Crop Biosecurity Guidelines

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Saskatchewan

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1. Introduction

1.1 Purpose

The key purpose of these Biosecurity Guidelines is to help groups other than producers reduce the spread of crop pests, mainly diseases, insects, and weeds, that can reduce the productivity of agricultural lands and be difficult to control. The Guidelines are intended for use by a wide range of user groups and individuals who may be accessing private and public farm and ranch properties in Saskatchewan for business and recreational uses. It is critically important to recognize and manage potential high-impact pest/biosecurity risks that may be associated with this access, using education to ensure appropriate biosecurity practices are followed.

The information in these Guidelines is not intended to be prescriptive but to inform the development of company-specific protocols designed to mitigate the risk of accidentally introducing and/or spreading high-risk crop pests when working within agricultural operations. The Guidelines provide examples of assessment tools that can be used to estimate the level of pest risks associated with a wide range of industrial, recreational and agricultural activities of third-party contractors on farms and ranches. They also provide practical options for mitigating these risks.

Within the context of these Guidelines, agricultural operations are private and government lands under crop production that include, but are not limited to, farms with cultivated fields, annual and perennial forages and commercial horticultural operations, including both field-based and protected (e.g., greenhouses, tunnels) production systems.

Invasive plants, insects and plant pathogens can pose a significant risk to the native and human-made ecosystems to which they are introduced and may be costly, difficult or even impossible to manage or eradicate. Negative economic and societal impacts can include declining crop productivity and quality, adverse human health impacts, lower farm property values, reduced aesthetics, and the loss of natural habitat and biodiversity.

In summary, these Guidelines focus on the biosecurity risks associated with a wide variety of third party agricultural and non-agricultural work being conducted on agricultural lands in Saskatchewan. Some of the recommendations included in this document can be used to guide the development of specific protocols to manage high-impact pest/biosecurity risks associated with work being conducted on agricultural lands in the province.

1.2 Application

These guidelines apply to third parties needed to facilitate crop production and to utilities, customers, visitors and various industry groups that may occasionally need to access farm and ranch lands. The biosecurity guidelines presented in this document are to help educate third party operators and other groups accessing agricultural land regarding risks, and to guide the development of company or project-specific biosecurity protocols. The Ministry of Agriculture does not intend to mandate, regulate or enforce biosecurity practices but strongly recommend the development of company- or project-specific biosecurity measurements that can be implemented to prevent further pest transmission.

2. Biosecurity in Agriculture

2.1 Definitions

The term 'biosecurity' refers to a series of management practices designed to prevent, minimize and/or control the introduction and spread of pests into agricultural operations, including farms, ranches, market gardens, orchards, greenhouses and nurseries. Definitions of some other technical terms used in these Guidelines are given in the "Glossary of Technical Terms" in Section 8 of this document.

2.2 Key Biosecurity Risks in Crops

Biosecurity concerns in the crop industry can include things such as pathogens causing infectious plant diseases, insect pests, parasites, mites, plant parasitic nematodes and weeds. Avoiding or minimizing the potential introduction and establishment of these types of causal agents will help to avoid or minimize economic losses in crops.

These Guidelines will examine biosecurity principles and practices in Saskatchewan and the ways that user groups accessing agricultural lands can help to avoid introducing new high impact crop pests or preventing existing pest threats from being spread within and outside of these operations.

2.3 Potential Means of Introducing and Spreading Pests in Agricultural Operations

Pests can be spread into and within agricultural operations by several active and passive means, including:

- Farm machinery, equipment and vehicles
- Industrial machinery, equipment and vehicles
- Bio-industrial wastes, manure and sludge
- Domesticated, exotic and wild animals and birds
- Fertilizers and composts
- Humans and human activities
- Plants and plant products including crop residues
- Seeds and other propagative materials
- Soil and other types of growing media
- Water
- Wind

One the most frequent means of pest spread, especially for plant diseases, is that which occurs through infested soil and crop residues. Many of the high-impact plant diseases, insects and weeds listed in Table 1 can be distributed far and wide and be relatively easily moved through contaminated soil. As a result, these Guidelines will focus on soil-borne pests and biosecurity strategies that can be used to assess the relative risks of spread and to select and implement appropriate mitigation strategies.

2.4 High-Priority Pests of Biosecurity Concern

A few examples of high-impact crop diseases, insects and weeds, many of which can be found in soil, roots, crop residues and/or seed, are listed in Table 1. This is not an exhaustive list and could be added to in the future as new and emerging/re-emerging pests come to light. Biosecurity practices can be used to prevent the introduction and spread of pests into fields and regions where they are not currently present.

Table 1. Examples of high-impact crop diseases, insect pests and weeds that could pose a significant threat to field and horticultural crops in Saskatchewan if introduced and/or allowed to establish and further spread. *

Common Name	Latin Name	Key Crops Affected
Clubroot	*Plasmodiophora brassicae*	Canola, mustard, camelina, cruciferous vegetables
Aphanomyces root rot	*Aphanomyces euteiches*	Pulses (beans, lentils, peas)
Bacterial ring rot	*Clavibacter michiganensis* subsp. *sepedonicus*	Potato
Potato wart	*Synchytrium endobioticum*	Potato

Potato late blight	*Phytophthora infestans*	Potato
Soybean cyst nematode	*Heterodera glycines*	Beans, soybean
Stem and bulb nematode	*Ditylenchus dipsaci*	Peas, potatoes
Sudden death syndrome	*Fusarium virguliforme*	Soybean
Verticillium stripe	*Verticillium longisporum*	Canola
Verticillium wilt	*Verticillium albo-atrum* *Verticillium dahliae*	Alfalfa, canola, hemp, potato, sunflower, tomato
Insects		
Cabbage seed pod weevil	*Ceutorhynchus obstrictus*	Invasive: Canola Established in southern SK and moving north
Pea leaf weevil	*Sitona lineatus*	Invasive: Pulses Established in southern SK and moving north
Potato psyllid	*Bactericera cockerelli*	Native to North America but the range is expanding. Indication of distinct local populations. Vectors the zebra chip pathogen. Pepper, potato, tomato
Root maggots	*Delia species*	Canola, vegetables
Spotted wing drosophila	*Drosophila suzukii*	Invasive: Fruit crops
Brown marmorated stink bug	*Halyomorpha halys*	Invasive: very broad host range. Not yet established in SK though individuals in transport chain and transient populations have been detected.
Weeds		
Annual bromegrasses: Downy brome Japanese brome	*Bromus tectorum* *B. japonicus*	Cropland and field boundary habitats, hayland, pastures, roadsides, wasteland, rail and other types of rights-of-way, well sites
Common tansy	*Tanacetum vulgare*	As per knapweeds (see below)
Field scabious	*Knautia arvensis*	Field boundaries, hayland, pastures and other low management intensity sites
Herbicide-resistant weeds (kochia, wild oats, green foxtail, wild mustard, etc.)	Various species	Cropland
Jointed goatgrass	*Aegilops cylindrica*	Cropland and field boundary habitats
Knapweeds (diffuse, spotted, star-thistle, brown, meadow, etc.)	*Centaurea species*	Range, pasture, wildlife habitat, roadsides, wasteland, rail rights-of-way and other low management intensity sites
Leafy spurge	*Euphorbia esula*	As per knapweeds (see above)
Ox-eye daisy	*Leucanthemum vulgare*	As per knapweeds (see above)
Red bartsia	*Odontites serotina*	As per knapweeds (see above)
Water hemp	*Amaranthus tuberculatus*	Cropland

