

Barley diseases: Don't depend on a Single Strategy from the Disease Management Toolbox

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Abstract: *One of the principle requirements to fruitful barley creation comes about because of foliar diseases, which wreck green leaf territory and along these lines confine the barley plant's capacity to set yield and fill grain. Despite the fact that a scope of methodologies are accessible to control foliar and other oat diseases, once in a while does the utilization of a single "silver slug" arrangement give finish insurance. The fundamental barley foliar diseases in western Canada are burn, (*Rhynchosporium secalis*), got (*Drechslera teres* (Sacc.) Shoemaker) and spotted (*Drechslera teres* f. *maculata* Smedeg.) types of net smudge, and spot smear (*Cochliobolus sativus* (Ito and Kuribayashi) Drechs. ex Dastur). Burn, net smear and spot smudge each have remarkable life cycles, and as a result makers need to consider a combination of methodologies to give successful and reliable long haul assurance from these foliar diseases. This paper gives a diagram of the comprehensive management of normal foliar diseases of barley in western Canada, utilizing a various arrangement of management instruments, and applying a developing season viewpoint.*

INTRODUCTION

The normal foliar diseases of barley (*Hordeum vulgare* L.) in western Canada are single, (*Rhynchosporium secalis*, Figure 1), got (*Drechslera teres* (Sacc.) Shoemaker, Figure 2) and spotted (*Drechslera teres* f. *maculata* Smedeg., Figure 3) types of net smudge, and spot smear (*Cochliobolus sativus* (Ito and Kuribayashi) Drechs. ex Dastur, Figure 4). These diseases are significant imperatives to keeping up yield and quality in western Canada and

somewhere else, and the damage applied can be particularly intense when helpless assortments are developed. Since the pathogens are made out of a few to many strains or pathotypes^{1,2,3,4,5,6,7}, and new ones develop quickly in light of assortment changes or potentially creation alterations, even 'safe' assortments may wind up noticeably helpless and end up plainly diseased. Yield misfortunes of up to 20% because of these diseases have been accounted for previously^{8,9,10,11} and comparable misfortunes have been shown in cv. Harrington barley become under foliar disease weight in western Canada^{12,13}. Such examinations have likewise shown the value of foliar fungicides in improving yields, thousand portion weight, and bit stoutness in influenced crops. While a few systems including hereditary qualities, chemicals, and social alterations are accessible to control foliar and other grain diseases, once in a while does the utilization of a single one of these give finish insurance. Since a "silver shot" situation does not exist, makers need to consider a combination of systems from their disease management toolbox to give powerful and reliable long haul security from foliar diseases. It can be hard to consider the greater part of the potential associations that will happen among the different crop/disease approaches that a maker will utilize. Our goal here is to concentrate on all encompassing management of the normal foliar diseases of barley in western Canada, utilizing a various arrangement of management apparatuses, and applying a developing season viewpoint. Where accessible, we will bolster our approach with inquire about outcomes, and will likewise show where disease

management techniques may cooperate with weed and crop generation management.
Insects and Diseases



Figure 1: Typical symptoms of scald of barley.



Figure 2: Typical symptoms of netted net blotch of barley.



Figure 3: Typical symptoms of spotted net blotch of barley.



Figure 4. Typical symptoms of spot blotch of barley.

Management considerations prior to and at seeding Planning

Information from past developing seasons, for example, what diseases regularly show up in a specific generation area, is an intense apparatus to help decide the procedures that can be utilized. For instance, if an extreme leaf spot issue happened the earlier year, thought ought to be given to growing an alternate crop or utilizing an alternate field where the danger of the disease happening is lower. Field area, geography and wind-heading, can likewise be vital contemplations. This is especially so for net smudge and spot smear, since *P. teres* and *C. sativus* are wind-borne². Finding a barley field downwind from another that has had a past filled with net smear will constantly worsen the danger of disease. This might be less of an issue for *R. secalis* given that the pathogen is just scattered by rain-sprinkle over short separations, i.e. <2 m^{5, 2,14,15,16}.

