AgriNorthwest
Anderson Geographics
Blue Mountain Potato Grower
City of Hermiston
Crop Protection Services
Dexter Fortson Associates, Inc
Dupont
Elmer's Irrigation & Supply, Inc
Frederickson Farming
G2 Farming
Industrial Ventilation, Inc.
Inland Plumbing
Irrigation Specialists
IRZ Consulting
Morrow County
Nelson Irrigation
Northwest Farm Credit Services
Oregon Potato Commission
Oregon Wheat Commission
Portland General Electric
R.D. Offutt Company
RDO Equipment Co
River Point Farms
Ross-Brandt Electric, Inc
Syngenta Crop Protection
Three Mile Canyons
Umatilla County
Umatilla Electric Cooperative
Washington Potato Commission
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THANK YOU SPONSORS!

Washington Turfgrass Seed Commission

&

Crop Production Services

For supporting our annual Grass Seed

Field Day at OSU-HAREC

May 25, 2017

Oregon State University

Hermiston Agricultural Research & Extension Center
Oregon State University, 2121 South 1st Street, Hermiston, OR 97838
T 541-567-6337 | F 541-567-2240 | http//oregonstate.edu/dept/hermiston

HAREC GRASS FIELD DAY
May 25, 2017

8:30 am	Registration, Coffee and Donuts
8:55 am	Phil Hamm, Director OSU HAREC, Introductions
9:00 am	Nicole Anderson, OSU CSS "Current trends Oregon grass seed production: a western perspective"
9:30 am	Jeremiah Dung, OSU COARC, "IPM of Ergot in Grass Grown for Seed"
10:00 am	Darrin Walenta, OSU CSS, "Herbicides for Annual Winter Grass Weed Control and Expanding Grass Seed IPM Capacity"
10:30 am	Silvia Rondon, OSU CSS "March fly, Sawfly and Crane Fly: Relationship Advice"
11:00 am	Ken Frost, OSU HAREC, "Barley yellow dwarf virus in grass grown for seed"
11:30 am	Ray Qin, OSU HAREC, & Don Floyd, DLF Pickseed USA, Inc., "Assessment of Kentucky Bluegrass Hybrids for Seed Production Potential in North Central OR"
12:00 pm	Adjourn

Pesticide credits for Oregon and Washington & CCA credits will be available.

Thank you Sponsors!

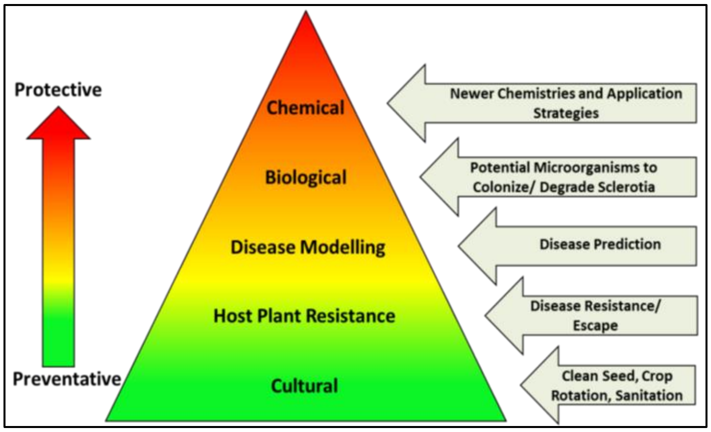
Washington Turfgrass Seed Commission

Crop Production Services

IPM of Ergot in Grass Grown for Seed

Jeremiah K.S. Dung
Oregon State University
Central Oregon Agricultural Research Center, Madras, OR

Over the last decade, a collaborative research effort between Oregon State University and USDA-ARS has contributed to the foundation for the development of a multi-tactic integrated pest management (IPM) approach for ergot that incorporates cultural control, host plant resistance, disease prediction modeling, and chemical control to minimize the impact of ergot in the grass seed industry.



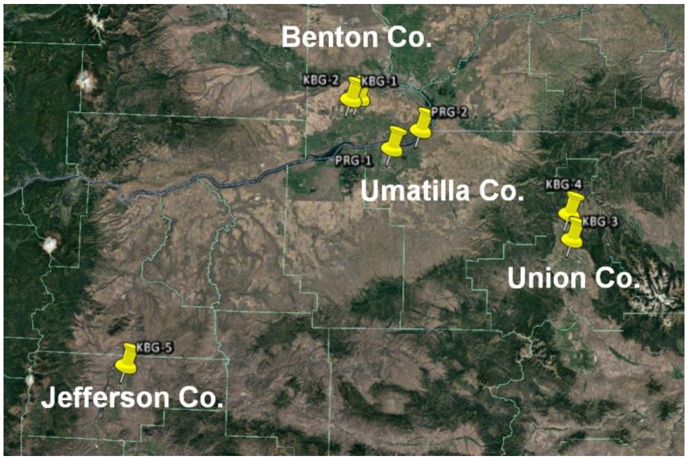
2017 Ergot Research Projects

We have several new and ongoing research projects at various locations in Oregon and Washington:

