

Activity 28

Wily Wild Oats

By Peter Moir

Study Question:

Why are wild oats such successful crop competitors?

Activity:

Students identify some biological factors that have made wild oats such a successful weed. Then the students collect wild oat samples and study the seed structures for possible clues revealing the reasons for the plants success. By doing crop sampling plots the students can estimate the percentage of losses the farmer can expect to incur.

Curriculum Fit:

Biology 20

- Ecology is the study of interrelationships between organisms and their environment

Math 20

- Analyzing graphs and collecting data..

Agricultural Concept:

Competition and diversity among plant species.

Dollar losses due to weeds can be extensive.

The most important factor affecting the final outcome of competition is the competitive advantage gained by one plant over another during their early stages of competition and development. If crops do not gain the competitive advantage over the wild oats during the initial growth stages, they never will do so.

Purpose:

- To use a local pest, wild oats, to illustrate the concept of competition between plants and also to show how resistance develops in a species, i.e., how a plant species evolves.

Materials Required:

- Dissecting microscopes to look at the seeds.
- Sampling quadrats - these can be made from scrap lumber and designed to be 1/4 square meter.

Time Required:

One class period per activity.

Background — For the Teacher

* Be sure to have the students collect several plants in plastic bags for further analysis in the classroom.

This lesson allows your class to study competition in plants using a very common weed in Alberta. This lesson can be done in the early fall or spring, but a spring field trip will require extra knowledge in identifying wild oat seedlings. This is best done by digging up the seedlings and looking directly at the seeds.

Procedure

DAY ONE

Preparation

1. Obtain permission from a local farmer to enter his field and do sampling. Choose a field in which wild oats are evident, and be sure that you know what type of crop is present in the field.
2. Students can be paired and each pair will require a sampling quadrat and a plastic bag for sampling. Students should be reminded that the field represents the farmer's livelihood and they should take great care to do as little damage to the crop as possible.

Introduction

3. Explain to the students that their purpose is to get a random sampling of wild oat infestation levels and also collect some wild oat plant samples.

Activity

4. Have the students walk into the field at least fifty paces before sampling. The edge of the field is an area exposed to a great variety of weed seeds and would not provide an accurate representation.

For sampling, have the students take one weed count every ten paces as they walk in a zig-zag manner. The quadrat is simply dropped to the ground over the plants. This will give the students data to determine the density of oats infestation. (In actual practice, oat densities are measured in the spring with the emerging plants. Identification of the species is more difficult at this time, but it does allow the farmer to plan his control measures.)

DAY TWO

Preparation

1. Run off Data Sheet One (% losses in yield with different densities of wild oats) and Task Sheet One.

Introduction

2. Explain to the students that different plants compete differently with wild oats. The degree of competition will determine the percent of loss incurred by the farmer.

Activity

3. Distribute the Data Sheet and Task Sheet to each pair of students. Using the data they have collected, have the students plot the density of the wild oats in the crop on their graph.

Conclusion

4. Lead a discussion on factors dealing with competition. Have the students compare their results and try to explain any irregularities.



DAY THREE

Preparation

1. Have the students take out the samples obtained in the field. Each pair should have a probe and a pair of tweezers. A small amount of water is also needed.

Introduction

2. Lead a discussion about adaptation in organisms. Ask them to hypothesize about what special adaptations of wild oats might give them a competitive advantage over the other varieties of crops.

Activity

3. Have students look at Data Sheet Two (Wild Oat Seed), then have them take several wild oat seeds apart as they go (these parts do not have to be memorized).
4. Then have the students complete the Task Sheet Number Two.

Conclusion

5. Lead a discussion about what adaptations the students think might be responsible for the tremendous success of wild oats in competition with other crop species.



Discussion Questions

1. List the advantages that wild oats have over other forms of plant life. How do these advantages allow the oats to outcompete many of the other plants in their community, i.e., crop plants?
2. If you were asked to give reasons why wild oats can be considered enemies to surrounding plant life, what would you say?
3. Wind, water and sunlight are all abiotic factors that can affect plant and animal life. How do these affect wild oats?
4. Describe why scientists emphasize experimentation on plants to help us solve some environmental problems.