Seeding - quality seed, seed placement, seed treatment, and seeding date

The utilization of good quality, without pathogen, non-harmed seed with great germination and life, is another essential foundation of a successful and comprehensive disease management program. Quality seed evades early-season disease issues, and diminishes or dispenses with the danger of acquainting a seed-borne pathogen with new territories (fields or districts). Powerful management of seed-borne pathogens at early crop growth stages is especially important when a vulnerable assortment is being developed, or when environmental conditions are helpful for disease improvement and spread amid the developing season.

Rather than stubble-and straw-borne pathogen inoculum, the absence of references and data in the logical writing with respect to seed-borne inoculum of *R. secalis*, *P. teres*, and *C. sativus* proposes that it isn't viewed as a noteworthy supporter of the general leaf disease pestilences on barley in western Canada. Nonetheless, seed-borne

inoculum can be an essential wellspring of disease somewhere else, as for the situation for net smudge in England, India, and New Zealand^{17,18,19,16,20}.

While seed-borne inoculum may not bring about calculable early-season disease, barley foliar diseases are polycyclic in nature and can finish and rehash their life cycles in 7-14 days², subsequently having the capacity to develop, spread, and achieve harming levels.

Research from Alberta demonstrated that amid the three-year time frame from 1995 to 1997, in the vicinity of 71 and 97% of barley grain tests tried had perceivable levels of *P. teres*, with percent seed pervasion that ran from 7.1 to 22.6%²¹. Most extreme pervasion levels by a similar pathogen in single grain tests were high in every year, going from 81 to 89%. Such levels would positively affect ensuing seed germination and rise, if seed treatment were not utilized as well as and early-season conditions supported the pathogen(s) over the crop plant.

For best outcomes, seeding with quality seed ought to be combined with shallow seed situation, which additionally diminishes the danger of 'seedling curses' and early season root and foliar harm. Low quality seed will bring about moderate germination and development when seeded profound, dragging out the introduction of the seed and youthful plants to pathogens. Profound seeding likewise brings about extra vitality being used by the plant to achieve the soil surface, debilitating it and making it more helpless against assault by soil-or surface-borne pathogens. Poor germination and rise can along these lines result in meager stands in which rivalry by weed species additionally debilitates the crop and diminishes its yield and quality potential. At the point when rise is moderated or lessened, extra tiller advancement may happen, bringing about postponed and additionally uneven maturity^{22,23}. Seed treatment with an enrolled fungicide is another practical strategy to address

potential early-season disease problems^{2,5,24}. Treating seed helps plants in getting a decent begin even under not as much as ideal conditions, and advances even stand foundation. Seed treatment is especially fitting under consistent barley generation or potentially if a more defenseless assortment is developed.

Field tests demonstrated that seeding date may influence seriousness of singe in focal Alberta. This examination has prompted the proposal that early seeding of singe helpless barley cultivars ought to be stayed away from in burn pervaded fields. Burn defenseless cultivars might be seeded late for swath touching to lessen the danger of singe development²⁵.

Crop residue management

Devastation of invaded barley buildups is frequently proposed as a way to take out potential wellsprings of essential inoculum that start leaf spot plagues. With the across the board reception of preservation culturing hones, there are worries that the act of leaving more crop buildup on the soil surface may expand the danger of barley leaf spot pestilences. Research from various trials in Canada and somewhere else have demonstrated that the selection of protection culturing has not prompted a sensational increment in barley leaf spot diseases and a negative effect on crop yields contrasted with customary tillage^{26,27,28,29,2,30}. Despite the fact that, a United Kingdom think about by Jordan and Allen³¹ exhibited a decline in net smear on winter barley under traditional furrowing contrasted with coordinate boring (zero culturing), in western Canada the most widely recognized type of regular culturing is the utilization of a substantial obligation cultivator (etch furrow), while furrowing is less common³². In western Canada, run of the mill customary culturing rehearses leave between 50-80% deposit cover after every culturing operation, contingent upon the culturing actualize utilized (Anon. 2003), and these deposits could at present go about as a noteworthy wellspring of pathogen

inoculum. In spite of the fact that furrowing deserts a littler measure of residue³³, resulting culturing operations identified with seedbed arrangement could in any case convey pervaded crop deposits to the soil surface. By and large, crop generation factors, for example, environmental variety among singular fields, areas and years, crop revolution, seed-borne inoculum, and decision of cultivar (level of disease protection) will probably largely affect the danger of disease improvement contrasted and the kind of culturing framework that is used^{34,35,36}. Albeit consuming has likewise been supported as a technique for devastating wellsprings of essential inoculum, late research has demonstrated that the utilization of flame for barley leaf disease management is inadequate, while consuming of deposits can prompt decreased soil quality^{37,38}.