** Compiled by crop protection specialists from Saskatchewan Agriculture. For a complete list of prohibited and other important pathogens, insect and weed pests of agricultural crops in Saskatchewan, consult the provincial Acts and Regulations listed in Section 3.2.*

3. Governmental Responsibilities for Crop Biosecurity in Saskatchewan

3.1 Federal Government

The federal *Plant Protection Act* aims to protect plant life and the agricultural and forestry sectors of the Canadian economy by preventing the import, export and spread of pests by controlling or eradicating

them. Under this Act, the Canadian Food Inspection Agency (CFIA) has a broad mandate to monitor for and regulate the introduction of crop pests into all provinces and territories in Canada. Over the past decade, this agency has developed National Voluntary Farm-Level Biosecurity Guidelines and/or Producer Guides for four crop sectors, namely, Grains and Oilseeds, Potatoes, Greenhouse, Nursery and Floriculture, and Fruit and Tree Nuts. These documents are listed in the References section of these Guidelines and can be accessed through the CFIA website. Individual producers can use these guides to assess external and internal biosecurity risks in their own operations and to design, implement and evaluate a farm-specific biosecurity program to meet their own unique needs.

3.2 Provincial Government

Several pieces of legislation enacted by the Government of Saskatchewan restrict the movement, importation and transportation of potentially harmful plants, diseases and insect pests, including high-impact pests. They include:

- *The Weed Control Act*
- *The Pest Health Act*
    - *The Plant Health Regulations*
- *The Forest Resources Management Act*
    - *The Dutch Elm Disease Regulations*
- In both rural and urban agricultural areas, crop diseases, insect pests and weeds are major concerns to producers. *The Weed Control Act* designates the prohibited, noxious and nuisance weeds of concern in Saskatchewan. A list of these species can be found in a Ministerial order. For a list, please contact the Agriculture Knowledge Centre at 306-694-3727. There are five regulated pests of concern in the province: bacterial ring rot of potato (*Clavibacter michiganensis* ssp. *sepedonicus* also known as *Corynebacterium sepedonicum*), brown rat or Norway rat (*Rattus norvegicus*) and roof rat, black rat or ship rat (*Rattus rattus*), feral pigs (free-living members of the family Suidae), late blight (*Phytophthora infestans*) and potato wart (*Synchytrium endobioticum*).

3.3 Municipal Governments/Municipalities

Municipal governments/municipalities have powers to prevent and manage declared pests in Saskatchewan under *The Plant Health Act*. These powers include: the appointment of pest control officers to enforce, enter land, perform inspections, collect specimens or issue orders to any person; the authority to pass bylaws to prevent, control or destroy pests; and the ability to require individuals to take actions to control or destroy pests on the land they own or occupy.

The Saskatchewan Ministry of Agriculture has partnered with the Saskatchewan Association of Rural Municipalities (SARM) to deliver the Pest Biosecurity Program funded through the Sustainable Canadian Agricultural Partnership, a federal-provincial-territorial initiative. Under this partnership, SARM delivers the following programs to rural municipalities and First Nations communities in Saskatchewan:

- Plant Health Network
- Invasive Plant Control Program
- Rat Control Program
- Beaver Control Program
- Gopher Control Program

Visit SARM for more program details.

4. Biosecurity Measures in Diverse Types of Agricultural Operations

4.1 Overview

Agricultural producers are encouraged to develop biosecurity plans that are specific to their respective production regimes, physical setups and current pest management practices. There are useful resources indicated in Section 7 that can be used for the development of these plans including the Biosecurity for Preventing the Introduction of Crop Pests document. These farm specific plans may outline protocols for employees, visitors, customers, custom operators and other service providers to follow when visiting or conducting work activities on these operations. It is highly recommended that user groups directly contact the producers on whose farm or ranch operations they may be working, or vice versa, to see what biosecurity restrictions may already be in place and what level of adherence is expected by the producers and/or landowners.

There may be situations where certain user groups or utilities have rights of access (easements) to enter farm and ranch properties to conduct vital activities such as utility installation and maintenance. This includes restorative work in emergency situations. In emergencies, all desired biosecurity mitigation strategies may not be achievable due to time restrictions associated with returning service or addressing concerns in a timely manner as per their governing legislation. Agricultural producers should take these permissions into account when planning their biosecurity programs. They should also notify these groups when and where high-impact pests or other biosecurity concerns may be present on or near their operations.

If extensive projects are being planned, such as the installation of significant new infrastructure, utility companies may meet with landowners along the construction route to discuss issues such as project timelines and the biosecurity practices that will be followed by the on-site contractors. Efforts should be made to harmonize the biosecurity interests of both parties through mutual discussions and negotiations.

4.2 Assessing Relative Pest Impacts on Crop Production

In general, agricultural operations that rely upon intensive production methods are at a greater risk of negative economic impacts from pest introductions than those that are of relatively low intensity. For example, the costs of growing horticultural crops per unit area of production and their corresponding market values are generally much higher than for field crops, so even small pest infestations can cause significant monetary losses. As a result, biosecurity standards for horticultural crops are much higher than for the traditional field crops, such as cereals, oilseeds, forages and pulses.

Furthermore, crops grown in protected environments often lack the natural predators and parasites that help to hold pests in check in comparable field settings, so when an outbreak occurs, relative pest impacts on the yield and quality of protected crops can be much greater. As a result, protected crop producers generally monitor their crops frequently and intensively. Therefore, they may be able to respond more quickly to pest threats, especially high-impact pests, thus reducing their specific impacts. The following table indicates the relative economic impacts of biosecurity threats to the main types of fields and protected crops grown in Saskatchewan.

Table 2. Relative economic impacts of pests on the main types of crops produced in Saskatchewan in terms of potential losses per unit area of production.

Protected Crops	High Economic Impact
Greenhouse Ornamentals Greenhouse Vegetables Field Vegetables and Potatoes Tree and Small Fruits Nursery Crops and Turf Specialty Crops Oilseeds and Pulses Cereals and Corn Range Grasses and Pastures	
Field Crops	**Low Economic Impact**

Most activities being carried out by the user groups will take place on farmland where either none or very few of the high-impact pests listed in Table 1 will be present. In cases where a high-impact pest is initially confirmed, and especially if it is the result of a recent introduction, their incidence may be relatively low, and their spatial distribution may be limited. Nevertheless, they should still be considered a potentially serious risk. A Pest Risk Assessment can be completed to assess relative biosecurity risk(s) for projects conducted on agricultural lands which helps in managing the risk of spreading high-impact pests beyond an infested field. A decision on what on-site biosecurity measures may be needed for a given project can be made after a Pest Risk Assessment has been completed. An example of a risk assessment matrix which can be developed to assess relative biosecurity risk(s) for projects conducted on agricultural lands potentially infested with high-impact pests is provided in Section 6 with clubroot of canola as an example. Companies may wish to use this example as a suggested template to work from to develop their own mitigation plan for clubroot or other pests.

4.3 Developing a Pest Risk Mitigation Plan

The risk of accidentally introducing pests to a worksite or spreading them around will be proportional to the scope, intensity and duration of activities. Due diligence and practical mitigation measures will help reduce risks to producers and the environment.

