Smart Farming: Using data to make decisions

Herbicide Action (III.A.i.)

What are the issues of using herbicides? What do they mean for farmers?

Farming uses a wide variety of herbicides to control weed pressure. There are over 200 herbicides available worldwide (http://www.ewrs.org/et/docs/herbicide_interaction.pdf) Weeds take sunlight from growing crops and nutrients from the soil which help a crop grow in the field. Farmers want to reduce the number of weeds that grow and compete with their crops. Herbicides, chemicals that control weeds, can be used, but some weeds have developed resistance to some herbicide actions, or the way the herbicide kills the weed.

Herbicide resistance costs U.S. farmers an estimated $2 billion each year in decreased land values, decreased yields and increased input costs (*Herbicide Classification Guide*; Take Action, 2014). There are 11 different weeds that threaten growers because they are resistant to the actions of common herbicides. What does this mean for growers? Decisions need to be made to reduce the impact of the weeds through controlled use of the herbicides to which they are susceptible. How might a farmer know which weeds are resistant and which are susceptible? The *Herbicide Classification Guide* was created by the Soybean Checkoff to help farmers figure that out. Farmers use several methods to control weeds including: planting cover crops, changing tillage practices, managing field borders and cleaning equipment before moving to the next field. If using herbicides, farmers try different modes of action to reduce the development of resistance.

Herbicides can be classified by their site of action. Question #2 describes those sites of action.

1. Review the eleven weeds that show resistance and the threats they possess, fill in the chart below by visiting this website: http://reader.mediawiremobile.com/USB/issues/107147/viewer?page=1 (electronic booklet titled: “I will know the eleven herbicide-resistant weeds that threaten”).

Weed	Threats	Resistant to:
Common Waterhemp		
Palmer Amaranth (Pigweed)		
Horseweed (Mare's Tail)		
Giant Ragweed		
Common Ragweed		
Common Lambsquarters		
Kochia		
Italian Ryegrass		
Barnyard Grass		
Johnson Grass		
Giant Foxtail		

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2. Complete this table to determine which weeds might be controlled by each Site of Action category.

Site of Action (# group)	Description of Action	Weeds that are susceptible
ACCase Inhibitors (1)	Block the first step in fatty acid synthesis; plants will lack phospholipids to build new cell membranes	
ALS Inhibitors (2)	Inhibit a common enzyme so that leucine, valine and isoleucine are not synthesized by the plant	
Microtubule Inhibitors (3)	Blocks microtubule polymers from being formed (loss of microtubule structure and function) so cell wall formation is negatively affected	
T1R1 Auxin Receptors (4) (Auxins cause plant cells to elongate.)	Cause abnormal growth leading to plant death	
Photosystem II Inhibitors (5,6,7)	Bind to photosystem II in chloroplast thylakoids to negatively affect the processes and products for transport of chemical energy	
Lipid Synthesis Inhibitor (8)	Inhibit biosynthesis of fatty acids and lipids and affect acetyl-coenzyme A	
EPSP Synthase Inhibitor (9)	Glyphosate depletes the amino acids: tryptophan, tyrosine and phenylalanine	
Glutamine Synthase Inhibitor (10)	Inhibits the enzyme that converts ammonia to glutamine, allowing ammonia to accumulate leading to cell destruction and reducing the pH gradient	
Diterpene Biosynthesis Inhibitor (13)	Inhibits the production of carotenoids	
PPO Inhibitors (14)	Inhibit the production of chlorophyll	
Photosystem I Electron Diverter (22)	Accepts electrons from photosystem I and lead to the formation of hydrogen peroxide that destroy lipid membrane fatty acids and chlorophyll	
HPPD Inhibitors (27)	Gives rise to bleaching on new growth due to inhibition of carotenoid synthesis	

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Targeted application

An herbicide is determined to be effective if it keeps weeds from spreading (producing seeds). As you have seen from your previous reading, there are many avenues for the herbicide to work. In addition, the amount used may vary depending on the growth stage of the weed and the growth stage of the crop in the field with it. In order to be effective, the following steps should be followed:

- Identify the pest correctly.
- Select the appropriate product.
- Calibrate equipment properly.
- Measure the pesticide accurately.
- Review the treatment site before and during application.
- Monitor the results

In addition, the proper equipment must be used with the appropriate timing and placement.
Taken from: https://www.extension.purdue.edu/extmedia/ppp/ppp-96.pdf

Herbicides perform best if they are applied when plants are rapidly growing. Plants in the germination and early-seedling stage are likely to be severely damaged by herbicides. However this applies to both weeds and crops. Choosing the time and location for herbicides correctly can lead to effective weed control. Spraying only when and where there are problems saves a grower time and money. Unmanned Aerial Vehicles (UAV's, aka drones) can help farmers to find problem areas of a field that are not visible from the edge of the field and can help to map the location through GPS or photos.

Read the following scenarios and describe how to solve the problem. Once these are answered, go to the Decision Tracker, roll the die to see what kind of weed problem you have in your assigned field, then enter the decision you make about the method for controlling the weeds.

Scenarios

1. A farmer has a problem with common waterhemp spread all across his field. This is an unusual situation. Usually, the resistant waterhemp will show up in one spot in the field one year and spread due to its ability to produce up to 1 million seeds per plant and the seeds may stay dormant for up to four years.

What herbicide do you recommend for this farmer? Give two reasons for your choice.

2. Another farmer is experiencing common ragweed and Palmer amaranth in the same field. Which herbicide should this farmer use? Give two reasons for your choice.

3. In order to reduce selection for herbicide resistance, it is possible to mix sites of action. Which two types of herbicides above might be recommended for a field that has both barnyard grass and mare's tail?

4. Create a scenario and present to one of your classmates to get advice for herbicide use.