Herbicides and Resistant Weeds

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Discussion Topics

Herbicide resistant weeds in Idaho
Selecting for herbicide resistant weeds
Herbicide classification
Herbicide resistance
Using these groups for resistance management
Sustainable uses of glyphosate

How Widespread is Herbicide Resistance?

154 Species in the US 11 Species in Idaho

| Weed species | Group # | Herbicide examples |
|-------------------|----------|---|
| Prickly lettuce | 2 | Affinity BroadSpec, Ally, Pursuit, etc. |
| Kochia | 2 | Same as above |
| Russian thistle | 2 | Same as above |
| Mayweed chamomile | 2 | Same as above |
| Italian ryegrass | 1 | Discover, Axial, Assure II, Poast, etc. |
| Wild oats | 1 | Same as above |
| Wild oats | 8, 26 | Avadex MicroActive, Avenge |
| Kochia | 4 | Clarity, Banvel |
| Italian ryegrass | 1, 2, 15 | Discover, Axial, Amber, Axiom |
| Redroot pigweed | 5 | Metribuzin |
| Kochia | 9 | Glyphosate |

Number Resistant Species for Several Herbicide Sites of Action (WSSA Codes)



Increase in Unique Resistant Weed Cases for the USA



How Does Herbicide Resistance Happen?

Lack of alternative herbicides with different site of action.
 Limited labor and time available to use non-chemical practices.

 High percentage of leased land with lack of previous herbicide history to the renter.

 Preference for annual cropping systems reinforces heavy reliance on herbicides.



Estimated that within a population of 1 million plants of any species 1 biotype is resistant to any given herbicide



Repeated use of same herbicide mode of action



The more effective and the more a herbicide is used increases selection pressure



After repeated use, many weeds of that biotype are resistant

Factors Affecting Speed of Selection

Length of time for selection of resistance varies by:

- Cultural practices
- Frequency of herbicide use
- Biology of weed species
- Frequency of resistant biotypes among weed species

Herbicide mechanism of action



How Does Resistance Spread?

✓ Gene flow- spread of seed or pollen

- Known that SU resistant kochia pollen can spread at least 30 m (>98 ft)
- Whole-plant kochia, Russian thistle, tumble mustard and others move by wind
 - Russian thistle moves up to 2.5 miles and disperses
 >50% of its seed.
 - Average seed/plant = 61,700
- Clean equipment before moving to another field

Herbicide Classification

✓1995 - Weed Science Society of America developed a herbicide classification system.

Numbering system

Currently, 27 classes/groups.

 The numbering system assigns each herbicide to a mechanism of action group.

EPA recommends labels display the group number that identifies the mechanism of action for the active ingredient(s) in a formulated product.

63045M1-9



Complete Directions for Use

EPA Reg. No. 524-537

AVOID CONTACT OF THIS HERBICIDE WITH FOLIAGE, GREEN STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS (EXCEPT AS SPECIFIED FOR INDIVIDUAL ROUNDUP READY[®] CROPS), DESIRABLE PLANTS AND TREES, AS SEVERE INJURY OR DESTRUCTION COULD RESULT.

Herbicide for Roundup Ready® Crops

Selective broad-spectrum weed control in Roundup Ready® crops

Non-selective, broad-spectrum weed control for many agricultural systems and farmsteads

THIS PRODUCT IS NOT REGISTERED IN ALL STATES.

This product is not registered in all states.

Read the entire label before using this product.

Use only according to label instructions.

Read the "LIMIT OF WARRANTY AND LIABILITY" statement at the end of the label before buying or using. If terms are not acceptable, return at once unopened.

THIS IS AN END-USE PRODUCT. MONSANTO COMPANY DOES NOT INTEND AND HAS NOT REGISTERED IT FOR REFORMULATION. SEE INDIVIDUAL CONTAINER LABEL FOR REPACKAGING LIMITATIONS.

1.0 INGREDIENTS

ACTIVE INGREDIENT:

| *Glyphosate, N-(phosphonomethyl)glycine, | |
|--|--------|
| in the form of its potassium salt | 48.8% |
| OTHER INGREDIENTS: | 51.2% |
| | 100.0% |

*Contains 660 grams of the active ingredient glyphosate, in the form of its potassium

3.0 PRECAUTIONARY STATEMENTS

3.1 Hazards to Humans and Domestic Animals

Keep out of reach of children CAUTION!

