9-1998

Iowa Agricultural Practices and the Environment -- Iowa Environmental Issues Series

Iowa Association of Naturalists

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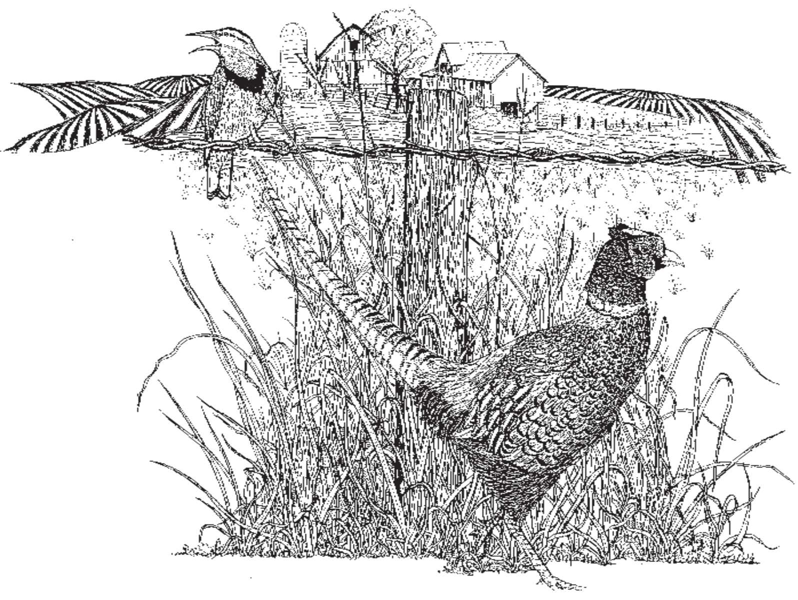


Iowa Environmental Issues Series

Iowa Agricultural Practices and the Environment

Plowing the prairie

When the early settlers reached Iowa, they found a rich land—abundant prairie soils with an incredibly rich, thick topsoil; adequate water for people, crops, and livestock; land teeming with diverse wildlife populations in riverine forests, extensive prairies, and wetlands.

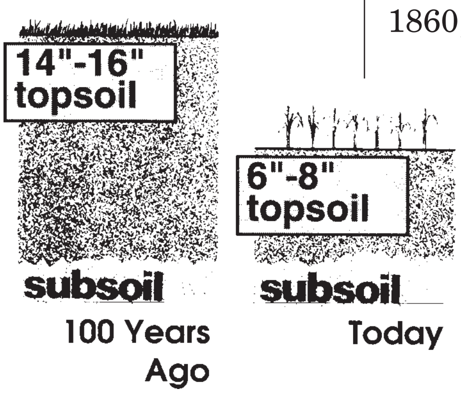
As more and more settlers came to Iowa, forests fell before the ax and the native prairie gave way before the plow. Domesticated crops such as corn and small grains began to replace the original prairie. Domesticated livestock began to replace native wildlife species.

As the land filled, new settlers looked for new land. The invention of the steel plow allowed the thick prairie soils to be broken and farmed. Large tracts of wetlands were drained with series of drainage ditches and networks of tiles to provide more rich farm land. Wooded land was cleared to plant crops. More settlers moved into the region. More crops were planted. More livestock arrived.

The very richness of the land began to lead to its decline. Through the years, agricultural practices led to the loss of soil, increased pollution of watersheds, and the loss of habitat and wildlife diversity.

Today, the agricultural community and state leaders are working to find solutions to these problems. Farming methods strive to balance environmental concerns like protecting valuable soil and water with agricultural production and profit. Today, agricultural leaders realize that these valuable resources must be maintained if agriculture is to continue to thrive in Iowa into the future.

Iowa's greatest asset– its soil–has become its worst pollutant



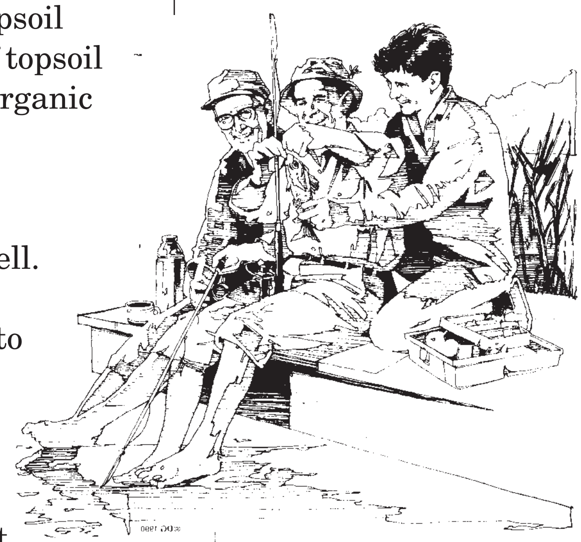
Just a little more than 150 years ago, the Iowa landscape was dominated by prairies. Today, much of Iowa is an intensively-farmed agricultural complex. In 1860, fewer than one million acres of Iowa's land was planted in corn or soybeans. By the mid-1990s, more than 27 million acres – more than 60 percent of the land– was crop land. This presents a particular problem as row crops traditionally tend to increase erosion compared to grassy areas.

