Manitoba

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Weed Facts

Herbicide-Resistant Weeds

Introduction

Herbicide-resistant weeds are now found in many countries throughout the world. Weed populations have adapted and become resistant to herbicides in the same way that insects, bacteria and fungi developed resistance to certain classes of pesticides in the 1960s and 70s

In recent years, the number of herbicide-resistant weeds and the areas they infest in Manitoba have increased. Without close attention to the problem the situation will only get worse. Anyone using herbicides should know about herbicide resistance and how to avoid it.

How Resistance Occurs

All weed populations will have a tiny number of individual weeds which are naturally able to withstand a particular herbicide (or herbicide group) which are labelled for that weed.

These "one-in-a-billion" weeds possess this resistance naturally. The resistance is not due to weather factors, or application technique. The rare plants are inherently resistant as part of their "make-up".

Ordinarily you will not see these rare weed plants because they are such a small part of the weed population. However, if you continually use the same herbicide (or herbicide group) year after year, you will allow them to set seed and multiply. In addition, by removing the normal "susceptible" weeds, you give more room for the resistant strains to flourish.

What is a Herbicide Group?

A herbicide group is comprised of herbicides that have the same "mechanism of action", or method of killing weeds. For instance, although Hoe-Grass and Poast have many differences as far as weed spectrum and crop tolerance, both products kill wild oats by inhibiting fatty acid synthesis. Therefore, they belong to the same herbicide group.

Herbicide Resistance Cases in Manitoba

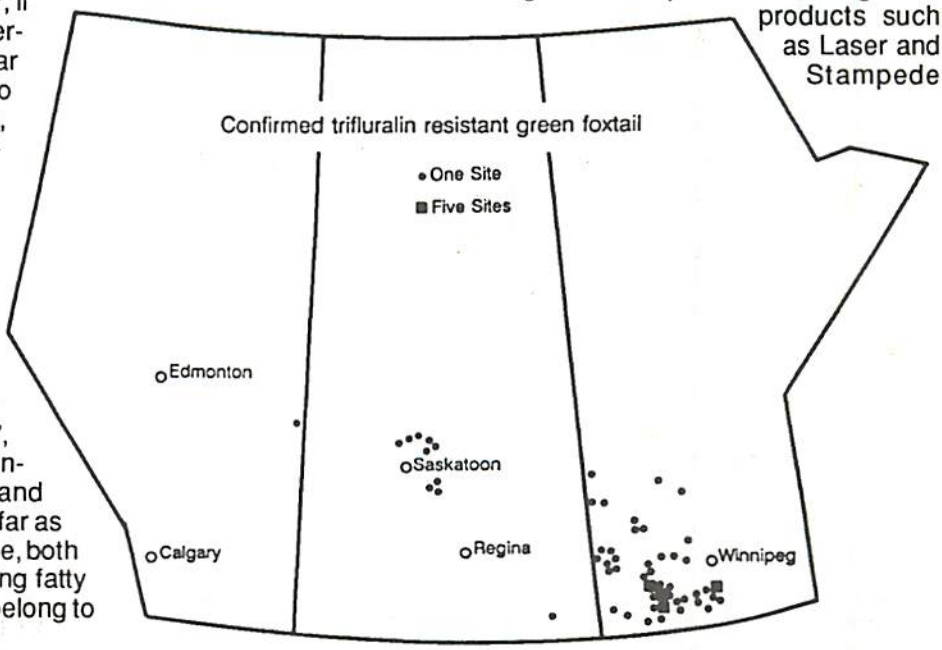
Trifluralin/Edge-Resistant Green Foxtail

Products containing trifluralin (Treflan, Rival, Triflurex, Advance and Fortress) and Edge belong to the same group of herbicides.

Trifluralin-resistant green foxtail has evolved in response to repeated applications of trifluralin. It appears most often where the chemical has been applied both in oilseed crops and as a harrowed-in treatment in wheat (see example in Table 1). Research has confirmed that trifluralin-resistant foxtail is cross-resistant to Edge which is also in the same group of herbicides and has a similar mechanism of action.

Trifluralin is a residual chemical and there can be sufficient carryover from the high rates used in canola to control susceptible green foxtail in the following wheat crop. Thus, resistant green foxtail plants are favoured and reproduce every year, including those years where wheat is produced without using trifluralin.

Research on trifluralin resistance at the University of Manitoba has led to recommendations that have helped farmers successfully reduce the problem, particularly in southwestern Manitoba where it was most severe (see map). Farmers in this area are now alert to the situation and recognize the importance of using other products such as Laser and Stampede



Map of three prairie provinces indicating confirmed trifluralin-resistant green foxtail fields.