CAUSES MODERATE EYE IRRITATION HARMFUL IF INHALED Avoid contact with eyes, skin, or clothing Avoid breathing vapor or spray mist

| FIRST AID: Call a poison control center or doctor for treatment advice. | | | |
|--|--|--|--|
| IF IN EYES | Hold eye open and rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses if present after the first 5 minutes then continue rinsing eye. | | |
| IF ON SKIN | Take off contaminated clothing. Rinse skin immediately with plenty of water for 15 to 20 minutes. | | |
| IF INHALED | Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. | | |
| Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You can also call (314) 694-4000, collect, day or night, for emergency medical treatment information. This product is identified as Roundup PowerMAX[®] II Herbicide. EPA Registration | | | |
| No. 524-537 | | | |

DOMESTIC ANIMALS: This product is considered to be relatively nontoxic to dogs and other domestic animals; however, ingestion of this product or large amounts of freshly sprayed vegetation may result in temporary gastrointestinal irritation (vomiting, diarrhea, colic, etc.). If such symptoms are observed, provide the animal with plenty of fluids to prevent dehydration. Call a veterinarian if symptoms persist for more than 24 hours.

Personal Protective Equipment (PPE)

Some of the materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for Category A on an EPA chemical resistance category selection chart.

Mixers, Loaders, Other Handlers and Applicators, when handling this concentrated product or its application solutions of 30 percent concentration or greater, must wear: long-sleeved shirt and long pants, shoes, socks, and chemical-resistant gloves made of any waterproof material such as polyethylene or polyvinyl chloride.

Applicators, when handling only spray solutions where concentration is 30 percent of this product or less, must wear: long-sleeved shirt and long pants, shoes, and socks.

Follow manufacturer's instructions for cleaning/maintaining PPE (Personal Protective Equipment). If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

Discard clothing and other absorbent materials that have been drenched or heavily



syngenta.

Herbicide

Nonselective Foliar Systemic Herbicide for Weed Control

10AAA

Active Ingredient:

*Potassium salt of glyphosate: N-(phosphonomethyl) glycine . . . 44.9%Other Ingredients:55.1%Total:100.0%

*Contains 4.17 pounds per U.S. gallon of glyphosate acid.

KEEP OUT OF REACH OF CHILDREN.



AVOID CONTACT OF HERBICIDE WITH FOLIAGE, GREEN STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION MAY RESULT.

| ACTIVE INGREDIENT | | |
|---|-------------|----|
| *Glyphosate, N-(phosphonomethyl)glycine, in the form of its isopropylamine salt | t | 1% |
| OTHER INGREDIENTS: | | 1% |
| | TOTAL 100.0 | 1% |

*Contains 480 grams per liter or 4.0 pounds per U.S. gallon of the active ingredient, glyphosate, in the form of its isopropylamine salt. Equivalent to 356 grams per liter or 3.0 pounds per U.S. gallon of the acid, glyphosate.

Licensed for Roundup Ready® cotton, corn, canola, Flex cotton, sugarbeets and soybeans.

KEEP OUT OF REACH OF CHILDREN



syngenta.

Postemergence Herbicide for Control of Perennial and Annual Grass Weeds

| Active Ingredient: Fluazifop-P-butyl Butyl (R)-2-[4-[[5-(trifluoromethyl)-2- pyridinylloxylphenoxylpropanoate* | |
|---|--------|
| Other Ingredients: | 75.5% |
| Total: | 100.0% |

*Fusilade DX Herbicide contains 2 pounds (+) isomer (fluazifop-P-butyl) per gallon. Contains petroleum distillates.

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syngenta

Foliar systemic herbicide with residual weed control for corn, cotton, legume vegetables (succulent or dried), peanuts, potatoes, sorghum, soybeans, sugar beet (glyphosate-tolerant), sunflowers, and tomatoes

Active Ingredient:

| *Glyphosate: N-(phosphonomethyl) glycine | 21.8% |
|--|-------|
| **S-metolachlor (CAS No. 87392-12-9) | 29.0% |
| Other Ingredients: | 49.2% |







For use in bean (dry), beets (sugar), corn (field and pop grain, seed, fresh sweet), garlic, horseradish, onions (dry bulb, green), peanut, perennial grasses grown for seed, potato, shallots (dry bulb), sorghum (grain), soybean, and winter squash