Erosion of land is a major environmental and economic problem for Iowa. In the first 100 years of farming, portions of Iowa lost half its topsoil to spring erosion. The problem began once the prairie cover was broken and land was laid bare to the effects of wind and rain. Between 1940 and 1970, larger farm equipment, federal farm policies, and improved corn hybrids led to more intensive farming, especially on steep, marginal corn-growing land.

Soybeans were also increasing in popularity, replacing pasture and cover crops such as oats and alfalfa.

Soil erosion can cause serious problems for farming, our surface water, plant and animal life, and the residents of Iowa. It is, by sheer volume, the number one pollutant of Iowa's waters. It threatens our environment for two reasons: soil is eroded from areas where we need it—our crop fields—and then must be removed from areas where we don't want it – our drinking water, reservoirs, lakes, and ditches.

Soil erosion is a major problem affecting the productivity of crop land. Topsoil has the greatest capacity for storing water and nutrients necessary for plant growth. Loss of topsoil makes the field more susceptible to drought. Loss of topsoil also reduces available natural plant nutrients and organic matter and leads to heavier reliance on commercial fertilizers.



Soil run-off causes many other costly problems as well. Counties must repair roadbeds and clean sediment from road ditches, culverts, and tile outlets, adding to our overall tax burden.

Estimating damage to recreational areas is difficult. Without a doubt, muddy and polluted water is less desirable to swim in, but how can a cost be determined? Many of Iowa's lakes are actually dammed rivers and streams that carry silt to the reservoir where the silt settles out. The only solutions, once an area has silted in, are to dig out the mud or to raise the level of the dam—both costly undertakings.

Many cities rely on lakes, reservoirs, and rivers for their drinking water supplies. Large amounts of runoff cause numerous problems. **Turbidity** (cloudy water) caused by silt is generally considered acceptable at one unit for drinking water. Turbidity levels after a heavy runoff may range from 50 to 1,000 units, and removing the silt is difficult and expensive. Heavy runoff can also lead to high levels of nitrates and other agricultural chemicals that must be removed to make it safe to drink.

Solutions to save the soil

Keeping soil on the crop fields benefits individual farmers and all Iowans

Changing conventional tillage methods to minimum-till or no-till is one preferable way to reduce soil loss. Many of these methods rely on **crop residue**—the plant roots, stalks, and leaves left over after harvesting—to help protect the soil.

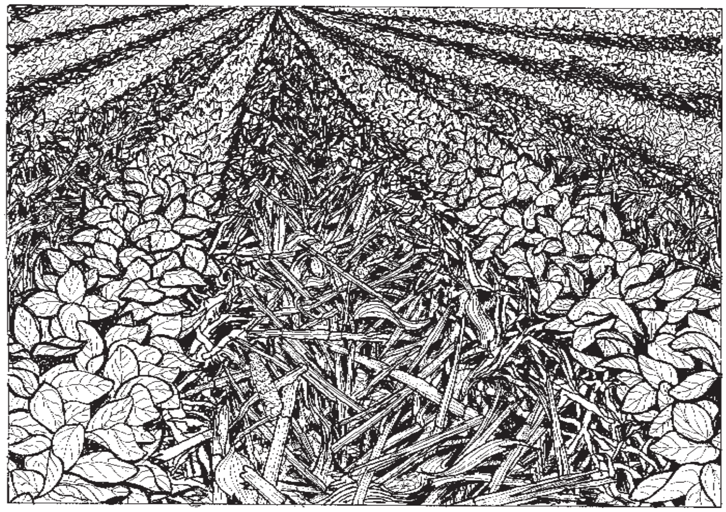
Conventional tillage

Minimum-till

Conventional tillage methods leave less than 30 percent of the soil covered with crop residue. Generally, a moldboard plow or other plowing method is used to turn nearly all the stalks and other crop residue under the soil. This leaves the soil exposed to wind and rain erosion. Few farmers continue to use this method because of the loss of soil.

Minimum-till systems leave at least 30 percent of the ground covered with stalks and other residue and helps stop erosion due to wind and water. Two common methods are ridge-till and mulch-till. **Ridge-till** leaves the soil undisturbed from harvest time in the fall to planting time, except for the addition of some fertilizer and nutrients. Plant roots, stalks, and crop residue help hold the soil in place. A special type of planter sweeps away residue from the plant row as the seeds are planted but leaves the previous year's residue between rows. Cultivation is used for weed control and ridges are built up around the base of the plant. **Mulch-till** is similar to ridge-till but may use a chisel plow, disc, or other implement to break the surface before planting.

With **no-till** farming, no tillage equipment is used. A special planter sweeps away the debris for planting. Herbicides are used for weed control except for emergency control when a cultivator might be used.



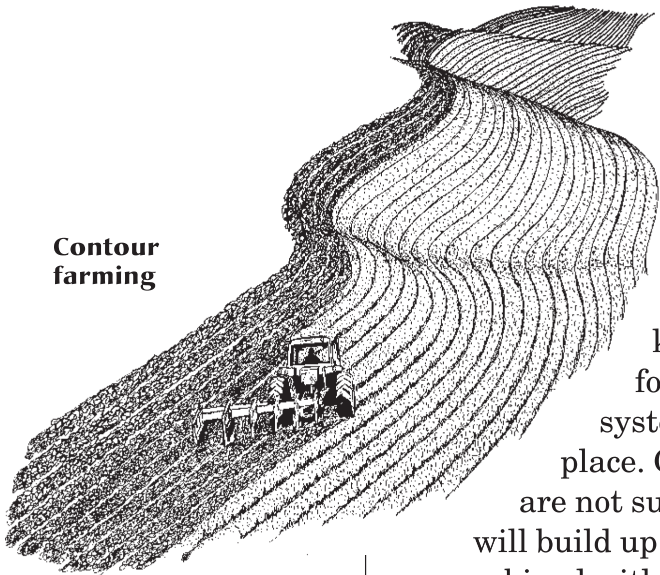
No-till

Common farming practices to reduce soil erosion
In addition, there are many other farming practices that help reduce erosion and soil loss. At the same time, these practices provide cover for wildlife and increase plant and animal diversity.

No single farming practice works for all situations. The types of crops planted in rotation, steepness of the slope, and soil type all contribute to erosion problems. Consult your local Natural Resource Conservation Service (NRCS) office to help plan the most effective control for your land.

No-till or minimum-till farming
These methods may reduce soil loss up to 90 percent. The residue helps keep raindrops from directly hitting the soil and breaking the soil into small erodible particles. The residue also helps stop the soil from washing away. This practice will not stop erosion on steep hills, especially with lower residue amounts from soybeans. The most effective erosion control on these lands is planting grasses, alfalfa, or small grains.

Contour farming
Contour farming involves planting crops in rows that circle around a hill rather than in straight lines up and down the hill. These contours help break the water flow



Contour farming

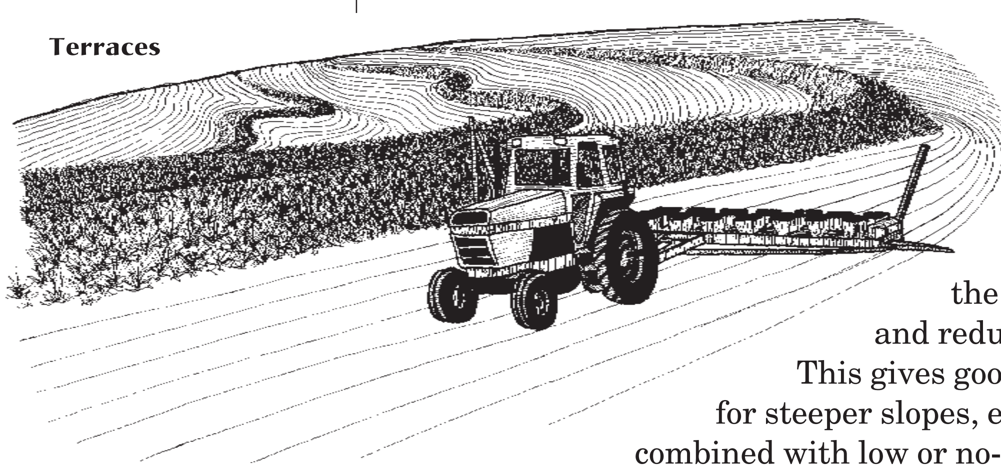
and help stop soil runoff. This practice is suitable for moderate slopes but may not work well on very steep slopes.