- Fungicide screening for ergot control (Madras and Hermiston)
- Kentucky bluegrass cultivar evaluations for ergot escape/resistance (Madras and La Grande)
- Screening biocontrol products (Hermiston)
- Forecasting model evaluation, refinement, and validation (Oregon and Washington)
- Investigate the use of micronutrients to improve pollination and reduce ergot (Madras)

2017 Spore Trap Sites

This year we have seven spore traps deployed in three grass seed production areas: the Columbia Basin (Umatilla Co., OR and Benton Co., WA), the Grande Ronde Valley (Union Co., OR), and central Oregon (Jefferson Co., OR). These data will be used to refine and validate regional models and inform growers of spore production through the season.



Acknowledgements: The researchers would like to thank the Washington Turfgrass Seed Commission, the Oregon Seed Council, the Columbia Basin Grass Seed Association, the Jefferson County Seed Growers Association, and the Union County Growers Association for funding this research. In-kind support was also provided by BASF, Bayer CS, Central Oregon Seeds Inc., Columbia River Seeds, DuPont, Jacklin Seed, Pratum Co-op, PureSeed, Riverview Seeds, Syngenta, and Wilbur-Ellis.

Screening fungicides and biocontrol products for ergot control

- Applications of new, unlabeled fungicides during anthesis reduced honeydew and sclerotia in field trials at HAREC during 2015 and 2016
- Some products performed similarly to Quilt Xcel (industry standard)

	2015		2016	
Treatment	**Honeydew**	**Sclerotia**	**Honeydew**	**Sclerotia**
Non-treated control	15.8 A	15.5 a	19.8 A	38
Product W	11.5 AB	2.5 b	15.3 AB	35
Product X	11.3 ABC	3.8 b	13.3 ABC	23
Product Y	2.0 D	3.8 b	9.3 ABC	18.5
Product Z	3.3 BCD	2.0 b	8.5 B	19.25
Quilt Xcel (industry standard)	2.8 CD	0.3 b	4.0 C	14
***P*-value**	0.002	0.0079	0.004	0.078

- 2017 trials will test 7 unlabeled products in Kentucky bluegrass plots at HAREC and COARC (Madras) and perennial ryegrass plots at HAREC
- Coordinated effort with Steve Salisbury in the Willamette Valley (mildew and rust)
- Biocontrol products are also being screened in test plots at HAREC

Product	Active ingredient	FRAC	Manufacturer
Aproach	Picoxystrobin	11	DuPont
Luna	Fluopyram	7	Bayer CS
Miravis	Adepidyn	7	Syngenta
Priaxor	Pyraclostrobin + Fluxapyroxad	7+11	BASF
Propulse	Fluopyram + Prothioconazole	3+7	Bayer CS
Solatenol	Benzovindiflupyr	7	Syngenta
Trivapro	Azoxystrobin + Benzovindiflupyr + Propiconazole	11+7+3	Syngenta
Contans WG	*Coniothyrium minitans*		Sipcam Agro
RootShield WP	*Trichoderma harzianum* Rifai strain KRL-AG2		BioWorks
SoilGard	*Gliocladium virens* strain GL-21		Certis USA
Serenade Soil	*Bacillus subtilis* strain QST 713		AgraQuest

- *Application of a pesticide to a crop or site that is not on the label is a violation of pesticide law and may subject the applicator to civil penalties.*
- *In addition, such an application may also result in illegal residues that could subject the crop to seizure or embargo action by ODA and/or the U.S. Food and Drug Administration.*
- *It is your responsibility to check the label before using the product to ensure lawful use and obtain all necessary permits in advance.*
- *Use of commercial and trade names does not imply approval or constitute endorsement by Oregon State University.*

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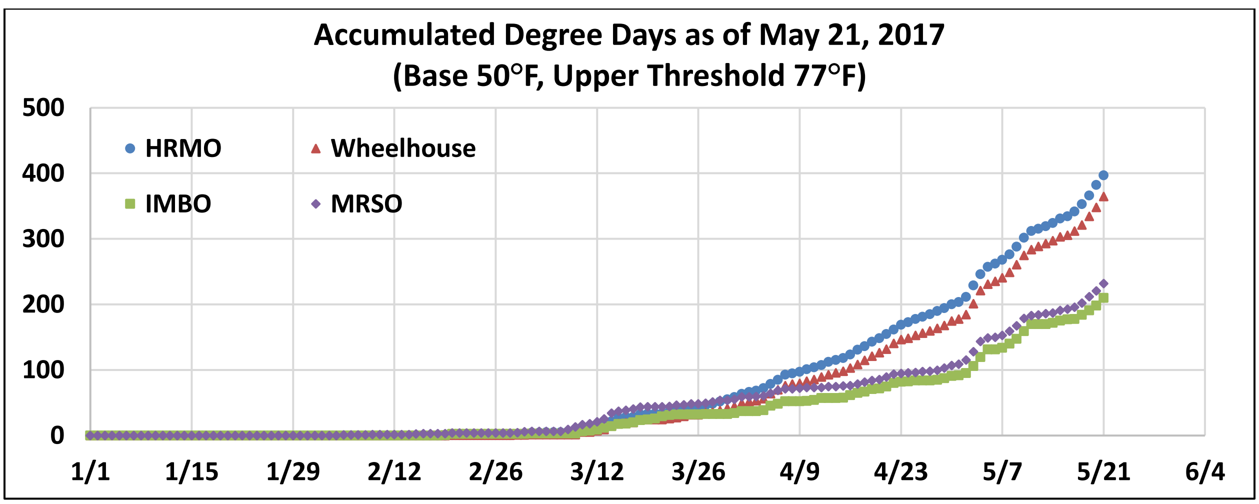
Disease Prediction Models