The following three-step Pest Risk Mitigation Plan should help to reduce the impact of most types of pests for specific worksites (see Figure 1).

Step 1: Avoidance

Avoidance is a basic strategy for managing crop pests and usually involves methods such as selecting field sites where pest pressure is likely to be absent.

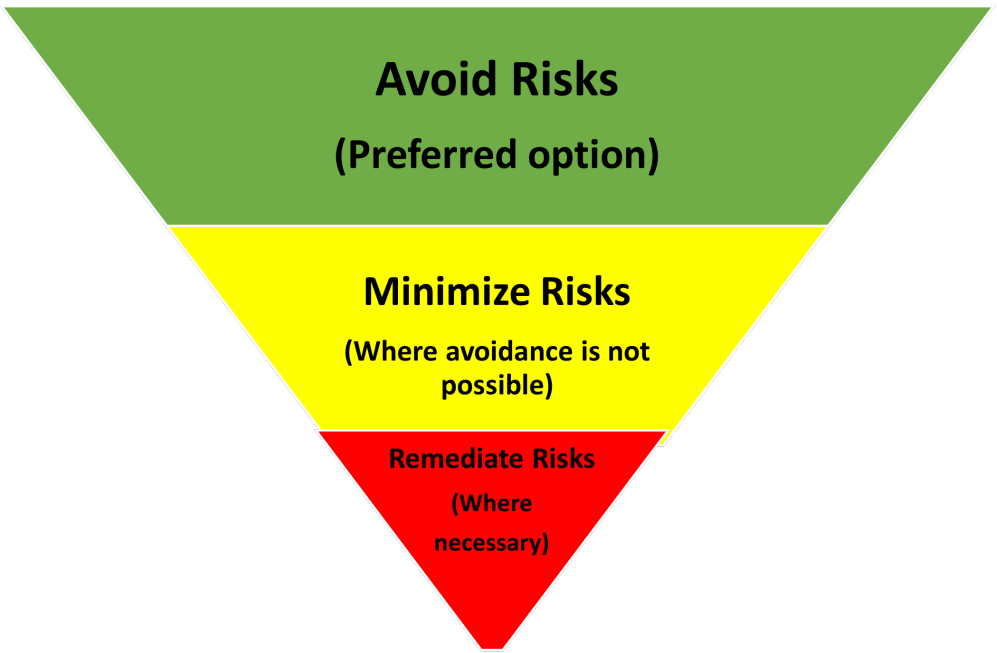
Step 2: Minimization

If it isn't possible to fully avoid a pest infestation in a field, steps should be taken to minimize the risk of spreading it by tactics such as only entering pest-infested fields on foot or with an ATV instead of a car or truck, working in fields when the soil is dry rather than wet and more likely to contaminate vehicles and equipment, and accessing fields via approaches or a single access point rather than at multiple spots along the sides. Modifying the environment so it's unfavorable for pest development and coming to the worksite with clean equipment and sanitizing pest-contaminated vehicles and equipment before leaving an infested worksite to prevent spread can also be considered minimization. Where soil- and residue-borne crop pests are a major concern, emphasis should be placed on minimizing soil disturbance and movement. In cases where a contractor is doing work such as tillage, land levelling,

excavating or other activities that involve disturbing and moving soil, then efforts should be taken to avoid moving soil from pest-infested to non-infested areas within and outside of the worksite field wherever possible. Steps should also be taken to reduce the possibility of soil and water erosion that could move pests from disturbed to non-disturbed areas. This could include the use of preventative measures such the use of silt fences, tackifiers or cover crops like cereals or grasses on rights-of-way, topsoil piles and the like.

Step 3: Remediation
Remediation is the act of remedying a pest problem through targeted actions; for example, applying herbicides to control localized patches of weeds and seeding grass in disturbed, pest infested areas to reduce soil erosion.

Figure 1. A Risk Mitigation Plan for Soil- and Residue-Borne Crop Pests



- Avoid entering or working on agricultural lands where high-risk pests are present.
- Avoid working in cultivated fields especially where wet soil conditions are present.

- Minimize soil disturbance and movement out of the field as much as possible.
- Where available, follow farm- or company specific biosecurity plans and practices.
- Only use vehicles, equipment and tools that have been cleaned and disinfected.
- Sanitize vehicles, equipment, tools, footwear and/or clothing upon exiting the field.
- Review scouting reports to determine if high-risk pests may be present in a field.
- Access cultivated fields on foot rather than with vehicles.
- Reduce or eliminate tillage operations to prevent further spread within the field.
- Install signage to prohibit unauthorized entry into heavily infested fields.
- Use Level 3 sanitization procedures on vehicles and equipment used in infested fields.

- Use registered pesticides to control or eradicate pests, where practical and necessary.
- Seed grass in disturbed, pest-infested areas to reduce soil erosion.

4.4 Risk Assessment Strategies for Crop Pests that can be Spread by Wind and Other Means

The preceding risk assessment strategies emphasized soil-borne pests but there are other pests that can also be spread within and between fields by natural means such as wind, rain, overland water, seeds, transplants and vectors such as insects and wildlife. These types of spread may be beyond the control of both producers and user groups working in the same fields, but there are options for assessing and dealing with some of them (see Table 3). Some of these minimization/mitigation measures should be undertaken by producers, whereas others should be done by the user group working on the farm. Decisions on who should undertake specific mitigation tasks should be made after mutual discussions between the involved parties.

Table 3. Risk factors, assessment strategies and mitigation measures for wind/water-borne pests.

Risk Factors	Risk Assessment Strategies and Potential Mitigation Measures

Wind	• For long-duration projects, determine how exposed worksites are to prevailing winds/wind erosion by checking Environment Canada weather records for the area.
	  • Construct silt fences or windscreens to prevent soil erosion.
	  • Apply tackifiers to or use erosion blankets on topsoil piles.

Overland water	• Identify slopes and natural drainage patterns on worksite fields. • Cut shallow drain ditches, install culverts or grade slopes to direct water away from low-lying (problem) areas of fields.

Seed dispersal	• Identify patches of noxious or prohibited weeds.
	  • Contact the landowner and request that they control the weeds before work begins.
	  • Alternatively, mow the weeds or control them with herbicides before they set seed.
	  • Clean mowers, sprayers and other equipment to avoid spreading weed seeds either on- or off-site.

Transplants	• Control patches of weeds before work begins.
	  • Use a double disc rather than a cultivator to uproot tall weeds to minimize potential spread and re-rooting of the weeds.
	  • Alternatively, use a flail mower to cut and mulch the weeds.

Vectors	• Check for unusually high insect or wildlife populations on worksites.
	  • Submit insect samples to the Crop Protection Laboratory for diagnosis and, if they are a potential disease vector, request control information.
	  • Consult provincial wildlife specialists for advice on animal control.

5. Sanitization (cleaning and disinfecting) as a Key Biosecurity Strategy

5.1 Overview

Sanitization involves cleaning and disinfecting vehicles, equipment, footwear, tools, etc. that may be infested with pests. Cleaning should focus on areas where soil and plant materials are likely to accumulate (see Section 9.1). This includes tires, wheel wells, undercarriages, tracks, buckets, blades, etc. Where possible, cleaning should be done in the field where the work was carried out so the soil and crop debris can be left behind there. If this is not practical, following rough cleaning, vehicles and equipment should be taken to a nearby car or truck wash and further cleaned there.