Herbicide Groups- PNW 437

PNW 437

Herbicide-Resistant Weeds and Their Management

Download for free at uidaho.edu/extension Click on 'Search Publications'

Download at: uidaho.edu/extension 'Search Publications'

| Herbioide group num ber and site of action | Herbickleichemical family | Herbicide common name | Herbicide trade names | Resistant weeds in the PNW | States with resistant weeds |
|--|--|---|---|--|-----------------------------------|
| Group 1 | oydohexane- | cleth odim | Select Max, Envoy, | Italian ryeg rass | ID,WA |
| Acetyl CoA | aiones | seth acyclim | Poast several others | Italian ryea rass | ID.WA |
| ACCase) | | | | Downy brome | OR |
| nhibitors | | tralkoxydim | Achieve | Italian ryegrass | ID,WA |
| | aryloxyphenoxy- | clodinafop | Discover NG | Italian ryeg rass | ID,WA |
| | pro panoates | | | Wild on t | ID |
| | | diolofop | Hoelon | Wild oat | ID, OR, WA |
| | | | | Italian ryeg rass | ID, OR, WA |
| | | fence aprop | Puma, others | Wild oat | ID, OR |
| | | fluazifop | Fusilade DX | Do wry b rome | OR |
| | | quizalofop | Assure II, Targa | Italian ryegrass | ID,WA |
| | all and a second | ninwadar | Avial | Downy brome | OR ID CO WY |
| | prenypyrazorne | bruck agen | Autor | natan ryograss | ID, CR, WA |
| Group 2 | imidazofinones | imazamox | Raptor, Beyond, Clearmax (Beyond + | Downy brome | OR |
| Acetolacta te | | | MCPA) | opiny sowthistle | WA |
| ALS) | | imazapio | Plateau, others | | |
| nhibitors | | imazapyr | Arsenal, Chopper, several others | | |
| | | imazethapyr | Pursuit, others | Prickly lettuce | ID |
| | | | | Kochia | ID |
| | | | | Spiny sowthis the | ID |
| | | | | Black mustard | ID |
| | | | | thayweed chamomile | D |
| | sulfo ny lu reas | ohlorsulfuron | Glean,Telar | Prickly lettuce | ID, OR, WA |
| | | | | Kochia | ID, OR, WA |
| | | | | Russian thistle | ID, OR, WA |
| | | | | Italian ryegrass | OR |
| | | | | Mayweed chamomile | ID,WA |
| | | | | Smallseed falseflax | OR |
| | | halo sulfuron | Sandea, others | | |
| | | mesosulfuron | Osprey | Italian ryeg rass | ID,WA |
| | | mesosulfuron/ | Olympus Flex | | |
| | | metsulfuron | Ally Escort | Prickly letture | ID, OR |
| | | | Cimarron, others | Koohia | OR |
| | | | | Russian this tle | OR |
| | | | | Smallseed falseflax | OR |
| | | n icosulfuro n | Accent, others | | |
| | | primisulfuron | Beacon, others | Downy brome | OR |
| | | prosulfuron | Peak Spirit | | |
| | | rimsulturon | matrix, others | | |
| | | sufformaturon | Manariak Outriche | Downy brome | OR |
| | | Se ao se ne rom | Certainty | courry bronne | - n |
| | | thifensulfuron | Harmony, others | Spiny sowthistle | WA |
| | | | | Prickly le tluce | ID ID |
| | | | | Mayweed chamomile | D |
| | | thifensulfuron/ | Hamony Extra, | | |
| | | tibenuron | Affinity | | 10.07 |
| | | triasulfuron | Amber, others | Prickly lettuce Vechie | ID, OR |
| | | | | Noohia Dunaise this is | OR |
| | | | | Italian ryes race | ID WA |
| | | tiberuron | Express, others | Prickly le tluce | ID ID |
| | | | | Maywood | ID |
| | | | | chamomile | |
| | | triflusulfuron | UpBeet | h-P | ID MC |
| | suffortylam ino- carbonyl- | flucarbazo ne | Everest, others | Italian ryegrass | ID,WA |
| | triazolino nes | propoxycarbado ne | Orympus | | |
| | triazolo - | florasularn | Orion (contains MCPA |) others | |
| | P | pyroxsulam | Gold Sky (contains flo PowerFlex | na sulam & fluroxypyr), | |