- Disease models to predict ascospore release could be used as decision aids to improve the timing and reduce the number of protective fungicide applications
- A predictive model for ergot ascospores was recently developed for the Columbia Basin of Oregon. The model uses accumulated degree-days (beginning January 1, with a base temperature of 50°F and upper threshold temperature of 77°F) to forecast when ascospores are likely to be present.
- According to the model, most ascospores are produced in Oregon's Columbia Basin when accumulated degree-days are between 414 and 727. On average, this degree day period corresponded to a 23 day period from May 14 to June 6, but started as early as May 1 or as late as May 25 and ended as early as May 24 or as late as June 17.

Year	Start date	End date	Days	Ascospores (% total)
2008	May 25	June 17	23	82%
2009	May 24	June 9	16	84%
2010	May 18	June 17	30	90%
2012	May 19	June 14	26	87%
2013	May 11	June 7	27	96%
2014	May 12	June 2	21	76%
2015	May 4	May 26	22	94%
2016	May 1	May 24	23	85%
Average	**May 14**	**June 6**	**23.5**	**93%**

- This model was developed using data collected from the Columbia Basin, so model performance may vary among the different production regions. Ongoing research aims to refine and expand these models for other areas where ergot is a problem.



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Sequential Herbicide Applications for Cheatgrass (*Bromus tectorum*) Control in Established Kentucky Bluegrass following Late Season Propane-flaming – Grande Ronde Valley of NE Oregon.

Oregon State University

D. L. Walenta, A.G. Hulting, B. Merrigan and D. W. Curtis

Objective

A study was conducted in an established Kentucky bluegrass field to evaluate downy brome control and crop injury potential from sequential applications of registered pre-emergent and post-emergent herbicides in established Kentucky bluegrass (KBG).

Materials and Methods

The experiment was located in an established commercial field of "Merit" Kentucky bluegrass in the Grande Ronde Valley of northeastern OR. The field was seeded spring 2014 and second seed crop was harvested in 2016. After baling residue, the field was propane-flamed on September 2, harrowed twice, and then re-flamed. Starter fertilizer was applied September 9. Prowl H2O at 5 pts/acre was applied by the grower on September 10. Approx. 4" irrigation water was applied with a wheel line sprinkler system following pre-emergent herbicide application on September 10, 2016. Conditions at time of application are summarized in Table 1. All treatments were applied with a hand-held CO_2 sprayer delivering 22 gpa at 30 psi. In order to minimize drift potential, TeeJet® air induction extended range (AIXR) 11002 nozzle tips were used for all applications. Plots were 8 ft by 25 ft in size and arranged in a randomized complete block design with 4 replications. Soil at the site consisted of a Palouse silt loam. Seed yield was not determined in this study.

Table 1. Conditions at time of herbicide application.

Application Timing	Sept. 25, 2016 Early Post	Oct. 22, 2016 Mid-Post	Nov. 13, 2016 Late Post
KBG growth stage	0 - 4" re-growth	4 - 6" height	4 – 6" height
BROTE growth stage	Coleoptile 1"	3" height, 2-4 tillers	4" height, 3-5 tillers
Air temperature (F)	72	53	48
Relative humidity (%)	33	47	85
% Cloud cover	clear & sunny	Partly cloudy	100% overcast
Wind velocity (mph)	0 - 3 from S-SW	0 – 4 from N-NE	0 – 2 from N-NE
Soil temp surface (F)	72	54	49
Soil temp 1 inch (F)	80	55	48
Soil temp 2 inch (F)	74	54	49
Soil temp 4 inch (F)	61	54	48

NOTICE: *Fierce®, Alion®, and Impact® products are* ***not registered*** *for use in any grass seed crops in the PNW. Metribuzin products are* ***not registered*** *for use in northeastern Oregon or Columbia Basin-OR grass seed production. Everest® registered only for Kentucky bluegrass seed crops during the establishment year east of the Cascades. Evaluations are experimental-only, therefore, mention of these products used in this trial should not be considered a recommendation for commercial use.*

Table 2. Sequential herbicide applications for cheatgrass control in established Kentucky bluegrass in the Grande Ronde Valley of northeastern Oregon – 2017 (Exp. 17-102).