Crop Rotation

Enhancement of crops in a turn separates the life cycles of numerous disease-causing living beings. It additionally gives the chance to a general ascent in crop efficiency and more viable management of creepy crawly and weed species. Cook and Veseth³⁹ show that "pivot enables time for common foes to pulverize the pathogens of one crop while one or ideally two irrelevant crops are developed". They likewise recommend that pivot goes about as characteristic "soil fumigation", where the aggregate action of "anti-toxin, ruthless, and aggressive living beings" disposes of plant pathogens from soil and plagued crop buildups. In any case, financial contemplations entice makers to limit turns.

Variety choice

Despite pivot and field area, makers should develop assortments that have the best disease protection bundle accessible, with the understanding that such assortments should likewise meet agronomic and promoting prerequisites. This data is incorporated into the yearly refreshed commonplace Seed Guides; data in these



aides shows that disease protection levels shift generally among enlisted varieties^{40,41,42}. Weighing and organizing varietal characteristics (grain yield, quality, development, disease execution, and so forth.) significant to a specific circumstance is no simple errand. Luckily, barley reproducing programs in western Canada are discharging ever-enhanced assortments that fuse the same number of the agronomic, quality, and disease properties as could reasonably be expected.

Research in Alberta has demonstrated that growing an alternate barley assortment yearly, even without turn, can diminish foliar disease seriousness and enhance yields⁴³. This is especially viable if the barley assortments begin from various rearing projects, as their hereditary qualities for disease protection and different attributes will probably contrast. Developing a similar assortment every year gives the burn and net smear pathogens, specifically, with a more noteworthy opportunity to adjust and conquer any protection exhibit, bringing about upgraded harm and lessened yield.

Fertility

Richness is regularly connected with general crop efficiency identifying with yield and quality, yet it can likewise affect disease severity^{28,24}. An adjusted fruitfulness program will meet the large scale and miniaturized scale supplement needs of the crop and advance sound root frameworks and more vivacious growth. Conversely, a supplement inadequate crop will exhibit slower, poorer growth. Ideal fruitfulness may not ensure that a disease won't grow, but rather an enthusiastic developing crop will probably be better ready to endure disease. Conversely, a supplement lacking crop is probably going to be more helpless and endure more prominent harm and misfortune.

Albeit adjusted fruitfulness is essential, over the top treatment (particularly with nitrogen) will advance improvement of a lavish, thick

shade with a small scale condition helpful for the improvement of foliar diseases. At the point when the need is to boost yields by means of overwhelming treatment, makers should choose safe assortments if accessible, and additionally apply an enrolled foliar fungicide to counter the upgraded probability of disease.

Management considerations during the growing season Resources -information, field scouting and disease control

A disease management apparatus that is frequently neglected is the accessibility and usage of data, directed to makers, as well as to the business and research work force. Compelling disease management depends on precise distinguishing proof of diseases and their causal operators. Diseases have novel life cycles and formative necessities, and might be best controlled by particular means. Makers should benefit themselves of the data from their neighborhood agricultural office or common expansion division, industry experts, government or college specialists, or suitable destinations on the web. What's more, different productions identifying with plant diseases are accessible through book shops, and expert social orders. One helpful distribution that incorporates disease portrayals and shading images and identifies with barley and other oat and field crops is 'Diseases of Field Crops in Canada, second Edition', distributed by the Canadian Phytopathological Society (CPS) and accessible at some college book shops or specifically from CPS at www.cps-scp.ca/publications.html. The American Phytopathological Society (APS) offers an expansive choice of productions identified with plant diseases through their APS Press Bookstore at <http://www.apsnet.org/apsstore/Pages/default.aspx>. Both society sites offer connects to other pathology-related destinations. All commonplace agricultural governments keep up web destinations that offer a wide assortment of augmentation materials