Table 1

Herbicide history of two fields infested which have developed trifluralin/ Edge resistant green foxtail.

Year	Field 1		Field 2	
	Crop	Trifluralin (500g/l EC) (L/Acre)	Crop	Trifluralin (Granular 5%) (Kg/Acre)
1988	Canola	1.05	Lentils	11.3
1987	Wheat	0.45	Wheat	0
1986	Wheat	0	Rape	11.3
1985	Canola	1.05	Wheat	0
1984	Wheat	0.45	Flax	11.3
1983	Wheat	0	Wheat	0
1982	Canola	1.05	Lentils	11.3
1981	Wheat	0.45	Wheat	0
1980	Wheat	0	Lentils	11.3

pede in their rotations to combat further development of resistance.

Herbicide-Resistant Wild Oats

In 1990, populations of wild oats resistant to Hoe-Grass 284 and Poast, as well as several other herbicides containing similar active ingredients such as Hoe-Grass II, Excel, Fusilade, Fusilade II, and Triumph Plus, were identified in Manitoba. While these products all have different names and contain different active ingredients they all attack the same biological system in wild oats. They all have the same mechanism of action and are considered to be in the same herbicide group. Research has proven that the resistant wild oats are up to 40 times more tolerant to the herbicides than susceptible ones.

Long-term herbicide planning should ensure against using products from the same group year after year. For instance wild oat herbicides that are not in the same group as those mentioned above, and could provide alternatives for use in cereal crops, include Avenge, Mataven, Assert, Avadex and Fortress. Similarly, trifluralin products (e.g. Treflan, Triflurex, Rival) and Edge, could be used as alternatives in oilseeds and certain special crops. A single alternative herbicide should not be used year after year as this may result in further selection of herbicide resistance.

Table 2 summarizes herbicide use in two fields where resistant wild oats were identified.

Note in Table 2 that in both examples, herbicides from the same group were applied for nine years in a row with no rotation to other products with a different mechanism of action. The repeated use of Hoe-Grass and Poast during the early '80s undoubtedly contributed to the development of the problem. Continued use of newer herbicides in this class, such as Triumph Plus, Fusilade II or Excel would further encourage the development of resistance in these fields.

Herbicide resistance in wild oats is not restricted to post emergence products. Avadex BW-resistant wild oats have been reported in Alberta.

Sulfonylurea-Resistant Broadleaf Weeds

A number of new products such as Glean, Ally and Refine all belong to the sulfonylurea group of herbicides. Sulfonylurea-resistant kochia, chickweed and Russian thistle have been identified in Alberta and Saskatchewan as well as in many locations in the USA.

Kochia populations with resistance to sulfonylurea herbicides have developed on two industrial sites in Manitoba in response to Glean applications. This is a forewarning that resistant weeds could also appear in field crops in Manitoba.

Herbicide Cross-resistance in Grasses

To date, Manitoba producers have been fortunate that herbicide resistance in wild oats, green foxtail and kochia is limited to resistance within groups of herbicides. Much more serious problems have occurred in Australia and England where two grass weeds have become resistant to several different groups of herbicides – leaving no chemical alternatives for control of these weeds in field crops!

How to Delay or Avoid the Development of Resistance

Follow the guidelines below to delay the appearance of resistance.

- **Rotate herbicides**

  Using the same herbicide year after year may cause resistance to develop. **To avoid resistance herbicides must be rotated. It is important not only to use a different herbicide but to use one in a different herbicide group with a different mechanism of action.** If rotation is not practised, resistant plants escape control and continue to add to the problem. Table 3 lists herbicides in groups with the same mechanism of action. Successive use of products in the same group is not a true herbicide rotation. In planning a herbicide rotation farmers should reserve the use of a group of herbicides for crops where there are few or no alternative classes that could be used.

- **Use herbicides only when needed**

  Herbicides should be used as part of an integrated control program and not as the sole method of weed control. Cultural control practices that favour strong crop competition and timely cultivation can be used effectively to reduce weed populations. Attempting to eradicate a particular weed in a field over 8-10 years with a program using the same herbicide can result in the development of resistance. Weeds should be tolerated in a crop if they are below economic damage levels. Refer to Weed Facts — Knowing When it Pays to Spray Wild Oats — Agdex No. 641, March 1988.

- **Keep records of herbicide applications**

  Records are necessary to make sensible decisions on herbicide rotation and to evaluate the probability of resistance developing. Records should consist of the field location/name, year, crop, herbicides and rates applied, weed infestations present at spraying and the control provided by the herbicide(s). The more detailed the records (e.g. environmental conditions at time of spraying, date and time of spraying, spray volume/acre) the better the chance of accurately interpreting the probable cause of weed control failures.