5.2 The Sanitization Process

The sanitization process consists of three main levels:

1. Rough cleaning – Hand tools, such as scrapers, shovels, wire brushes, brooms, etc., should be used to physically remove as much soil and plant debris as possible. Compressed air can be used to clean hard-to-reach places and around sensitive electrical junction boxes and electronic sensors.
2. Fine cleaning – Pressure washers should be used to remove any remaining soil and plant debris from surfaces. Avoid washing areas with sensitive electronics to prevent possible damage from the water. These areas should be decontaminated using hand brushes or compressed air. Detergents may be helpful in loosening stubborn soil residues and areas contaminated with grease and oil. Pulsating (turbo) nozzles may help to break up larger deposits. At the end of this process, the equipment should be free of all visible soil and plant material.
3. Disinfection - Apply a freshly made solution of two per cent sodium hypochlorite bleach (see Section 9.2), or another broad-spectrum disinfectant known to be effective against the pest of concern, to the clean surface and allow for a minimum of 15-20 minutes of contact time. It may be necessary to apply more bleach if the surface dries too quickly. For this reason, it's recommended that, when practical, disinfection be done in the early morning or evening under slow drying conditions. **Avoid applying bleach to sensitive equipment and clothing and use personal protective equipment to minimize exposure to this chemical and its fumes.** If bleach is unavailable or if users are concerned about corrosion, alternative products can be used (see Section 7, "Information Resources").

The "Information Resources" section (Section 7) of these Guidelines contains publications that give detailed descriptions of procedures for cleaning and disinfecting vehicles, equipment, tools and footwear, and information on preparing bleach solutions for disinfecting cleaned surfaces.

6. Example of a Pest Risk Assessment Matrix to Assess Relative Biosecurity Risk(s) for Projects Conducted on Agricultural Lands potentially Infested with High-impact Pests

6.1 Overview

To prevent the accidental introduction of new, emerging and/or high-impact diseases, insects and weeds from infested fields or areas to non-infested fields or areas, user groups may wish to use a Pest Risk Matrix to assess the risk of pest spread on a project-by-project basis. This matrix considers two key parameters:

- The likelihood of the pest being present at a current worksite or at another nearby worksite and being accidentally transferred to the current site; and,
- The potential for spreading the pest within or outside of the field, worksite or other area, or from a previous worksite, via infested soil or plant material.

Based on these two parameters, the overall risk of the project can be estimated. The project can be objectively categorized as Negligible, Low, Moderate or High Risk and appropriate mitigation strategies can be implemented depending on the relative level of risk. Risk assessments such as this may require some in-depth information on the current geographical distribution of the pest and knowledge of the mechanisms of how it may spread by both natural means and human activities. As such, detailed pest-specific risk assessments may only be practical for high-impact pests that could cause significant yield and quality losses in agricultural crops if they become established on a farm or in a certain geographical area, or where restricting their spread is considered a high priority by the agricultural industry and provincial or federal government.

To illustrate the kind of information that may be required to develop a detailed Pest Risk Assessment Matrix, clubroot, an economically important disease of canola, mustard, and cruciferous crops in Saskatchewan, will be used as an example. Clubroot is a soil-borne disease caused by the pathogen P*lasmodiophora brassicae*. It overwinters and survives in the soil between crops and can be spread in virtually any way that soil can be moved. Clubroot was first found in the province in 2008 and has since been confirmed with visible symptoms in 82 commercial fields in various production areas. Wind and water erosion and wildlife may serve to spread the pathogen in infested soil, but the most significant means of distribution is through human activities, including farm and industrial equipment, machinery, passenger and off-road vehicles and even foot traffic. Not all activities have the same level of risk. Those that move large volumes of soil including farm and industrial machinery and equipment and those that move soil directly from clubroot-infested areas to non-infested locations are considered to have the highest risk. This risk increases when fields are wet and decreases when the soil is dry or frozen.

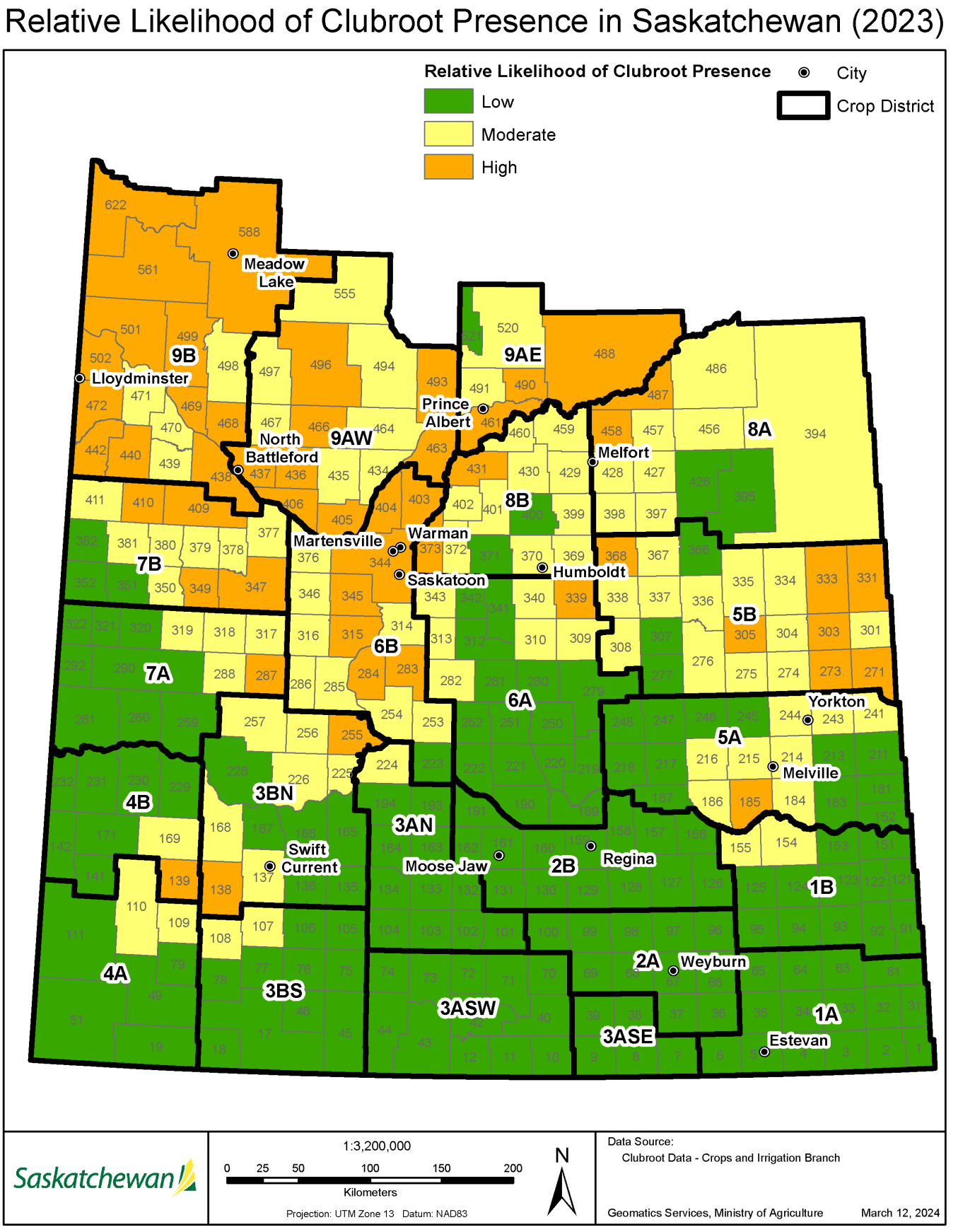
For clubroot management, a key focus has been on preventing the movement of infested soil through activities conducted on cultivated agricultural land. The biosecurity requirements needed to minimize clubroot spread will vary depending on the level of risk.