Evaluation Strategy

1. Participation in, discussion and general understanding of the topic and activities.
2. Thoroughness and accuracy of the completed Task Sheets.

Related Activities

1. Students can do a germination test on wild oat seeds. A comparison could be done between seeds that have been exposed to a heat treatment (40°C for a few hours), and some which have been freshly picked and have not been exposed to heat treatment. Heat treatment will break dormancy in many of the seeds.
2. The class could obtain some Robin Hood Wild Oat Flour (not necessarily that brand name) and compare the contents (eg, % protein) with an all-purpose flour. Wild oat cookies could be made with the Wild oat flour by following one of your favorite recipes.
3. Students could look up the prices of wild oat herbicides and determine the cost of spraying the study field. This value could then be compared to the estimated losses that the farmer would incur from the wild oats.
4. The awn on wild oats starts to unwind when exposed to water. Line-up several wild oat seeds. Assign each student one of the wild oat seeds, and give each an eyedropper. The student whose wild oat travels the fastest and farthest wins (Use oatmeal cookies as prizes).

Resources

Growth Habit and Control of Wild Oats, Publication 1531, Agriculture Canada, revised 1977 (copies obtained from Information Services, Canada Department of Agriculture, Ottawa, K1A 0C7)

Wild Oats, binder available from Alberta Agriculture.

O'Donovan, J.T., Sharma, M.P., Wild Oats, Competition and Crop Losses, an abstract from Wild Oats Symposium Proceedings, Agriculture Canada, 1983.

Raju, M.V.S., Awn Anatomy and Its Relation to Germinability of Wild Oat Caryopses in abstract from Wild Oats Symposium Proceedings, Agriculture Canada, 1983.

Wild Oat Information

A. THE PLANT

Wild oats represent the number one weed problem to western Canadian farmers and almost 90% of Alberta farms are infested with the weed. Wild oats compete with crop species for available light, moisture and soil nutrients. The success of wild oats can be attributed to several adaptations present in the plant. These include the following:

1. Seed Production: Wild oats can produce as many as 250 seeds per plant (ideal conditions) so a light infestation can quite quickly become a heavy infestation (eg, some fields may have greater than 70 bushels of wild oats per acre in the upper soil layer).

2. Seed Dispersal: Wild oats have a rapid seed development and show an early maturity. The wild oats seeds also show an easy “shattering ability” which means that the seeds fall off the plant very easily as when, for example, blown by the wind, hit by hail or rain, or touched by an animal or piece of machinery. The seeds also ripen unevenly so that some seeds (top) ripen and fall off before others (bottom). This characteristic allows the plant to release seeds that germinate at different times.

Wild oats also have small hairs on the seeds which make them stick to animal fur. Finally, if animals eat wild oats the passage through the digestive tract can break seed dormancy. The wastes that they are deposited with provide an excellent environment for germination.

3. Seed Dormancy: Wild oat seeds can go into a dormancy which allows them to wait until conditions are favorable for their survival. Research has indicated that this dormancy can last as long as 14 years or more. The dormancy is due to a hard seed coat which prevents oxygen and water from reaching the embryo and also as a chemical growth inhibitor that exists in the seed coat.

To break dormancy the seeds need warm, dry conditions. The wild oat seed will not germinate in light. Several mechanisms can bury seeds (such as drifting soil) but the wild oat seed also has a spike like awn that, when moistened, unwinds to push the seed down below the soil surface level (this may also be an adaptation which twists the seed off the plant).

Information — cont'd

B. COMPETITION

The amount of damage caused by the competition of wild oats with crop species is a very complex interaction and is dependant upon a variety of factors. These include:

1. Density of wild oats:

Obviously the higher the density the greater the losses.