Treatment	Active Ingredient	Product rate/acre	Application Timing	Site of Action Group#
1. Untreated Check				
2. Outlook®	dimethenamid-p	21 fl oz	EPOST	15
3. Goal 2XL® +	oxyfluorfen	8 oz	EPOST	14
Metribuzin DF	metribuzin	2.7 oz		5
4. Beacon® +	primisulfuron	0.38 oz	EPOST	2
Sinbar WDG®	terbacil	0.5 lb		5
5. Callisto® +	mesotrione	6 fl oz	EPOST	27
Sinbar WDG	terbacil	0.5 lb		5
6. Beacon //	Primisulfuron	0.38 oz	EPOST	2
Beacon +	Primisulfuron	0.38 oz	MPOST	2
Sinbar WDG	terbacil	0.5 lb		5
7. Goal 2XL +	oxyfluorfen	8 fl oz	MPOST	14
Sinbar WDG	terbacil	0.5 lb		5
8. Goal 2XL +	oxyfluorfen	8 fl oz	EPOST	14
Everest®	flucarbazone	1 fl oz		2
9. Beacon //	primisulfuron	0.76 oz	EPOST	2
Outlook	dimethenamid-p	21 fl oz	MPOST	15
10. Goal 2XL +	oxyfluorfen	8 fl oz	EPOST	14
metribuzin DF //	metribuzin	2.7 oz		5
Beacon +	primisulfuron	0.38 oz	MPOST	2
Sinbar	terbacil	0.5 lb		5
11. Beacon //	primisulfuron	0.38 oz	EPOST	2
Beacon +	primisulfuron	0.38 oz	MPOST	2
Sinbar WDG //	terbacil	0.50 lb		5
Prowl H2O	pendimethalin	5 pts	LPOST	3
12. Goal 2XL +	oxyfluorfen	8 fl oz	EPOST	14
Sinbar //	terbacil	0.50 lbs		5
Outlook	dimethenamid-p	21 fl oz	LPOST	15
13. Fierce®	flumioxazin +	3 oz	MPOST	14
	pyroxasulfon			15
14. Alion®	indaziflam	2 fl oz	MPOST	29
15. Impact®	topramezone	2 fl oz	MPOST	27

Weed Science Society of America

Site of Action Group#	Site of Action
2	Inhibits ALS (branched chain amino acid synthesis/cell division in roots & shoots)
3	Inhibits microtubule assembly (cell division in roots & shoots); swelling of root tips
5	Inhibits photosystem II (photosynthesis); loss of chlorophyll and carotenoids/leaky cells
14	Inhibits protoporphyrinogen oxidase (PPO); loss of chlorophyll, leaky cell membranes
15	Inhibits synthesis of very long chain fatty acids (VLCFA); affects seedling emergence
27	Inhibits 4-HPPD enzyme for carotenoid synthesis; bleaches new tissues
29	Inhibits cellulose synthesis

Fig. 1 Cheatgrass Control with Sequential Herbicide Applications in established Kentucky Bluegrass in the Grande Ronde Valley of northeastern Oregon - Fall 2016 to Spring 2017 (Exp. 17-102)

