A Classroom and Extension Activity for Teaching Practical Limitations to Proactive Herbicide Resistance Management

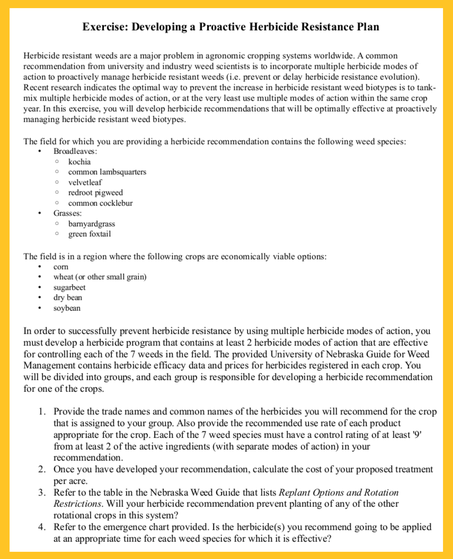
Andrew R. Kniss, University of Wyoming

Introduction

- Recommendations from industry and university weed scientists focus heavily on incorporating multiple herbicide modes of action to proactively manage herbicide resistant weeds.
- Recent research indicates the optimal way to incorporate multiple herbicide modes of action is in the form of mixtures, whereas annual rotations are comparatively ineffective (Beckie & Reboud 2009; Evans et al. 2016).
- A common question from students (and some academics) is "Why don't farmers simply use multiple modes of action to proactively manage herbicide resistance?"
- A classroom activity and lesson was developed to teach upper-division undergraduate students and crop advisors how to develop an effective proactive herbicide resistance management plan, and the difficulty in implementing such a plan.

Activity Setup

- Before the activity, students are provided background information on using mixtures for herbicide resistant weed management, including results from Beckie & Reboud (2009) and Evans et al. (2016) .
- Students are divided into groups and each group is assigned one crop (corn, soybean, sugarbeet, dry bean), and the *Guide for Weed Management in Nebraska*. Groups are then asked to:
    1. develop a herbicide program that contains at least 2 active ingredients (with different sites of action) effective against 7 different weeds
    2. calculate the cost of the herbicide recommendation
    3. determine which rotational crops would be allowed/prohibited if their recommendation was followed by a farmer



Exercise: Developing a Proactive Herbicide Resistance Plan

Herbicide resistant weeds are a major problem in agronomic cropping systems worldwide. A common recommendation from university and industry weed scientists is to incorporate multiple herbicide modes of action to proactively manage herbicide resistant weeds (i.e. prevent or delay herbicide resistance evolution). Recent research indicates the optimal way to prevent the increase in herbicide resistant weed biotypes is to tank-mix multiple herbicide modes of action, or at the very least use multiple modes of action within the same crop year. In this exercise, you will develop herbicide recommendations that will be optimally effective at proactively managing herbicide resistant weed biotypes.

The field for which you are providing a herbicide recommendation contains the following weed species:

- Broadleaves:
    - kochia
    - common lambsquarters
    - velvetleaf
    - redroot pigweed
    - common cocklebur
- Grasses:
    - barnyardgrass
    - green foxtail

The field is in a region where the following crops are economically viable options:

- corn
- wheat (or other small grain)
- sugarbeet
- dry bean
- soybean

In order to successfully prevent herbicide resistance by using multiple herbicide modes of action, you must develop a herbicide program that contains at least 2 herbicide modes of action that are effective for controlling each of the 7 weeds in the field. The provided University of Nebraska Guide for Weed Management contains herbicide efficacy data and prices for herbicides registered in each crop. You will be divided into groups, and each group is responsible for developing a herbicide recommendation for one of the crops.

1. Provide the trade names and common names of the herbicides you will recommend for the crop that is assigned to your group. Also provide the recommended use rate of each product appropriate for the crop. Each of the 7 weed species must have a control rating of at least '9' from at least 2 of the active ingredients (with separate modes of action) in your recommendation.
2. Once you have developed your recommendation, calculate the cost of your proposed treatment per acre.
3. Refer to the table in the Nebraska Weed Guide that lists *Replant Options and Rotation Restrictions*. Will your herbicide recommendation prevent planting of any of the other rotational crops in this system?
4. Refer to the emergence chart provided. Is the herbicide(s) you recommend going to be applied at an appropriate time for each weed species for which it is effective?

The activity given to the students.

Table 1: Effective mixture herbicide costs (USD per acre) calculated by students over seven events where this activity was used.

Dry bean	Sugarbeet	Corn	Soybean
$71.75	$120.25	$60.25	$73.10
$68.28	$162.44	$52.75	$65.72
$78.00	$176.75	$40.00	$22.06
$54.76	$186.01	$50.99	$38.50
$101.34	$166.93	$64.06	$52.73
$75.25	$232.50	$66.00	$45.38
$57.75	$130.75	$73.00	$70.88
AVERAGE: $72.45	**$167.95**	**$58.15**	**$52.62**

Post-activity Discussion

- After students develop their effective mixture treatments, potential barriers to adoption of their plans are discussed. Cost, access to effective herbicides, and crop rotation restrictions are regularly mentioned by students.
- Students realize for themselves how difficult it is to manage herbicide resistant weeds if herbicides are the only management tools being used. Prioritizing weed species and herbicide modes of action, as well as crop economics are then discussed in the context of using herbicides effectively.
- Subsequent lessons and discussions address how to manage herbicide resistant weeds by doing more than just changing herbicide recommendations.

Literature Cited

- Beckie & Reboud (2009) Weed Technol. 23:363-370
- Evans et al. (2017) Pest Manag. Sci. 72:74-80

UNIVERSITY OF WYOMING

Scan the QR code to download a PDF version of this poster: