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Investigating Iowa's Weeds

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INVESTIGATING IOWA'S WEEDS*

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Introduction

The term "weed" is often defined as a plant out of place. A. C. Martin (3) has complained that this definition reflects human bias and that pest plants are out of place only with respect to man's immediate purpose. In nature's scheme, they often serve useful functions such as providing food for wildlife throughout the growing season and covering barren soil, thus preventing soil erosion. Judging from their competitive success with many so-called desirable species, they are anything but out of place.

H. G. Baker (1) has proposed a more definitive definition for weeds which states that essentially weeds are plants whose populations grow spontaneously in restricted geographical areas, predominantly in situations markedly disturbed by human activities. This definition recognizes that certain plants have evolved and adapted to conditions associated with man and infers that the numerous plants associated with stable prairie and woodland communities are not to be considered weeds.

Weeds, as defined by Baker, are readily available for study by Iowans of all ages, whether they live in cities or rural areas. With some imagination and an unbiased attitude, weeds provide interesting objects for botanical studies. The remainder of this paper outlines some simple investigations involving common weeds found throughout the State of Iowa.

Population Studies

A good way to introduce students to the study of weeds, and lead them to an understanding of Baker's definition, is to build a circular frame of heavy wire or a piece of garden hose. The frame should have a circumference of 2.51 m to enclose a 0.5 m^2 area.

This frame is used in sampling population densities of common weeds in different habitats. Habitats selected should include the edges of cultivated fields, alleys, gardens, roadsides, footpaths, salt-licks or watering areas for livestock, and areas subjects to occasional flooding. Sampling should also be done in natural, undisturbed areas for comparison. For each location sampled, a record should be made of the dominant land use, habitat description, measurements of selected soil conditions and the density of specific weed species in terms of plants per m^2. Some classes may want to identify specific species while others may wish merely to determine the total number of weeds present.

*Adapted from *Kansas School Naturalist*, Vol. 23.

Upon completion of the survey, students should be asked to identify the general conditions that promote the highest weed densities. In the past, some common weed species were found in the highest densities along bison trails where they prevented erosion.

Seed Studies

The success of many weedy species centers around their high production of seeds, an adaptation possibly resulting in nature due to the rare occurrence of large areas of disturbed soil in stable, natural communities. To illustrate the seed production capacities of weedy species, have students find the mean total seed production per plant for a given species of weed and make notes on the seasonal distribution of the seeds produced by each species. Compare the number of seeds produced per plant and the duration of seed production of weedy species with garden or agricultural species, or wild non-weedy species of prairies and woodlands. What do the results of these studies indicate about weeds' ability to compete with other plants? Of what importance is the seasonal distribution of seeds to wildlife?

Some species, such as dandelions, produce seeds continuously throughout the season, while cultivated crops produce seeds for only a short period each year. Common ragweed has been observed to produce 3,380 seeds per plant; shepard's purse has recorded 38,550 seeds per plant. Among the most prolific seed producers is common mullein with a yield of 223,000 seeds per plant.

Seed production is only one factor contributing to the success of weeds. Seed germination is another. Seed germination does not always immediately follow seed formation. Germination is often delayed due to the absence of some important factor other than soil and moisture. This time of delayed germination is called *dormancy*. For example, the seeds of common ragweed mature in late summer and fall to the ground but do not germinate in the fall as the seedlings would be killed by harsh winter temperatures. The dormancy of ragweed is broken only by freezing winter temperatures. The dormancy of cocklebur seeds can be broken by breaking the seed coat which apparently increases the oxygen supply to the embryo. The dormancy of pigweed, wild mustard and shepard's purse can be broken by drying at 43^{o} C or by the mechanical injury or removal of the seed coat. Light, and even the specific wavelength of light, effects the dormancy of some seeds. The details concerning the mechanisms of dormancy are just beginning to be understood.

To illustrate these concepts, have students collect seeds from individual weed species and set up germination experiments. Germination chambers can be constructed from Petri dishes and paper toweling cut to fit the dishes. Place three layers of paper toweling in a Petri dish and saturate with water. Remove the excess water and deposit seeds on the top towel layer. Replace the Petri dish lid and store in a dark, warm place. Each day record the total number of germinations. Plot on graphs, total germination versus day after planting.

Inhibition Studies

Some species of weeds produce substances that inhibit the growth of other plant species with which they compete. To illustrate this, use a blender or a mortar and pestle to grind up the rhizomes and roots of quackgrass. Add 100 ml of distilled water to 10 gm of freshly ground plant material and filter through cheesecloth. Use the filtrate to water alfalfa seedlings. Alfalfa seedlings can be started either in Petri dishes or in soil. Treatment with the filtrate may begin either at the time of planting or after germination which occurs within two days after planting. You should have a control culture of alfalfa seedlings which are watered only with an equal amount of distilled water. Observe the rate of seedling growth in both cultures. Does quackgrass produce a substance that inhibits the growth of alfalfa?

In addition, try similar extracts made from the roots of Jimson weed or the stems, leaves and roots of any species of ragweed, Japanese bromegrass, annual sunflower or horseweed on cultures of tomato, alfalfa or other garden species. Observe the percentage of germination or the rate of seedling growth under the various conditions. Plot the germination of both treated and untreated seeds versus time on the same graph.

After initial observations of germination rates of given weed species, allow the seeds of different species to be germinated in a variety of temperatures, light intensities, moisture gradients, and kinds of substrates. Compare these observations with those made with farm and garden seeds. Which seem to be most adaptable to varying conditions? Which species are least adaptable?

Also have students gather cocklebur fruits, determine and compare the germination times of the two seeds found in each fruit. Do both seeds germinate simultaneously? Of what survival value is there in different germination rates for seeds of the same species?

Vegetative Studies

Another factor contributing to the success of some weeds is that they are not dependent upon seed production as the sole mode of reproduction. To illustrate this, remove the entire plant of either quack grass, field bindweed, Canada thistle, dandelion or dock from the soil, and chop the plant into one-inch segments. Allow the parts to air dry from one to several days and then plant them in potted soil. Note any signs of growth that occurs. How does this method of plant propagation contribute to the survival of the species?

Conclusion

By having students survey and study the common weed species in their environment through direct observation, experimentation and library study, they learn to conduct scientific inquiries that clarify the ecological role of weeds in natural and man-made communities. Extension of such investigations may reveal new sources of food, fiber, medicine or plant growth regulators, but most important they provide a basis for the appreciation and understanding of the scientific method and the world of life around us, particularly that portion that we tend to ignore because of bigotry. These valuable lessons are taught with a minimum amount of expense; the major investments are in time, patience, energy and imagination.

Citations and References

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Compositae and SO_2

The Exxon Company employs biomonitoring to check air quality in the vicinity of some of its oil and gas installations. Native plants are used as monitors since they are far more sensitive to certain types of air pollution that man and his domestic animals and crops. The major pollutant being monitored is sulphur dioxide. Some plants which are sensitive to sulphur dioxide may react to concentrations in the parts per million range. State and federal air standards do not permit ground level concentrations of sulphur dioxide to exceed one part per million when averaged over a three-hour period.

Native "weeds' are used for monitoring these low levels. Of the sulphur dioxide sensitive species many are in the family Compositae. Some of the most sensitive species are bind weed (Convolvulaceae), fleabane (Compositae), prickly lettuce (Compositae), ragweed (Compositae), native sunflowers (Compositae), and blackberry (Rosaceae).

The level of sulphur dioxide required to damage any plant may range from 1.5 parts per million for gladiolus to 15.0 parts per million for sorghum.