2. Crop Species: Some crops compete better with the wild oats than others. In order of decreasing ability to compete with the wild oats these species are: barley, rye, canola, wheat, tame oats, and flax.

The total leaf surface area available for photosynthesis and the number of stomata on the leaf surface will determine how much transpiration and photosynthesis the plants can perform. Also root length and the number of roots indicate the ability to absorb nutrients and water. Wild oats start off behind most crop varieties for all these factors when young, but as the plants mature wild oats catch up and surpass the crops.

3. Time of emergence: If the wild oats germinate before the crop they will do much more damage than later emergence. To counteract this, farmers often delay seeding the crop and allow wild oats to come up briefly. The wild oats are then tilled down and followed by seeding of the crops.

4. Timing Control: The longer wild oats are allowed to remain in the field the more damage they will do. Effective control relies on early control measures.

C. CONTROL

Farmers can use both cultural and chemical control on wild oats.

1. Cultural control: Farmers often delay seeding to allow the wild oats to germinate and start growing. The soil is then tilled and a majority of the wild oats are killed. The crop is then seeded.

2. Chemical Control: A variety of chemical herbicides are available to farmers for wild oat control. The chemicals will not eliminate wild oats but will bring them to a manageable level. These chemicals include: **Avadex**, **Carbyne** and **Avadex BW** for control in flax, barley and wheat crops. Also **Terflan**, **Asulox F**, **Avenge**, and **Eptam** are available for more specialized control. Development of chemical controls for wild oats is an arduous process because wild oats are members of the grass family and most crops are also in this family. For instance, it is much easier to develop herbicides to eliminate broad leaf weeds in the grass family.

Data Sheet

PERCENTAGE LOSS IN YIELD WITH DIFFERENT DENSITIES OF WILD OATS IN WHEAT, BARLEY, RAPESEED, AND FLAX WHEN THE WEED-FREE YIELD OF THE CROP IS 2.1, 1.6, 1.9 AND 1.7 TONNES PER HECTARE, RESPECTIVELY (30 BU/AC)

Wild oat plants		Percentage loss in yield			
per m ²	per sq ft	Wheat	Barley	Rapeseed	Flax
1	0	0	0	0	0
10	1	10.7	7.3	8.0	19.0
21	2	15.0	10.3	11.3	27.0
32	3	18.7	12.7	14.0	33.0
53	5	24.0	16.3	18.0	42.3
75	7	28.3	19.3	21.3	50.3
107	10	34.0	23.0	25.7	60.0
161	15	41.7	28.3	31.3	73.7
215	20	48.0	32.7	36.3	

From Friesen (1973)

Task Sheet One

Graphing Exercise

1. Convert the graph from the percentage loss table into graph form. Staple your graph to the back of this page.
2. Determine the number of wild oats per m from your field data by taking an average of your ten samplings. Remember that if your quadrat was 1/4 m, to *multiply by four* to get m results.

AVERAGE NUMBER OF WILD OATS PER M² = _____

3. Plot your density value on the graph which you have prepared.
4. Questions:
 - a. When you are sampling for wild oats, why should you not take your samples from the outer edge of the field?
 - b. List crop varieties in order of their decreasing ability to compete with wild oats. (best competitor _____ worst competitor)