6.2 Assessing the Likelihood of Clubroot Presence in a Field or Other Type of Work Area

The following table outlines some of the key factors to consider when assessing the risk of whether the clubroot pathogen is likely to be present in soil in a farm field based on its location relative to where the disease has previously been confirmed. As clubroot is a soil-borne disease, movement of infested soil is the main way by which it spreads to new locations. Movement via machinery, equipment and vehicles contaminated with infested soil and/or crop debris can occur over both short and long distances and represents the main means of geographical spread for this disease. It is also recommended that user groups talk to landowners about the clubroot history of their fields, as well as neighboring ones, because only a small proportion of the canola fields in Saskatchewan are surveyed each year. The following tables are an example of how a pest-specific risk assessment can be developed by using available information for different areas of the province and by using clubroot as the example.

Relative Likelihood of Clubroot Presence	Land Locations and Characteristics
Negligible	• Non-agricultural lands (forest, road rights-of-way, etc.) anywhere within the province, including urban areas. • For clubroot, non-cultivated agricultural land (ex. pastures).
Low	• Agricultural lands in RMs with no confirmed clubroot and are not adjacent to RMs with a confirmed clubroot.
Moderate	• Agricultural lands in RMs adjacent to RMs with confirmed clubroot.
High	• Agricultural lands in RMs with confirmed clubroot.
Confirmed	• Agricultural lands (fields) with confirmed clubroot.

Figure 2. Relative likelihood of clubroot presence in Saskatchewan at an RM level based on the proximity to within-province infected fields (2023). Inter-provincial projects being conducted in RMs bordering other jurisdictions should also consider the additional risk from corresponding neighbouring regions not reflected in the map below.



6.3 Assessing the Potential for Spreading Clubroot Within or Outside of a Field, Worksite or Other Area via Movement of Infested Soil and Plant Material

The following table illustrates the potential for the spread of clubroot spores via infested soil that may be transported by human and machines during routine industrial and farming activities under normal (dry) soil conditions. The risk rating could increase one or even two categories if soils were wet and muddy at the time the soil disturbance activity was being carried out. In other words, the risk would be proportional to the amount of soil being moved or transported. Another factor that could affect the risk rating is the relative concentration of clubroot spores in the soil. In fields with a history of clubroot and high populations of resting spores per gram of soil, the movement of even small quantities of soil from 'hotspots' could serve to spread the disease over a much wider area.

Table 5. Potential for Significant Transport by Activity (suggested examples) *

Activity	Description	Potential for Spread via Soil Movement
Examples for Third Party Agricultural Activities		
Foot traffic	Access under dry or frozen soil conditions	Negligible
ATV traffic	Access under dry or frozen soil conditions	Low
Passenger truck traffic	Access under dry or frozen soil conditions	Low
Spraying	High clearance or tractor-drawn unit	Low
Swathing	Self-propelled or tractor-drawn unit	Low
Harvesting	Self-propelled combine and tandem trucks	Moderate
Seeding, harrow packing	Tractor-drawn unit	Moderate
Soil testing	Hand auger or truck-mounted drill	Moderate
Land levelling	Killefer scraper	High
Tillage	Double disc, cultivator or plow	High
Tracked/multi-wheel equipment traffic	Tracks and multiple large tires can disturb and move soil	High
Examples for Industrial Activities		
Foot traffic	Access under dry or frozen soil conditions	Negligible
ATV traffic	Access under dry or frozen soil conditions	Low
Passenger vehicle traffic	Access under dry or frozen soil conditions	Low
Directional boring	Boring under roads, railways, etc.	Moderate
Drilling	Water wells	Moderate
Direct plowing-in	Directly embedding cables and pipelines	Moderate
Drilling	Oil and gas wells	High
Remediation	Replacing topsoil, land levelling and tillage	High
Sanitization station	Washing and disinfecting equipment	High
Topsoil stripping	Stripping and stockpiling topsoil	High
Tracked equipment traffic	Tracks can disturb and move soil	High
Trenching	Excavating and burying cables and pipelines	High

**These are estimated impacts to provide an example of how risk assessments can be conducted and could change significantly depending on the specific equipment being used, its size and footprint, and the type of work being done. Furthermore, the risk rating could increase if soils are wet and muddy at the time the activity is being carried out.*

6.4 Pest Risk Assessment Matrix for Clubroot Disease

The overall risk of a particular piece of work is derived by multiplying the likelihood of clubroot being present by the potential for significant soil transport (Table 6).

Table 6. Pest risk assessment matrix for clubroot disease for field activities involving potential soil-borne spread*

		Negligible Likelihood Urban and non-cultivated lands	**Low Likelihood** RMs with no clubroot history and adjacent to RMs with no history	**Moderate Likelihood** Adjacent to positive RMs	**High Likelihood** Positive RMs	**Confirmed Clubroot** Positive fields
Potential for Significant Soil Movement or Transport	High Potential	Negligible Risk Activity	Low Risk Activity	Moderate Risk Activity	Moderate Risk Activity	High Risk Activity
	Moderate Potential	Negligible Risk Activity	Low Risk Activity	Low Risk Activity	Moderate Risk Activity	High Risk Activity
	Low Potential	Negligible Risk Activity	Low Risk Activity	Low Risk Activity	Low Risk Activity	High Risk Activity
	Negligible Potential	Negligible Risk Activity	Negligible Risk Activity	Negligible Risk Activity	Negligible Risk Activity	High Risk Activity

**Negligible risk activities may require little, if any, cleaning of vehicles, machinery and equipment after project completion, and low risk activities will require less cleaning time than for moderate and high-risk activities.*

6.5 Biosecurity Measures and Sanitization Procedures Based on Pest Risk Assessment Matrix for Clubroot

The following table demonstrating suggested mitigation (equipment sanitation) levels for each risk category (Table 7). The four sanitation levels are none, rough cleaning, fine cleaning, and disinfection in this example. The equipment involved in a certain activity would need to receive the recommended sanitation level before departing the field (on-site cleaning) or accessing another cultivated property (off-site cleaning). Off-site cleaning may be considered if fine cleaning and/or disinfection are required but not possible to perform on-site.

Table 7. Biosecurity measures and sanitization procedures for vehicles, equipment and personnel based on pest risk assessment matrix for clubroot

Activity Risk Level	Equipment Sanitization Effort	Equipment Sanitization and Boot Cleaning Procedures
Negligible Risk Activity	No cleaning required	None
Lower Risk Activity	Rough Cleaning (Quick cleaning is required)	Use hand tools such as scrapers, shovels, wire brushes, brooms, backpack blowers and compressed air to remove loose and clinging soil and crop debris.
Moderate Risk Activity	Fine Cleaning (Some cleaning is required)	Following Rough Cleaning, use pressure washers to remove any remaining soil and plant debris from surfaces. Detergents may be helpful in loosening stubborn soil residues and areas contaminated with grease and oil. Pulsating (turbo) nozzles may help to break up larger deposits. At the end of this process, the equipment should be free of visible soil and plant material.
Higher Risk Activity	Disinfection (More thorough cleaning is required)	Following Rough and Fine Cleaning, apply a two per cent sodium hypochlorite bleach to the clean surface and allow for a minimum of 20 minutes of contact time. It may be necessary to apply more bleach if the surface dries too quickly. **Avoid applying bleach to sensitive equipment and clothing and use personal protective equipment to minimize exposure to this chemical and its fumes.** Disposable boot covers or rubber boots should be worn when working in infested fields if boots are unable to be disinfected properly.