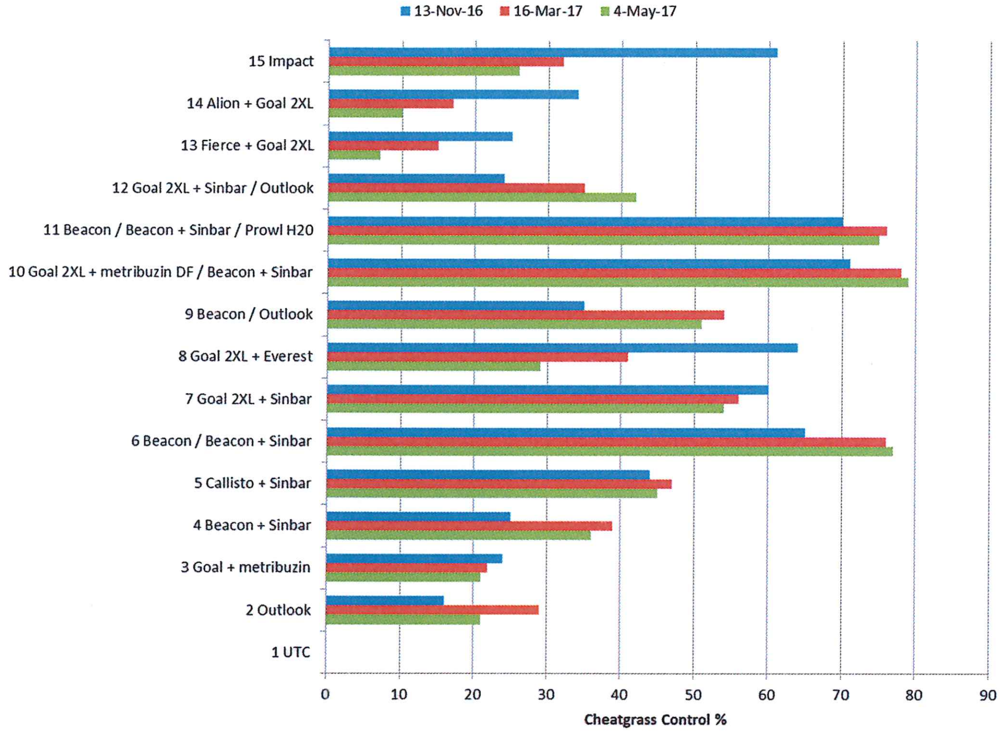
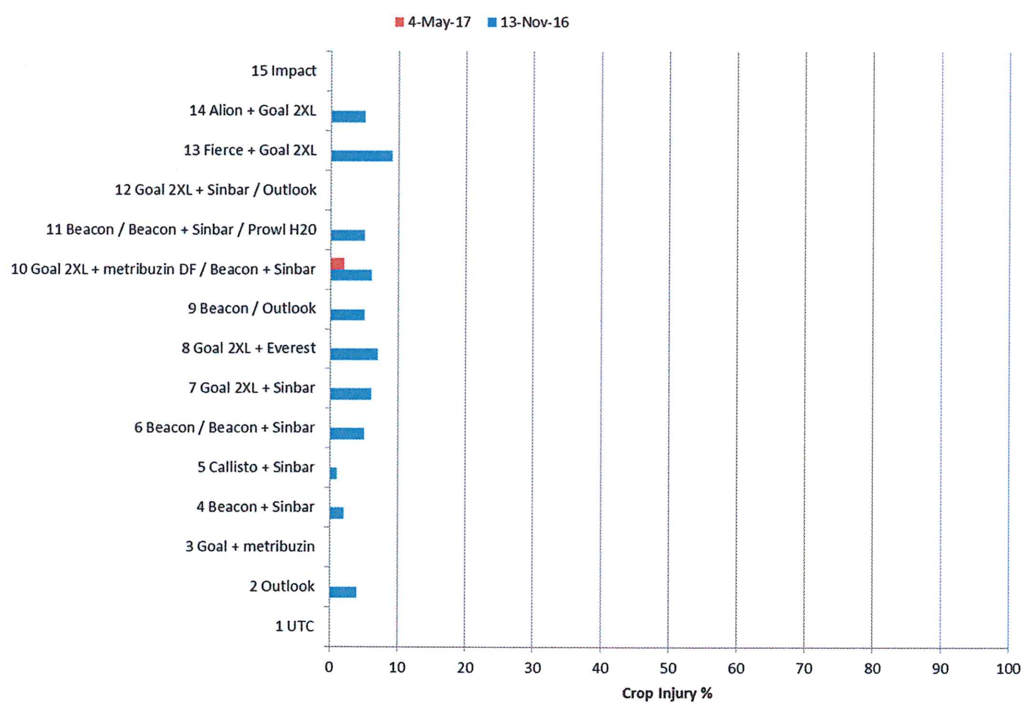
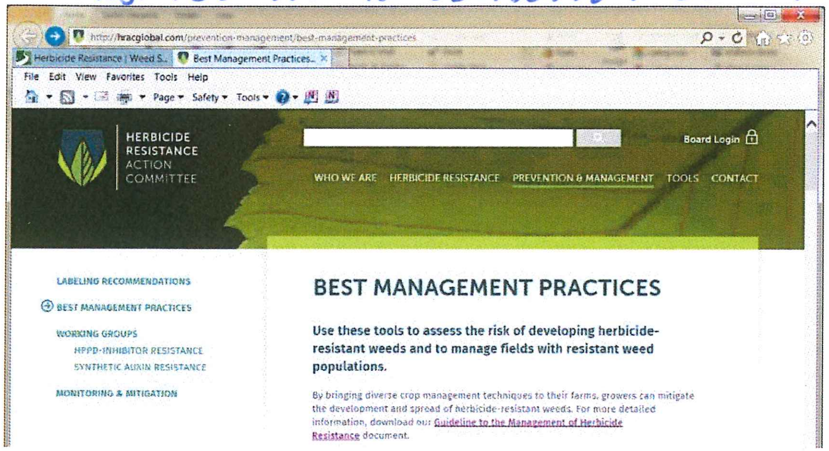


Fig. 2 Crop Injury from Sequential Herbicide Applications for Cheatgrass Control in established Kentucky Bluegrass in the Grande Ronde Valley of northeastern Oregon - Fall 2016 to Spring 2017 (Exp. 17-102).



HERBICIDE RESISTANCE ACTION COMMITTEE



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WSSA.NET (WEED SCIENCE SOCIETY OF AMERICA)

RESISTANCE RISK ASSESSMENT

For farmers to assess the risk of developing herbicide resistance, they need to evaluate their farming practices as well as the biology and herbicide susceptibility of their target weeds. The table below provides a checklist of resistance risk factors and can rank the risk of resistance development from LOW to HIGH.