| Group 3 | dinitroanalines | be nefin | Balan, others | | |
| Microtubule | | ethalfluralin | Sonalan, others | | |
| n hibitors | | oryzalin | Suffan, others | | |
| | | pendimethalin | Prowl H, O, | | |
| | | | others | | |
| | | prodiamine | Barricade, | | |
| | | | others | | |
| | | | Treflan, others | | |
| | | trifluralin | | | |
| | benzamides | trifluralin pronamide | Kerb | Wild on t | OR |
| Group | benzamides | trifluralin pronamide 2.4-D | Kerb | Wild on t Prickly lettuce | OR WA |
| Group 4 | benzamides phenoxy acetic acids | trifluralin pronamide 2,4-D | Kerb several | Wild oat Prickly lettuce | OR WA |
| Group 4 Synthetic Suizine | benzamides phenoxy acetic acids | trifluralin pronamide 2,4-D 2,4-DB | Kerb several several | Wild oat Prickly lettuce | OR WA |
| Group 4 Synthetic Suizine | benzamides phenoxy acetic acids | trifluralin pronamide 2,4 D 2,4 DB MCP | Kerb several several | Wild oat Prickly lettuce Prickly lettuce | OR WA WA |
| Group 4 Synthesic Subline | benzamides pheno xy acetic acids | trifluralin pronamide 2,4 D 2,4 DB MCP mecoprop (MCPP) | Kerb several several several | Wild on t Prickly lettuce Prickly lettuce | OR WA WA |
| Group 4 Synthesic Wixing | benzamides phenoxy acetic acids benzoic acids | trifluralin pronamide 2,4-D 2,4-DB MCP mecoprop (MCPP) dicemba | Kerb several several several Banvel, Clarity, several others | Wild on t Prickly lettuce Prickly lettuce Kochia Prickly lettuce | OR WA WA |
| Group 4 Synthesic Mixine | benzamides phenoxy acetic acids benzoic acids pyridines | trifluralin pronemide 2,4-D 2,4-DB MCP mecoprop (MCPP) dicemba aminopyrald | Kerb several several several Banvel, Clarity, several others Miles bre, several | Wild on t Prickly lettuce Prickly lettuce Kochia Prickly lettuce | OR WA WA |
| Group 4 Synthesic Kusine | benzamides phenoxy acetic acids benzoic acids pyridines | triffuralin pronemide 2,4-D 2,4-DB MCP mecoprop (MCPP) dicemba aminopyralid clopyralid | Kerb several several several Banvel, Clarity, several others Milestone, several Stinger, others | Wild cent Prickly lettuce Prickly lettuce Kochie Prickly lettuce | OR WA WA |
| Group 4 Synthetic Kizine | benzamides phono xy acetic acids benzoic acids pyridines | trifluratin pronemide 2,4 D 2,4 DB MCP mecoprop (MCPP) dicemba aminopyralid clopyralid fluroxypyr | Kerb several several several Banvel, Clarity, several others woral others Milsione, several Stringer, others Stranse, others | Wild on t Prickly lettuce Prickly lettuce Kochia Prickly lettuce | OR WA WA ID WA |
| Group 4 Տյուրեցնց Աջնոջ | benzemides phenoxy ecetic acido benzoio acido pyridines | vrifluralin pronemide 2,4-D 2,4-DB MCP mecoprop (MCPP) dicemba aminopyralid olopyralid fluroxypyr pidoram | Kerb several several several several Banvel, Clarity, several others Miles tone, several Stringer, others Starane, others Tordon K, Tordon, 22K | Wild oat Prickly lettuce Prickly lettuce Kochia Prickly lettuce Yollow starthistle | WA WA ID WA WA |
| Group 4 Synthesic Sultime | benzamides phenoxy ecetic acide benzoic acide pyridines | trifluralin pronemide 2,4-D 2,4-DB MCP mecoprop (MCPP) dicemba aninopyralid elopyralid fluroxypyr pidoram tridopyr | Kerb several several several Benvel, Clarity, several others Milestone, several Strame, others Tordon K, Tordon 22K Garlon, Remedy, | Wild oat Prickly lattuce Rickly lattuce Kochia Prickly lattuce Yellow starthistle | WA WA WA WA |