7. Information Resources on Crop Biosecurity

7.1 References on Crop Biosecurity in Canada

Note: The websites cited within the following references were accessed in May 2023.

Canadian Food Inspection Agency. 2013. *National Voluntary Farm-Level Biosecurity Standard for the Grains and Oilseeds Industry*. Website: http://publications.gc.ca/site/eng/436686/publication.html.

Canadian Food Inspection Agency. 2013. *National Voluntary Farm-Level Biosecurity Standard for the Grains and Oilseeds Industry - Producer Guide*: A Guide for Implementing Proactive Biosecurity into Farm Management. Website: http://publications.gc.ca/site/eng/470985/publication.html.

Canadian Food Inspection Agency. 2013. *National Voluntary Farm-Level Biosecurity Standard for Potato Growers*. Website: https://www.inspection.gc.ca/plants/potatoes/guidance-documents/national-farm-level-biosecurity-standard/eng/1351685363578/1351685528151.

Canadian Food Inspection Agency. 2013. *Producer Guide to the National Voluntary Farm-Level Biosecurity for Potato Growers: A Guide to Developing Your Farm Biosecurity Plan*. Website: https://www.inspection.gc.ca/plants/potatoes/guidance-documents/guide-to-developing-your-farm-biosecurity-plan/eng/1367841058884/1367841193074.

Canadian Food Inspection Agency. 2017. *National Voluntary Farm-Level Biosecurity for the Greenhouse, Nursery and Floriculture Sectors*. Website: https://www.inspection.gc.ca/plants/plant-pests-invasive-species/biosecurity/national-voluntary-farm-level-biosecurity-standard/eng/1456344248841/1456344249699.

Canadian Food Inspection Agency. 2017. *Greenhouse Vegetable Sector Biosecurity Guide*. Website: https://www.inspection.gc.ca/plants/plant-pests-invasive-species/biosecurity/greenhouse-vegetable-sector-biosecurity-guide/eng/1484722296145/1484722331070.

Canadian Food Inspection Agency. 2017. *Nursery Sector Biosecurity Guide*. Website: https://www.inspection.gc.ca/plants/plant-pests-invasive-species/biosecurity/nursery-sector-biosecurity-guide/eng/1485922257359/1485922305072.

Canadian Food Inspection Agency. 2017. *Floriculture Sector Biosecurity Guide*. Website: https://www.inspection.gc.ca/plants/plant-pests-invasive-species/biosecurity/floriculture-sector-biosecurity-guide/eng/1489427460069/1489427556596.

7.2 References on Crop Biosecurity in Western Canada

Note: The websites cited within the following references were accessed in March 2020.

Alberta

Vogel, P. 2015. Controlling Biosecurity Risks – A New Standard for Energy Development. Cohen Highley Lawyers, London, ON. Website: http://cohenhighley.com/articles/farm-regulation/controlling-biosecurity-risks-a-new-standard-for-energy-development/.

Manitoba

Manitoba Agriculture. 2010. Biosecurity: Help Protect the Health of Livestock and Crops. Website: https://www.gov.mb.ca/agriculture/crops/pubs/biosecurity-factsheet.pdf.

Manitoba Agriculture. 2010. Biosecurity in Crop Production. Website: https://www.gov.mb.ca/agriculture/crops/biosecurity.html.

Manitoba Agriculture. 2010. Biosecurity Guidelines for Inspection, Surveys and Complaints in Manitoba Fields. in Crop Production. Website: Accessed: February 2020. Website: https://www.gov.mb.ca/agriculture/crops/biosecurity-agronomist.html.

Manitoba Agriculture. 2010. Measures to Reduce Soil or Pest Movement in Manitoba for Custom Applicators. Website: https://www.gov.mb.ca/agriculture/crops/biosecurity-custom-applicator.html.

Manitoba Agriculture. 2010. Biosecurity on the Farm a Must for Prairie Farmers. Website: https://www.gov.mb.ca/agriculture/animal-health-and-welfare/animal-health/biosecurity-on-the-farm-a-must-for-prairie-farmers.html.

Manitoba Agriculture. 2010. Biosecurity and Reduction of Pest Movement Strategies for Producers. Website: https://www.gov.mb.ca/agriculture/crops/biosecurity-landowner.html.

Manitoba Agriculture. 2010. Biosecurity Management on Agricultural Land for the Energy and Transportation Industries. Website: https://www.gov.mb.ca/agriculture/crops/biosecurity-energy-and-transportation.html.

Manitoba Agriculture 2020. Reducing Clubroot Risks Associated with Field Research. Website: https://www.gov.mb.ca/agriculture/crops/biosecurity-r-and-d.html.

Saskatchewan
Saskatchewan Agriculture. 2018. Crop Disease and Invasive Species Protocol. Website: https://pubsaskdev.blob.core.windows.net/pubsask-prod/107291/107291-Biosecurity_ProtocolOne-pager.pdf.

Saskatchewan Agriculture. 2018. How to Make a Two Percent Sodium Hypochlorite Solution Disinfectant. Website: https://publications.saskatchewan.ca:443/api/v1/products/90539/formats/107453/download.

Saskatchewan Agriculture. 2023. Pest Biosecurity Program. Website: https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/sustainable-canadian-agricultural-partnership/programs-for-farmers-and-ranchers/pest-biosecurity-program.

Saskatchewan Agriculture. 2019. Scouting for Biosecurity Risks. Website: https://www.saskatchewan.ca/-/media/images/agriculture/crops/crop-protection/disease/scouting-biosecurity-infographic.jpg.

Saskatchewan Agriculture. 2019. Biosecurity for Preventing the Introduction of Crop Pests. Website: https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/crop-guides-and-publications/biosecurity-for-preventing-the-introduction-of-crop-pests.

Saskatchewan Agriculture. 2019. Knock It Off. Website: https://www.saskatchewan.ca/-/media/images/agriculture/crops/crop-protection/disease/knock-it-off.jpg?h=580&w=750&hash=46B96C8EAD8C7EEE5EB8667941607E71.

Waterer, D. 2019. Farm Biosecurity Guide for Saskatchewan Greenhouse Growers. Saskatchewan Greenhouse Growers Association. Website: http://www.saskgreenhouses.com.

Waterer, D. 2019. Farm Biosecurity Guide for Saskatchewan Vegetable Producers. Saskatchewan Vegetable Growers Association. Website: http://www.svga.ca.

7.3 References on Crop Biosecurity in Western Canada with Emphasis on Clubroot of Canola

Note: The websites cited within the following references were accessed in March 2022.