- **Use of tank mixes**

  In a few special cases, use of a tank mix may delay the appearance of resistance. Use of a tank mix for this purpose is only worthwhile in combatting resistance if the components of the tank mix kill the same weed by different mechanisms.

  For instance, either Refine or MCPA will kill lamb's-quarters — each using a different method of killing the plant. Using the tank mix of Refine and MCPA, rather than using one product or the other on its own, means less chance of lamb's-quarters developing herbicide resistance.

  Tank mixing does not delay resistance if the products used in the mix each control different weeds.

How to Tell if You Have Resistance

To date, few instances of poor control by herbicides are due to weed resistance. However, this does not mean the possibility should be ignored. Suspicious situations should be checked out as soon as a problem appears. Before assuming herbicide resistance, rule out all other factors that might have affected herbicide performance including misapplication, spray misses, unfavourable weather conditions, improper leaf staging and weed flushes after application. Having ruled out the above possibilities look for the following:

- Other weeds listed on the product label are controlled satisfactorily,
- Herbicide failure is patchy and there is no reasonable explanation,

Table 2

Herbicide history of two fields which developed herbicide resistant wild oats.

Year	Field 1		Field 2	
	Crop	Product	Crop	Product
1990	Wheat	Triumph Plus	Wheat	Hoe-Grass
1989	Flax	Poast	Canola	Poast
1988	Barley	Hoe-Grass	Wheat	Hoe-Grass
1987	Flax	Poast	Wheat	Hoe-Grass
1986	Wheat	Hoe-Grass	Wheat	Hoe-Grass
1985	Barley	Hoe-Grass	Canola	Poast
1984	Wheat	Hoe-Grass	Wheat	Hoe-Grass
1983	Barley	Hoe-Grass	Wheat	Hoe-Grass
1982	Wheat	Hoe-Grass	Wheat	Hoe-Grass

- Herbicide failure occurred in this area of the field in the previous year with the same herbicide/herbicide group,
- Weeds do not show herbicide injury symptoms e.g. root pruning by trifluralin.

If one or more of these apply, it's possible that the weeds are resistant. If resistance is suspected consult either your local weed supervisor, Manitoba Agriculture, or the relevant chemical company to follow-up on the problem.

Managing Resistant Weeds

Once weeds have become herbicide resistant, alternative methods of control must be employed. It's impractical to assume that resistant weeds can be eradicated. Even after many years resistant weeds will persist in the field and continue to pose a problem.

Care must be taken to ensure resistant weeds are not spread throughout the field, or to other fields, by harvesting equipment. It's also important to ensure that seed grain is not contaminated with resistant weeds' seeds.

In areas where resistant weeds are already a problem it will be important to rely on cultural control methods and to use herbicides from other groups. Where infestations are very heavy, the only practical solution may be to fallow the land for one or two years. This will prevent further seed set and allow seed reserves to decline to manageable levels.

Table 3: Herbicide groups based on their mechanism of action

Group 1 Excel, Fusilade, Fusilade II, Hoe-Grass 284, Hoe-Grass II*, Poast, Laser*, Triumph Plus*, Achieve**, Select**, Assure**, Puma **	**Group 2** Ally, Glean, Muster, Refine, Triumph Plus*
Group 3 Edge, Rival, Treflan, Triflurex, Fortress*	**Group 4** 2,4-D, MCPA, Banvel, Blagal*, Buctril M*, Diphenoprop 660*, Estaprop*, Dyvel*, Kil-Mor*, Lontrel, Target*, Tordon 202C*, Tropotox Plus*, Triumph Plus*
Group 5 Bladex L, Blagal*, Lexone, Sencor	**Group 6** Buctril M*, Hoe-Grass II*, Pardner, Laser*
Group 7 Lorox, Afolan	**Other Herbicides** The herbicides Avadex BW, Assert, Avenge 280C, Carbyne, Eptam Mataven, Stampede, TCA and Basagran are in groups of their own.

* Products contain more than one active ingredient and therefore may appear in more than one group.

** Products not registered of January 1991.

New herbicides do not necessarily have a unique mechanism of action and may fall within the groups listed above.

Note: Herbicides that have the same mechanism of action do NOT necessarily control the same weed spectrum or have the same crop safety. For example, Assert and Ally have the same mechanism of action, however, Assert controls wilds oats; Ally does not. Remember to always read and follow label instructions.

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