e than once within three years. Rather, rotate to a different group every year of the production system. States with Resistant weeds in the resistant PNW weeds Herbicide group number and she Herbicide chemical Herbicide common of action family name Herbicide trade names Group 5 triazi nes at raz ine AAtrex, others Common ID. OR. WA mbsquarters Photosystem II inhibitors (groups 5, 6, and 7 have the same site but different binding behavior) Pigweed spp. ID Common a roundsel OR.WA Annu al blu egrass OB Kochia simazine Princep, Simazine Common groundsel WA hexazinone Velpar, others Shepherd's purse OB metriburin Sensor other Shanhard's nurse OB Hyvar X, othe te da ci OR.WA Pigweed spp. OR Group 6 benzothia-diazoles bentazon Basagran Photosystem II inhibitors (see group 5) bromakynil Buctril, Bronate (contains MCPA) several others Common groundsel OR Karmex, Direx, others Group 7 urees diuron Common lambsquarters OR Photosystem II in hibitors (see group 5) Annual bluegrass OR linuron Lorex, Linex te buthiu Spile, others fhiocarbamates cycloate Ro-Neet Group 8 EPTC Eptam, Imperiu Lipid synthesis in hibitors but ot A OCase aistered in OR EPTC+ safener Eradicane ibitors tria llate Far-Go, Avadex, Wild oat Group 9 glyoines glyphosate Roundup, several Italian ryegrass OR Group 10 phosphinic solds glufosinate Rely, Liberty, several Italian ryegrass others Group 14 diphenylethers coupfluorfen Goal, several others N-phenyl-phithalimides flumiclorac Resource Inhibitors o protopor-phyrinoge oxidase (Protox) flumickazir Chateau , Valor aryl-triazino ne s Aim, several other carfon trazo n sufferitrazonie Spartan, others pyraflufen T, Edict py roxasulfone Fierce (contains flumicazi) Registration pendi pyrimidinedione saflufenacil Sharpen thiadiazola fluthiacet Cadet Group 15 dh loroacet-Inhibitors of acetoch lor Hamess, Surpass, several others MicroTech , several alachior very-long-ohain fatty acid synthesis others dimethenamid(-p) Outlook, others metolachlor Stalwart, Dual, thers oxyacetamides flufenacet Axiom (contains metriburgin) Defin Italian ryeg rass ID, OR, WA acetamide De vri nol napropamide Group 16 benzofurance ethofumesate Nortron, several Annual bluegrass OR Group 17 organo-arsenicals MSMA several Inknown Group 20 nitriles dichlobenil Casoron, others In hibitors of cell wall synthesis site A Group 22 bipyridiliums diquat Regione, others Gramocone Inteor several others Photosystem I paraguai lectron iverters Group 26 carboxylic acids pelargonic acid Scythe, others Unknow Huskie (contains Group 27 is contact les ovragu Histola romoxynil) Inhibitors of 4-HPPD* Callisto, others mesotrione Impact, Frequency topramezone * 4-hydroxyph onylpyru vate dloxyge

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Guide for Herbicide Rotation in the Pacific Northwest

New Herbicide Development

 No herbicides with new mechanisms of action are in advanced development trials.

- The last new mechanism of action was introduced over 20 years ago;
- Will have to rely on currently available herbicides for the foreseeable future.

✓'Stacked' resistance developed for corn and soybean.

Sugar beets next?

Herbicide Resistance Managment

Management Strategies

Proactive management- implementing tactics before herbicide-resistant weeds are apparent.

PROACTIVE: before confirmation



<u>Reactive management</u>- implementing tactics after herbicide resistance has been confirmed in the field.

REACTIVE: after confirmation



Proactive Management Tactics

Strategies to **proactively** delay herbicide resistance can include one or more of the following tactics:



Photo credits from left to right: Flickr jwinfred; Deere Photo Library; Allianz

The Proactive Fallacy

Can be cost and time prohibitive, e.g. tank mixing herbicides, increase integrated weed management practices
 Managing resistance often similar to preventive practices
 Increasing integrated practices considered prohibitive
 Less effective if neighbors are not using preventive practices

Herbicide Rotation and Mixtures

 Lack of suitable herbicide options associated with a crop rotation can impede herbicide rotation.
 Herbicides with same efficacy level

 Herbicide mixtures are considered better for delaying resistance longer than rotating herbicides.

