canker
Aspen/ Cottonwood/ Poplar	Aspen blotch leafminers (tentiform leafminer), *Chaitophorus* aphids, cottonwood leaf beetle, eriophyid mites, poplar vagabond aphids, poplar blackmine beetles, poplar borers, poplar bud gall mites, spider mites	Cytospora canker, Marssonina leaf spot
Cherry	Black cherry aphids, chokecherry gall midge, fall webworm, gall mites, leafhoppers, pearslugs/sawflies	Fungal canker, shot hole disease, powdery mildew
Cotoneaster	Oystershell scale, leafhoppers	N/A
Elm	European elm scale	Sooty mold
Fir	N/A	Needle cast disease
Juniper	False spider mites, spruce spider mites	Cedar-apple rust, Kabatina tip blight
Lilac	Eriophyid mites, root weevils	Bacterial blight, powdery mildew
Linden	N/A	Fungal canker
Maple	Bark beetles	Maple anthracnose, powdery mildew
Oak	Gall wasps-(*Callirhytis* sp.) and rough bulletgall wasp	Oak leaf blister
Pine	Adelgids, *Cinara* aphids (giant conifer aphids), *Dioryctria* moths, *Essigella* aphids, pine engraver beetles, pine needle scale, pine sawyer beetles, red turpentine beetles, sculptured pine borer, spruce spider mites	Dothistroma needle blight, blue stain fungus, Rhizosphaera needle cast
Plum/Pear/*Prunus* (Other than Cherry)	Blister mites, leafcurl plum aphids, pearslugs/sawflies	Cytospora canker, fire blight
Rose	Gall wasps, leafcutting bees	N/A
Spruce	Cooley spruce gall adelgid, giant conifer aphids, pine needle scale, spruce bud scale, spruce spider mites, western spruce budworm, white pine/sitka spruce weevil	Rhizosphaera needle cast, Cytospora canker, sudden needle drop
Willow	Willow redgall sawfly	Willow black canker, Cytospora canker