Cropping System Evaluation - Risk of Resistance

MANAGEMENT OPTION	LOW RISK	MODERATE RISK	HIGH RISK
Herbicide mix or rotation in cropping system	> 2 modes of action	2 modes of action	1 mode of action
Weed control in cropping system	Cultural*, mechanical and chemical	Cultural and chemical	Chemical only
Use of same mode of action per season	Once	More than once	Many times
Cropping system	Full rotation	Limited rotation	No rotation
Resistance status to mode of action	Unknown	Limited	Common
Weed infestation	Low	Moderate	High
Control in last three years	Good	Declining	Poor

**Cultural control can be by using cultivation, stubble burning, competitive crops, stale seedbeds, etc.*

HERBICIDE ROTATION AND MIXTURES

When planning a weed control program, herbicides should be selected from groups that use different sites of action to control the same weed and used in successive applications or in mixtures. The global HRAC has developed a classification system for herbicides based on site of action that the herbicide uses.

Guidelines for the sustainable use of herbicide site of action groups:

- Use mixtures or sequential treatments of herbicides having different sites of action. Each herbicide in the mixture should target the same weed species.]*
- Consider all chemical control options before planting, in-crop and after harvest.
- Avoid continued use of the same herbicides, or herbicides with the same site of action in the same field, unless integrated with other weed control practices.
- Limit the number of applications of a single herbicide or herbicides with the same site of action in a single growing season.
- Herbicide mixtures and herbicide rotations alone are not enough to prevent resistance. They must be used in a diversified plan than also incorporates mechanical, cultural and biological practices.

Growers should also do the following:

- Follow label use instructions, such as application rates, timing and equipment recommendations.
- Know the weeds in their fields and nearby non-crop areas and tailor their weed control program to weed densities and economic thresholds.
- Monitor herbicide results and be aware of any trends or changes in weed populations.
- Maintain detailed field records to confirm cropping and herbicide history.

Review MOA: Group 2 ALS Inhibitors example: Beacon®

- Inhibits amino acid production by blocking ALS enzyme activity (e.g. sulfonylureas, imidazolinones, etc.)
- Application timing: POST
- Primisulfuron (Beacon) is readily absorbed by foliage and roots
- Foliar – translocates to growing points and to roots.
- Root – absorbed and translocated efficiently to all foliage and meristematic tissue.
- Symptoms:
  - ✓Stunted, chlorosis, necrosis
  - ✓Reddish/purple discoloration of leaves
- SLN OR/WA (need label and indemnification agreement)

0
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Review MOA: Group 3 Mitosis Inhibitors example: Prowl H20®

- Interrupts cell division and growth
- Application timing: PPI, PRE, POST
- Pendimethalin is readily absorbed by roots and coleoptiles
- Absorption by coleoptile (grass), hypocotyl (broadleaf) and roots is key for effectiveness
- Translocation not important for un-emerged weed seedlings
- Symptoms:
  - ✓Failed grass/broadleaf seedling emergence
  - ✓Emerged grass shoots malformed
  - ✓BL stems swell and are brittle at soil line
  - ✓Thick, stubby root tips

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Review MOA: Group 5 Photosystem II Inhibitor example: Sinbar WDG®

- Inhibits photosynthesis (at photosystem II)
- Application timing: PRE, POST
- Terbacil is readily absorbed by roots (less so by foliage)
- Translocated into leaves of annual grasses/BL
- Symptoms:
  - ✓Foliar chlorosis/necrosis
  - ✓Inhibits root and shoot growth

2
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Review MOA: Group 5 Photosystem II Inhibitor example: metribuzin

- Not registered for use in grass seed in eastern OR
  - ✓Do we want to pursue a label?
- Inhibits photosynthesis (at photosystem II)
- Application timing: PRE, EPOST
- metribuzin is readily absorbed by roots and translocated to the foliage
  - ✓Moderate foliar uptake
- Symptoms:
  - ✓Seedling grass/BL weeds emerge then become chlorotic / necrotic

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Review MOA: Group 7 Photosystem II Inhibitor example: Diuron 4L®

- Inhibits photosynthesis at photosystem II
  - ✓Binds differently to proteins than Group 5
- Application timing: PRE
- Diuron readily absorbed by roots (less so by foliage)
- Translocated rapidly to shoots of annual grasses/BL
- Symptoms:
  - ✓Foliar chlorosis concentrated around veins
  - ✓Necrosis follows
- Not included in 2016-17 trials

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Review MOA: Group 14 Photosystem II Inhibitor example: Goal 2XL®

- Inhibits PPO
  - ✓enzyme key to chlorphyll and carotenoid synthesis
  - ✓causes cell membranes to leak
- Timing: PRE, POST
- Burndown herbicide to accompany grass herbicides
  - ✓May also suppress annual grasses
- Oxyflurfen is readily absorbed by BL weed leaves, no root absorption
- Not translocated in plants
- Symptoms:
  - ✓Rapid leaf bleaching, dessication and necrosis
  - ✓Localized around spray drop sites then general necrosis of foliage