Mixtures add to production cost

 Using a combination of rotation and mixtures might be more suitable.

Rotating Herbicide MOA

| | Herbicides/Herbicide Classes | | | |
|-------------|------------------------------|-----------------|-----------------|--|
| Corn | Glyphosate 9 | Glyphosate 9 | | |
| Sugar beets | Glyphosate 9 | Glyphosate 9 | Glyphosate 9 | |
| Wheat | Affinity BS 2 | Starane 4 | | |
| Corn | Glyphosate 9 | Glyphosate 9 | | |

Rotating Herbicide MOA

| | Herbicides/Herbicide Classes | | |
|-------------|------------------------------|-----------------|----------------|
| Corn | Status 4, 19 | Glyphosate 9 | |
| Sugar beets | Nortron SC 16 | Glyphosate 9 | Outlook 15 |
| Wheat | Axial XL 1 | Huskie 5, 27 | |
| Corn | Prowl 3 | Glyphosate 9 | Callisto 27 |

Consider Where Glyphosate is Used

Labeled for use in >40 crops or sites

- Other Roundup Ready crops.
- Pre-emergence or "Clean Sweep" applications in non-RR crops.
- Shielded/hooded sprayer & wiper applications
- Spot applications likely not a problem
- Non-crop applications
 - ✓ Ditchbanks
 - ✓ Roadsides
 - ✓Waste areas

Use the Full Labeled Rate

Labeled rate- A rate or range of rates set by herbicide manufacturers to consistently provide effective control of weed species across growth stages and site conditions.

 Routine exposure to low herbicide rates can allow a portion of the weed population to survive, leading to the evolution of herbicideresistant populations.

Use the Full Labeled Rate

Low rates may be due to:

- Intentional use of below-labeled rates
- Spraying plants larger than those recommended on the label
- Inadequate coverage of weeds because of size, density and/or crop cover
- Inaccurate sprayer calibration, faulty equipment, or mixing errors.

Alternatives to Management of Herbicide Resistant Weeds

 Impose government regulation- requires growers to comply with specified weed management practices
 Enforced with noncompliance penalties.
 EPA or ISDA enforced

Worst of the worst as a management alternative

Use incentive schemes (public or private)-

- Offers payments or rebates to alter behavior.
- More popular with growers than regulation, but requires funds to implement
- Suffer from high monitoring costs and inflexibility.

 Mixed record of success in agriculture due to a lack of targeting and unproductive spending.

Privatize the rights to the resource in question
 Prescription-based herbicide usage
 This approach is considered technically and economically infeasible

Community-based approach (CBA)
 Grass roots effort
 Growers actively design the management program
 Oversee implementation from the bottom up
 Universities, industry, and government provide technical and financial assistance.

Community-based approach (CBA)
 Program led by growers themselves
 Implementation and compliance requires significant design and monitoring effort and cost
 Clear description of the relevant stakeholders

Community-based approach (CBA)
 Examples of community-based resource management in agriculture

- Cooperative Weed Management Areas (CWMA)
- Watershed management
- Pest eradication programs- boll weevil
- Health Sciences

Keys to CBA Success

Establish clearly defined boundaries

Geographic area

Parties within the boundary who need to be involved.

 Find common ground on the cost and benefit of rules to live by

Involve as many as possible in decision-making process of resistant-management strategies used

Keys to CBA Success

Conduct effective monitoring of participants activities
 Institute sanctions for those not complying with CBA rules.
 Create mechanisms of conflict resolutions that are cheap and easy to address.

 It takes more than yourself using resistance management practices to prevent the spread of resistant weeds



Bob Blackshaw, Agric, Agric & Food Canada

Scouting For Resistant Weeds

More than one species not controlled is likely not due to resistance.



Scouting For Resistant Weeds

✓ If it's an individual species, especially later in the season
 ✓ Other weed species have been killed

 Spatial pattern consists of multiple plants of same species in a patch.





Scouting After a Herbicide Application

 Begin 7 to 14 days after (each) application, and continue at regular intervals until harvest.

Move across the field in a pattern covering the area



WSSA herbicide resistance management

Scouting After a Herbicide Application

Identify and record weed species present.

- Determine if plants survived previous application or emerged later.
- Observe individual plant responses

Consider previous field history to understand changes.



WSSA herbicide resistance management

Questions?

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