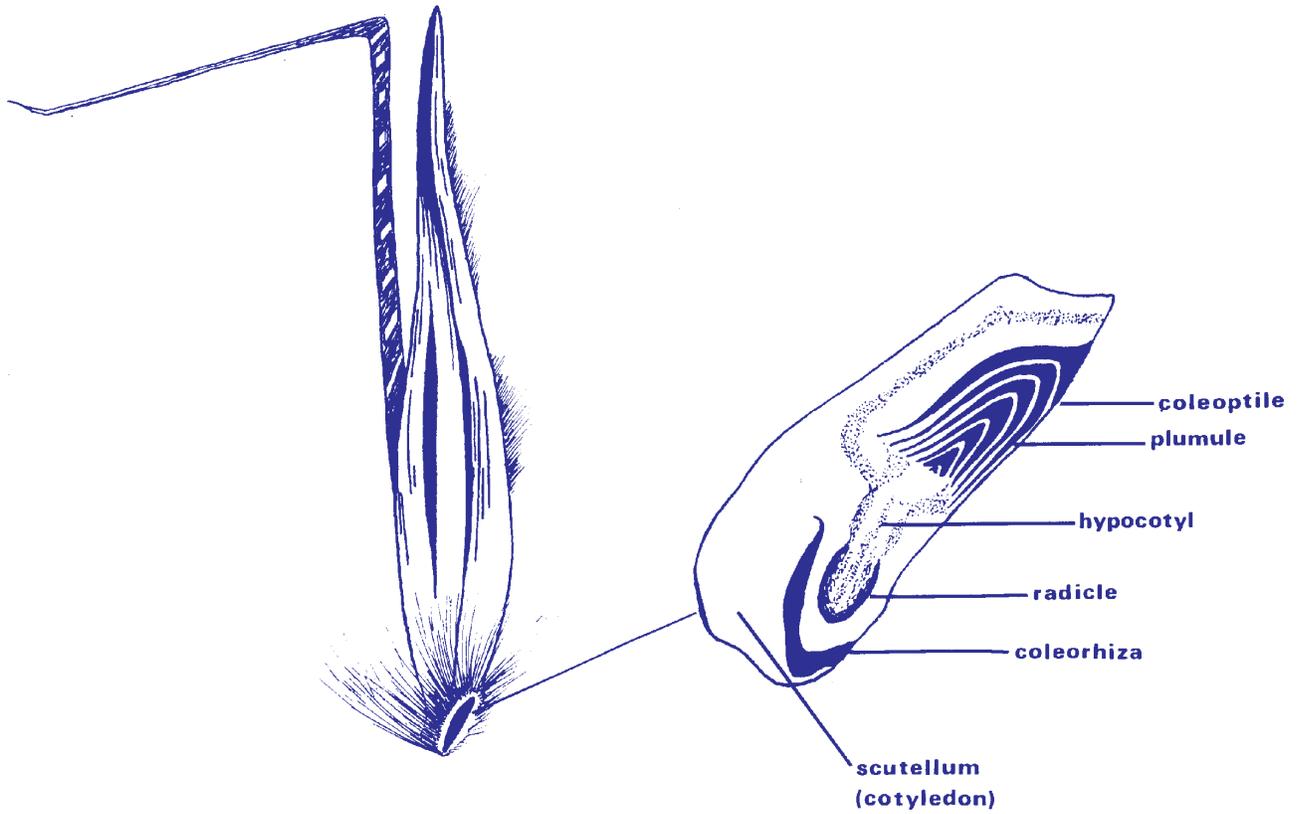
Task Sheet Two

Observe Your Samples of Wild Oats

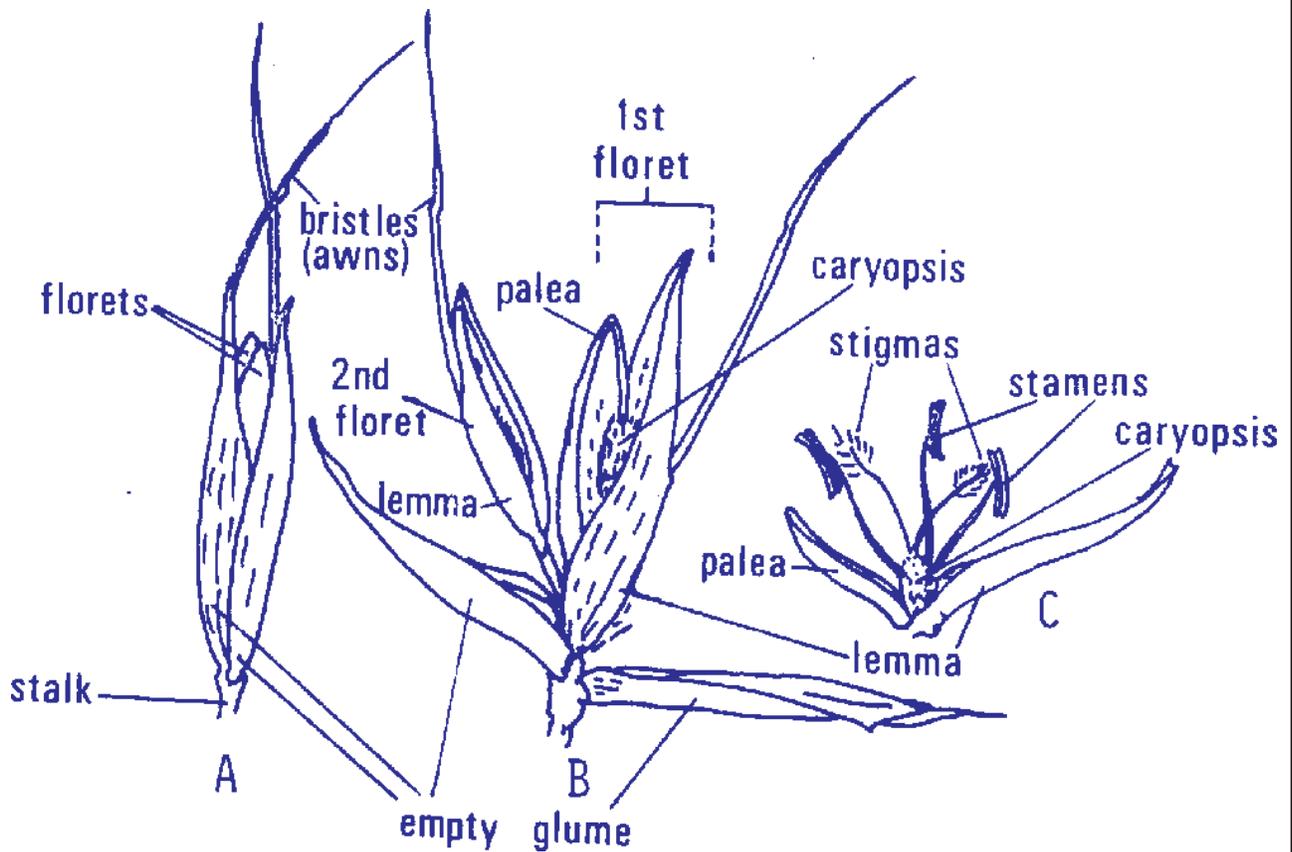
1. A wild oat plant can produce up to 250 seeds per plant. How might this adaptation be valuable to the species?
2. Describe the position of the wild oat seeds in the field in comparison to the crop seeds. (HINT: Were they above or below the crop?) How might this give wild oats an advantage in seed dispersal?
3. Observe several of the seeds from the wild oat plants collected. The seeds are pointed and have tiny hair like barbs on them. What advantages might this structure provide for seed dispersal?
4. a) Put some of the seeds on your desk. Put a small amount of water on each seed. Describe what happens.

b) How do you think this adaptation of the awn might benefit the plant?
5. Some wild oats, which show resistance to commonly used herbicides, have now been discovered in Alberta. Describe how you think this resistance may have developed?
6. Wild oat seeds often go into a period of dormancy that can last for up to 15 years. They can come out of the dormancy whenever conditions are suitable for their survival. How might this characteristic be frustrating to a farmer who sprays his field to eliminate the current wild oat plants?
7. Wild oat seeds fall from the plant very easily. This is called shattering. Why does this characteristic enhance the chances of survival for this species? When might this happen?

Wild Oat Seed



Spikelet of Wild Oats



A - SPIKELET CLOSED

B - SPIKELET WITH EMPTY GLUMES BENT BACK TO SHOW FLORETS

C - A SINGLE FLORET (DIAGRAMMATIC)

Source: Wild Oats, Alberta Agriculture, Food and Rural Development