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Review MOA: Group 15 Photosystem II Inhibitor example: Outlook®

- Inhibits synthesis of very long fatty chain acids (VLFCA)
  - ✓enzyme key to chlorphyll and carotenoid synthesis
  - ✓causes cell membranes to leak
- Timing: PRE, POST
- Dimethanenamid-P is absorbed primarily by
  - ✓Emerging grass shoots (coleoptiles)
  - ✓Emerging BL shoots (hypocotyls) and roots
- Phytotoxic only to emerging seedlings!
  - ✓Do not inhibit seed germination
- Symptoms:
  - ✓Failed seedling emergence
  - ✓Crop injury may appear as twisted seedlings, leaves rolled in the whorl, cupped/crinkled leaves, mid-rib "drawstring"

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Review MOA: Group 27 HPPD Inhibitor example: Callisto®

- Inhibits 4-HPPD enzyme for carotenoid synthesis
  - ✓Bleaches new tissues, followed by necrosis
- Application timing: PRE, POST
- Mesotrione is absorbed primarily by
  - ✓Seed and emerging roots/shoots
  - ✓Foliage and roots after post-application
- Translocated throughout plant by xylem/phloem
- Primarily BL weeds, some grasses
- Symptoms:
  - ✓Bleaching of new tissues followed by necrosis 3-5 days

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May 23, 2017

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MARCH FLY, SAWFLY, AND CRANE FLY: RELATIONSHIP ADVICE

SILVIA I. RONDON, EXTENSION ENTOMOLOGIST SPECIALIST

The following information is provided to be able to establish the relationship between march fly, sawfly, and crane fly species in the Pacific Northwest.

Root Feeders: Grass Seed March Fly (True Flies)

This is quite a common pest in western Oregon fields with high organic matter. It was reported in eastern Oregon in 2017. Adults are dark brown to black flies around 0.45 inches. Larvae are light brown to gray (0.5 inch long when mature). They feed primarily on decaying organic matter and only incidentally on grass seedlings.

Heavy fall and winter rains that cause water to puddle force the larvae to the soil surface.

The following cultural practices may help in reducing damage.

- Prepare a fine seedbed and pack well.
- Close seed row at planting.
- Well-established seedlings tolerate more injury than smaller ones.

There are no chemicals registered. More information @ http://oregonstate.edu/dept/nurspest/march_flies.htm

Leaf Feeders: Sawflies (Not True Flies)

They are not "true" flies, but are related to wasps.

Larvae look like "many-legged" armyworms, except that the sawflies have abdominal pro-legs on almost every segment of the abdomen. They are found at the soil surface around the periphery of plant crowns.

The larval stage feeds on leaves and chews through stems, resulting in the loss of the entire seed head; or, if the stem is not entirely severed, harvested seeds are usually sterile.

No products are labeled specifically for this use; however, field experience has shown that pyrethroids applied to control armyworm give good control.

More information @ https://pnwhandbooks.org/insect/legume-grass-field-seed/grass-seed/grass-seed-sawfly

Root Feeders: Crane Flies (True Flies)

There are more than 1600 species of crane flies known in North America; only 4 are related to agricultural damage. The larvae are known as leatherjackets, and they feed in the upper layer of the soul near roots, crowns, and stems of grasses.

They can be highly injurious to hay fields, pastures, turf grasses, clovers, mint crops, root vegetables, and probably even decaying matter.

There are two species of crane flies: The European crane fly and the common or march crane fly.

Adults are large (wingspan of 1 to 1.5 inches), grayish brown, and resemble large, long-legged mosquitoes. They do not bite! They are also known as "mosquito hawks" but THEY DO NOT eat mosquitoes; in fact, they probably feed only on a moisture during their short existence (3 to 7 days) because they do not have mouthparts.

Mature larvae are 1 to 1.5 inches long, legless, and earthy gray. Leatherjackets extends and retracts considerably, giving the larva a tightly packed and pudgy appearance. As larvae mature, they come to the soil surface at night and feed above ground on crowns of grasses.

Most larval infestations in grasses have been in irrigated turf-golf courses, lawns, parkways. Occasionally, they can be found in perennial ryegrass and other grass seed crops when there is heavy rainfall and excessive soil moisture.

The extent to which these crane fly larvae damage grass seed crops has not been researched adequately. In turf grasses that are of normal vigor, well fertilized and watered, and without other stresses, more than 20 crane fly larvae per sq ft have not produced aesthetic damage or stand loss. However, larval populations approaching 5-10 per sq ft in some grass seed crops are thought to damage grasses that are weakened or subject to other stresses.

Soil cores 3' deep are usually sufficient to detect larvae in root material. Pick apart roots and soil over a series of screens and observe larvae that collect on the screens. Berlese funnels also are used to process soil cores, but this can take a substantial amount of time to process.