Alberta Agriculture and Forestry. 2019. *Preventing Clubroot: Agricultural Sanitization*. Website: https://www.canolawatch.org/2018/06/27/clubroot-disinfectants-bleach-is-best/

Alberta Agriculture and Rural Development (AARD) and Alberta Clubroot Management Committee. 2014. *Alberta Clubroot Management Plan*. Website: https://www.alberta.ca/alberta-clubroot-management-plan.aspx.

Canadian Energy Pipeline Association (CEPA). 2017. Clubroot Management: Risk-based Guidance Document. [Note: This document is not publicly available]

Canola Council of Canada. 2018. Biosecurity for Field Crops: Why and How. Canola Watch Newsletter. Website: https://www.canolawatch.org/2018/05/02/biosecurity-for-field-crops-why-and-how/.

Canola Council of Canada. 2012. Managing Clubroot: Equipment Sanitation Guide. Website: https://www.canolacouncil.org/publication-resources/print-resources/crop-production-resources/managing-clubroot-equipment-sanitation-guide/.

Canola Council of Canada. 2022. About Clubroot. Website: https://www.canolacouncil.org/canola-encyclopedia/diseases/clubroot/about-clubroot/.

Canola Council of Canada. 2022. Control Clubroot. Website: https://www.canolacouncil.org/canola-encyclopedia/diseases/clubroot/control-clubroot/.

Canola Council of Canada. 2020. Clubroot Disinfectants: Bleach is Best. Website: https://www.canolawatch.org/2018/06/27/clubroot-disinfectants-bleach-is-best/

Manitoba Agriculture 2020. Reducing Clubroot Risks Associated with Field Research. Website: https://www.gov.mb.ca/agriculture/crops/biosecurity-r-and-d.html.

Saskatchewan Agriculture. 2021. Clubroot Management Agreement: Irrigated Land. Website: http://publications.saskatchewan.ca/api/v1/products/92995/formats/110075/download.

Saskatchewan Agriculture. 2021. Clubroot Management Agreement: Non-Irrigated Land. Website: https://publications.saskatchewan.ca/#/products/92155.

Saskatchewan Agriculture. 2019. Clubroot of Canola. Website: https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/disease/clubroot-of-canola.

Saskatchewan Agriculture. 2021. Saskatchewan Clubroot Management Plan. Website: https://publications.saskatchewan.ca/api/v1/products/102185/formats/113037/download.

Saskatchewan Agriculture. 2017. Clubroot Scouting and Management Tips. Website: https://publications.saskatchewan.ca/api/v1/products/88425/formats/105086/download.

Saskatchewan Agriculture. 2019. Clubroot Sampling on the Prairies. Website: https://publications.saskatchewan.ca/#/products/100972.

7.4 Contacts for General Information on Crop Pests and Specific Inquiries on Crop Biosecurity in the Saskatchewan Ministry of Agriculture

Crops and Irrigation Branch 125 – 3085 Albert Street Regina, SK S4S 0B1 Ph. (306) 787-4660	**Carter Peru** Provincial Specialist Integrated Pest Management carter.peru@gov.sk.ca
Alireza Akhavan Provincial Specialist Plant Disease alireza.akhavan@gov.sk.ca	**Clark Brenzil** Provincial Specialist Weed Control clark.brenzil@gov.sk.ca
Tayo Adegeye Provincial Specialist Pest Regulatory tayo.adegeye@gov.sk.ca	**James Tansey** Provincial Specialist Insect/Vertebrate Pest Management james.tansey@gov.sk.ca

8. Glossary of Technical Terms

Agricultural Lands
Lands in Saskatchewan which have been developed for commercial farming or ranching.

Best Management Practices
Proven and adopted crop production and protection practices that are specific to each farm or production area.

Biosecurity
A series of management practices designed to prevent, minimize and control the introduction of pests into a farm or production area, the spread of pests within a farm or production area and the movement of pests away from the farm or production area to adjacent properties and possibly beyond.

Biosecurity Plan
A written set of practices designed to prevent, minimize, control and contain pest movement into and spread within and away from a farm or production area. A biosecurity plan for a farm operation is usually farm specific, whereas plans for industry groups and government agencies are often project- or activity-specific in their focus.

Contamination
A situation where soils, plant materials, machinery, clothing, equipment and other materials become tainted or infested with pests.

Crop
Plants and plant products produced by a grower, producer, or farm operator for sale, including cereal, oilseed, forage, pulse and horticultural and specialty crops.

Crop District
The agricultural area of southern and central Saskatchewan is divided into about 20 crop districts of various sizes, each of which is comprised of multiple Rural Municipalities (RM).

Crops Extension Specialist
A position within the Ministry of Agriculture that provides assistance and advice to farmers on all aspects of farm management, cultivation, fertilization, harvesting, soil erosion and composition, disease prevention, nutrition, crop rotation and marketing.

Provincial Specialist
A position within the Ministry of Agriculture that provides expertise and advice on pest biology, prevention and management. Contact information is provided in Section 7.4.

Crown Corporation
A corporation owned and operated by the Government of Saskatchewan.

Disease
An impairment of the normal state of growth in a plant that prevents it from reaching its maximum potential. Diseases can be caused by biotic agents (pathogens), such as bacteria, fungi, viruses, phytoplasmas and nematodes, or by abiotic stresses, such as nutrient deficiencies, extreme temperatures, mechanical injuries and excess soil moisture. In the context of biosecurity plans, only biotic diseases are a threat.

Disinfection
A physical or chemical process that is used to inactivate, decrease or eliminate a pest from a surface or an object. The use of chemical disinfectants may require the use of personal protective equipment and additional precautions to minimize safety concerns associated with the use of these products.

Farm
A tract(s) of land, commonly referred to as a farm unit or farm operation, used for the purposes of field crop production, including annual and perennial crops. The farm unit includes residences and all farm storages, buildings and structures, as well as remotely located fields used to produce crops. Greenhouses, mushroom houses and other facilities where crops are grown in protected environments may or may not be considered farms depending on whether they are in rural or urban areas and what local zoning regulations may be in place.

Farm Equipment and Machinery
Tractors, farm machinery and implements and related equipment needed for farm operations, excluding farm vehicles.

Farm Vehicles
Includes cars, trucks, pickups and all-terrain vehicles used on the farm for various work activities and to deliver crops to the market.

Farmer/Farm Manager/Farm Operator/Producer
A person who owns or leases land or facilities for crop production, produces and markets crops, manages the assets used to produce and market crops and manages the farm business.

Field
An area of a farm designated to produce crops.

High-Impact Pest
A disease, insect, weed or other type of pest that has the potential to cause significant yield and quality losses in agricultural crops. May include pests that are regulated by federal or provincial legislation.

Industrial Equipment and Machinery
Machinery and equipment used for services provided by industry groups. Includes earth moving.

Infested Area/Infestation
Presence of a living pest of plants or plant products in a field or storage area.

Integrated Pest Management (IPM)
A broad-based approach to pest management that integrates practices for the prevention and control of pests, such as diseases, insects and weeds, in crops. It is a sustainable approach that combines biological, chemical, cultural and physical methods so the benefits of pest control are maximized, and health and environmental risks are minimized.

Invasive Species
A living organism that can cause ecological or economic harm in an environment where it is not native, e.g., many of the weed species found in Canada are invasive plants.

Landowner
The person who holds title to a specific parcel of land, but may or may not farm the land, and to whom pest notices under *The Plant Health Act* and *The Weed Control Act* may be sent, unless otherwise designated by the landowner.