identifying with plant diseases and their management - to peruse or download. In western Canada, these incorporate the locales by Manitoba Agriculture, Food and Rural Initiatives, <http://www.gov.mb.ca/agriculture/crops/diseases/index.html>, Saskatchewan Ministry of Agriculture, <http://www.agriculture.gov.sk.ca/Default.aspx?DN=65976d1a-8c66-4510-a96d-874a2b2b47a6>, and Alberta Agriculture and Rural Development, <http://www.agric.gov.ab.ca/app21/infopage?cat1=Diseases%2FInsects%2FPests&cat2=Crop Diseases>. Another management strategy that can be under-used is field exploring. Methodical investigation of a developing crop to survey its status is essential to powerful general creation management. This not just incorporates exploring for the nearness of diseases, yet in addition to check for populaces of bugs and weed species. This data is valuable to help with planning of management rehearses in the ebb and flow developing season, and also in the improvement of a management get ready for ensuing years. Field exploring will give data on what diseases are available at key phases of crop advancement and what affect these may have or are probably going to have. This information should shape the reason for basic leadership with respect to fungicide application (or the use of bug sprays and herbicides). Makers have the choice of exploring without anyone else or procuring an expert field scout. The last can give counsel with respect to an assortment of disease and other management systems. As a rule, exploring, if done viably, ought to distinguish potential issues, and combined with promptly accessible climate data, be demonstrative of whether an in-crop utilization of fungicide is justified. Disease determining frameworks intended to aid basic leadership by makers with respect to the utilization of fungicides are ending up more typical. These are to a great extent online and might be very broad in nature, or

require that significant detail, i.e. planting date, crop assortment, inputs, and so forth., be inputted. These can be found on the commonplace sites noted above, or as remain solitary elements. In western Canada, they have been created for fusarium head scourge of grains (<http://www.gov.mb.ca/agriculture/crops/fhb/index.html>). None have been created particularly for barley foliar diseases, yet singular crop security organizations may have restrictive choice aides accessible to offer to makers. Life sciences/concoction organization agents and their retailers may likewise be a valuable wellspring of choice help data. At the point when the disease hazard is sufficiently high, fungicide application is justified and can profit barley makers. More often than not, this information is most efficient for seed cultivators and malting barley makers; it may not be a monetary advantage for nourish barley makers. Nourish barley assortments have a to some degree better leaf disease protection 'bundle', including protection from burn, which no malting assortments right now have and in this manner may show a lesser reaction to fungicide application. Notwithstanding, the level of protection fluctuates among assortments. For instance, protection from got net smudge is poor, while protection from spotted net smear is great, and burn protection ailing in various bolster assortments 40(Agriculture and Rural Development 2011). Common Seed Guides ought to be checked for this varietal data, which, when combined with viable exploring to distinguish the issue, will go far to help with settling on a reasonable fungicide application choice. Research has shown the convenience of in-crop fungicides in decreasing disease harm, expanding grain or silage yields, and keeping up quality when direct to serious disease plagues occur 12,13,44. Appropriate planning of fungicide application is significant if ideal control is to be accomplished. Research has

demonstrated that fungicide applications at the banner leaf arrange (coordinate assurance of the leaves in the upper barley overhang) is vital to guaranteeing enhanced grain yield and portion weights^{45,46,47}.

CONCLUSIONS

Plainly, executing a powerful, financial, and enduring barley leaf disease management strategy isn't a basic issue. There are many variables for makers to think of some as, dangers, and various potential arrangements. In any case, as sketched out here there are an assortment of assets accessible to help with creating and actualizing such an arrangement, which, when combined with great crop management, should bring about a stage for reasonable barley generation. The diversity and combination of methodologies accessible, for management of diseases as well as in light of bugs and weed species, ought to accommodate an adaptable, responsive, and all encompassing crop management creation framework.

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