More information https://pnwhandbooks.org/insect/legume-grass-field-seed/grass-seed/grass-seed-crane-fly

Summary

Common name	Order	"Fly" or not a "Fly"	Damage
March fly	Diptera	Yes	Root feeder
Sawfly	Diptera	No	Leaf feeder
Crane fly	Hymenoptera	Yes	Root feeder

For more information about the Irrigated Entomology Program visit

http://oregonstate.edu/dept/hermiston/silvia-rondon

http://oregonstate.edu/dept/hermiston/ipm-insect-ecology-biological-control

http://extension.oregonstate.edu/umatilla/ipm

Barley yellow dwarf virus in grass grown for seed

Ken Frost and Sudeep Bag
OSU Hermiston Agricultural Research and Extension Center, Hermiston, OR

Barley yellow dwarf (BYD), is a disease of grasses caused by the caused by the barley yellow dwarf virus (BYDV), the type member of the leuteroviridae virus family. BYDV has an extensive and diverse host range including many agronomically important field crops and grass grown for seed. Symptoms (variable) are often confused with nutrient deficiencies or stress. Under ideal environmental conditions, plants are asymptomatic or symptoms are extremely mild. Common symptoms that are observed include:

- Yellowish or reddish leaf tips, tissue next to the midribs is greener than the rest of the leaf
- Yellow blotches turning to red or purple
- Youngest leaves may appear unaffected
- Underdeveloped root systems

The distribution of symptoms in the field may also be indicative of BYDV infection. Symptomatic plants will often occur in circular or misshapen patches in the field. The patches may appear to be randomly distributed and there may be "edge effects" in fields due to insect alightment (i.e. landing).

Outcomes:

- Crop is more susceptible to soilborne pathogens or drought-stress
- Prematurely die-back during hot, dry weather
- Increased sensitivity cold injury
- Yield loss
- (Overall) reduced number of years a field may remain in production

Host Range:

- About 100 monocotyledonous species, both cultivated and wild are known to be susceptible.
- A large proportion of these plant species have been determined to be hosts BYDV through environmental surveys and greenhouse bioassays; large scale field surveys have not been conducted.

There are multiple strains that vary in virulence, host range, and vector specificity.

- RMV - Weakly virulent in Coast Black oats
- (CYDV) RPV - Weakly virulent in Coast Black oats
- MAV - Moderately virulent in Coast Black oats
- PAV - Strongly virulent in Coast Black oat
- SGV - Weakly virulent in Clintland 64 oats

Transmission by aphid vectors occurs in a persistent (circulative) manner.

- BYDV is vectored by around 14 different aphid species.
- The most important vectors are
    - Metopolophium (Acyrthosiphon) dirhodum, rose-grain aphid

    - Macrosiphum avenae, English grain aphid
    - Rhopalosiphum maidis, Corn leaf aphid
    - Rhopalosiphum padi, Bird cherry-oat aphid
    - Schizaphis graminum, Greenbug
- After virus acquisition, the aphid remains virus persists in the vector for 2-3 weeks.
- Transmission of the virus offspring does not occur.

Transmission depends on many factors. Aphid species and BYDV strain are important.

- RMV
    - *R. maidis* (Corn leaf aphid)
    - Infrequently by *R. padi*, *M. avenae,* and *S. graminum* (Greenbug)
- RPV
    - *R. padi* (Bird cherry-oat aphid) and occasionally *S. graminum* (Greenbug)
    - Rarely by *R. maidis* and M. avenae
- MAV
    - *M. avenae* (English grain aphid)
    - Rarely by *R. padi*, *R. maidis,* and *S. graminum*
- PAV
    - *R. padi* (Bird cherry-oat aphid) and *M. avenae* (English grain aphid), occasionally by *S. graminum* (Greenbug)
    - Rarely by *R. maidis*
- SGV
    - *S. graminum* (Greenbug)
    - Rarely if at all by *M. avenae*, *R. padi*, or *R. maidis*

What is the impact of BYDV on grass grown for seed?

- In Western Oregon, BYDV is very prevalent in perennial ryegrass fields – this has been known for a while. In PRG, BYDV maybe reducing the number of years a field may remain in production. Now it appears BYDV may be becoming more prevalent in other grass species (e.g., Fescue, 2016 Seed Production Research Article pp. 5).
- We currently don't have a good idea of the impacts of BYDV in grass grown for seed in Eastern Oregon.

What are we doing?

- For 2017, we obtained funds from the western IPM center to begin to examine the prevalence and impact of BYDV in grass seed production of Eastern Oregon. As part of that project we are:
    1. Characterizing the genetic diversity of BYDV strains affecting susceptible grass seed crops to better understand which strain or set of strains are important for disease development. Sampling KBG, PRG, & Fescue in 4 regions (i.e. Columbia Basin, Grande Ronde Valley, Central Oregon, Western Oregon).
    2. Estimate yield loss due to BYDV (HAREC experiment).
        - Estimate the annual accumulation of BYDV in perennial ryegrass (PRG).
        - Determine if insecticide applications can reduce the occurrence, accumulation, or diversity of BYDV in PRG.