Monitoring Program
A scheduled activity to look for the presence or signs of pests, which may include observation and/or testing of soil, plants, equipment and facilities. The intensity and frequency of this activity depends on the time of year and the life cycle stage(s)of the pests of concern.

Off-Farm Vehicles and Equipment
Vehicles not originating on the farm but may come to pick up or deliver fuel, fertilizer, chemicals, building supplies, seed and other inputs. Also includes vehicles and equipment used on the farm by other agricultural service providers, government agencies, energy utilities and the energy industry.

Off-Road Vehicles
All-terrain vehicles (ATVs), such as quads and trikes, utility task vehicles (UTVs), such as side-by-sides, as well as dirt bikes (motorcycles), snowmobiles and the like. They may come to a farm for work-related or recreational activities.

Pathogen
An agent(s) that causes infectious disease in plants, such as bacteria, fungi, viruses, viroids and phytoplasmas.

Pathways
Routes by which pests can be introduced or moved from one location to another within and between farms.

Pest
Anything that is injurious or potentially injurious, whether directly or indirectly, to plants or to products or by-products of plants. As a group, pests can include other plants (weeds), animals, pathogens, nematodes, insects and mites.

Pest Risk Assessment
The process of determining the risk of a pest being transported, introduced, becoming established, increasing in abundance, spreading and causing negative economic impacts to a farming operation.

Pest Risk Mitigation
Steps that may be taken to avoid, minimize or remediate the impact that a pest may be having on a particular plant or crop.

Place of Production
A term used to describe a variety of crop production and handling areas, including farms, greenhouses, packing houses, storages, etc.

Prevention
Steps taken to preclude the introduction or movement of pests on farms and other places of production.

Production Area
A field, garden, greenhouse, building or other area designated for the cultivation of agricultural crops.

Property
The land on which the production area(s) are located, including all farm buildings and structures.

Protocol
Defined and written procedures which detail the steps to be followed to achieve an objective, for example, disinfecting a piece of farm equipment.

Quarantine Pest
A pest of potential economic significance to a farm or other specific area and which may not yet be there, or present but not widely distributed and being officially controlled. In Canada, quarantine pests are defined in the *Plant Protection Act*.

Regulated, Non-Quarantine Pest
A non-quarantine pest whose presence in plants or fields affects the yield, quality and/or end use in unacceptable ways and may be regulated within certain geographical areas.

Rural Municipality
A type of municipal district in the Province of Saskatchewan that is mostly rural in character; typically abbreviated to RM.

Sanitization
The process of cleaning and disinfecting farm equipment, machinery, vehicles, facilities and personnel from both on- and off-farm sources. The process usually consists of three key steps: rough cleaning, fine cleaning and disinfection.

Service Provider
Any business agent, consultant, contractor, subcontractor or temporary employee engaged by the producer for a specific service, e.g., utility installation and servicing, trucking, crop advisors.

Third Party(ies)
An entity that is involved in some way in an interaction that is primarily between two other entities. A term that is often used in legal, business and political discourse. This term is sometimes to refer to individuals and organizations that farmers and ranchers may have a service provider or other type of business or relationship with.

User Group(s)
A general term to describe entities that are using a particular product, service or workspace. In the context of these Guidelines, this term refers to individuals, commercial businesses and government organizations that may occasionally access and use agricultural lands on farming or ranching operations in Saskatchewan for business, recreation and other purposes.

Vector
A carrier or an agent that can transfer a pest from an infected host (e.g., a diseased plant) or an infested source (e.g., a plant colonized by many insects) to another host or hosts.

Visitor(s)
Any non-farm personnel who arrive at a farm or production area for business or non-business-related purposes and may include salespersons, inspectors, delivery people, contractors, custom customers, tour groups, friends/relatives of farm personnel, researchers, etc.

9. Appendices

9.1 Illustrations of select machinery, equipment and vehicles showing areas where soil, plant material, dust and other contaminants may accumulate and where special attention should be paid during the sanitization process.

Machinery and equipment photos courtesy of Tom King, Northland Agronomy, Saskatoon, Sask. and Raul Avila, Saskatchewan Agriculture, Regina, Sask.

John Deere 8270R MFWD Tractor

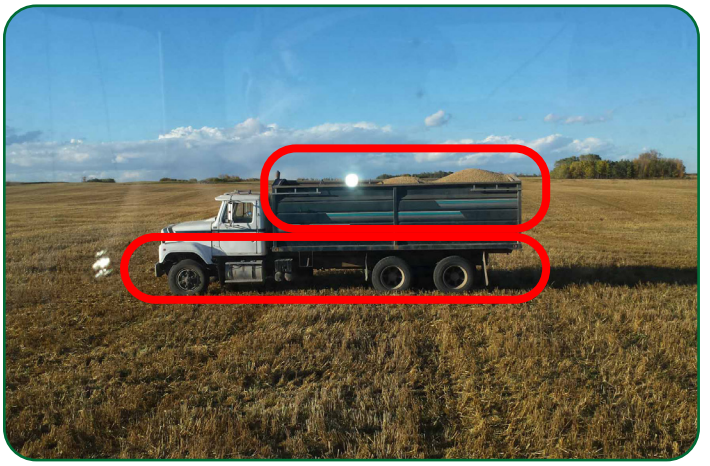
John Deere Air Seeder and Cart

John Deere 9560 Tractor and Double Disc

John Deere S680 Combine

John Deere High Clearance Sprayer

MacDon M135 Swather



Tandem Grain Truck

John Deere 2011 Deep Ripper

JFrontier TM5132 Tandem Disc Harrow

Degelman 7200 Rockpicker

Frontier TM5132 Tandem Disc Harrow

Degelman Land Roller

John Deere 333D Tracked Skid Steer

John Deere 850D Track Hoe Excavator

Medium Bulldozer

Case IH Steiger 550 QuadTrac Tractor

Cat Grader c/w Snow Wing and Plow

Case IH 550 QuadTrac Tractor

9.2 How to make a two per cent sodium hypochlorite solution solution for disinfecting vehicles, tools and equipment.

How to make a two per cent sodium hypochlorite solution disinfectant

	Product (original concentration)	Amount of bleach to add	Amount of water to add	Final volume
	Clorox disinfecting bleach (6% sodium hypochlorite)	250 mL	500 mL	750 mL
	President's choice disinfecting bleach (8.25% sodium hypochlorite)	182 mL	568 mL	750 mL
	Regular bleach concentrated (8.25% sodium hypochlorite)	182 mL	568 mL	750 mL

Look on the label or consult the product's safety data sheet to find the original sodium hypochlorite concentration.

Key considerations when using bleach

1. The concentration of sodium hypochlorite will decrease during storage.
   - Purchase bleach in small quantities and use it relatively quickly (within a few months).
   - If you are storing bleach, store it in a cool, dry location.
2. Organic matter will inactivate the sodium hypochlorite
   - If using a two per cent sodium hypochlorite solution to disinfect foot wear or other equipment, refresh the solution frequently or as it becomes dirty to maintain the two per cent solution.
3. Bleach degrades quickly when diluted with water
   - Keep diluted bleach out of direct sunlight and ensure lid is tightly sealed to prolong efficacy. Regularly refresh dilute bleach solution to ensure efficacy. It is ideal to prepare bleach solutions daily. If a two per cent sodium hypochlorite solution is stored properly, the solution should still be replaced at least once a week.