Grassed waterways

Planting grass or hay in areas where water runoff is concentrated helps keep these areas from washing out and forming gullies. The denser root systems of the grasses help hold the soil in place. Grassed waterways alone generally are not sufficient to control erosion since soil will build up quickly. They are most effective when combined with other methods of control.

Terraces

For very steep hillsides, terraces may be required. This practice breaks up the steep hill into a series of level areas where crops are planted. The slopes break up the water flow and are planted in grass to hold the slope in place and reduce erosion. This gives good protection for steeper slopes, especially if combined with low or no-till farming.



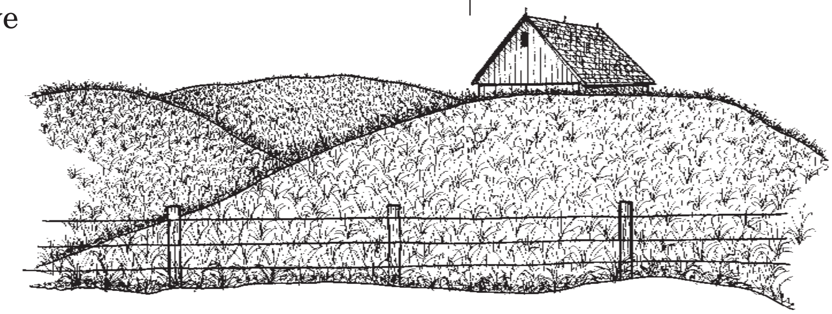
Terraces

Filterstrips

Filterstrips consist of grasses, shrubs, or trees generally planted along streams rivers, and lakes to trap sediment, fertilizers, and pesticides before they enter the waterway. Wildlife and people benefit from the cleaner water, and the strip provides important cover and nesting areas for wildlife. Again, filterstrips alone are generally not sufficient to prevent soil entering waterways and should be combined with other soil erosion methods.

Cover crops
For steep hills, the most effective treatment is to plant the land in a cover crop of grasses, alfalfa, and small grains that will hold the soil with their dense root systems. Also, fall-planted cover crops in soybean fields help reduce winter and spring wind erosion.

Grass or cover crops help reduce erosion on steep land.

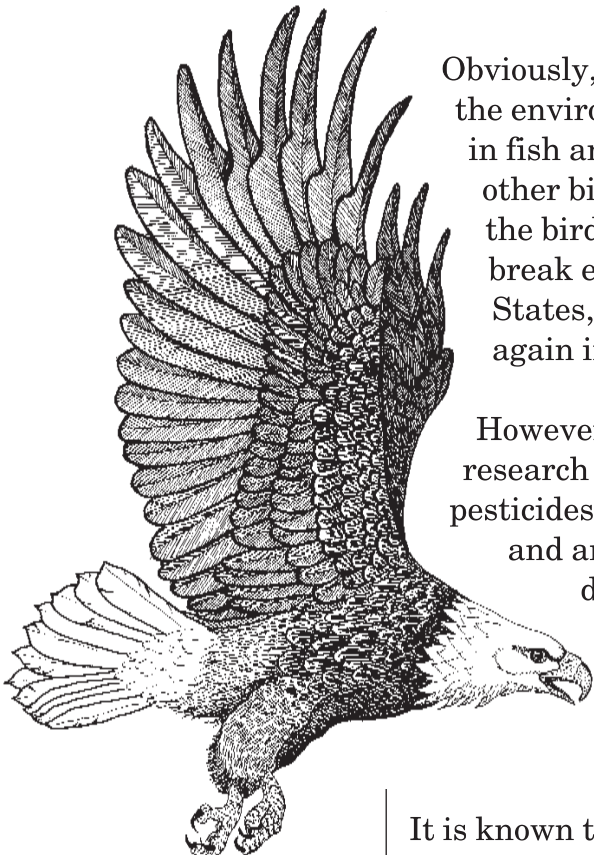


Chemical problems – chemical solutions

The word **pesticide** is a general term used to describe any chemical that kills or slows the growth of an undesirable organism. Specific types of pesticides include herbicides that control weeds, insecticides that control insect populations, fungicides that control unwanted fungi, and nematocides that control soil nematodes.

Since the mid-1980s, pesticide use in Iowa has declined slightly. However, of the 450 million pounds of pesticides applied throughout the U.S., Iowa still uses more than 50 million pounds or about 12 percent of the total. Too often, little is actually taken up by the targeted pest and some ends up drifting or flowing off the field.

The major concern with pesticides is that they eventually may end up in surface water and groundwater. The significance of pesticides in the environment is a matter of debate. They are definitely not a part of the natural environment and should be used with extreme caution. However, the impacts on plants, animals, and people in the environment are difficult to assess.



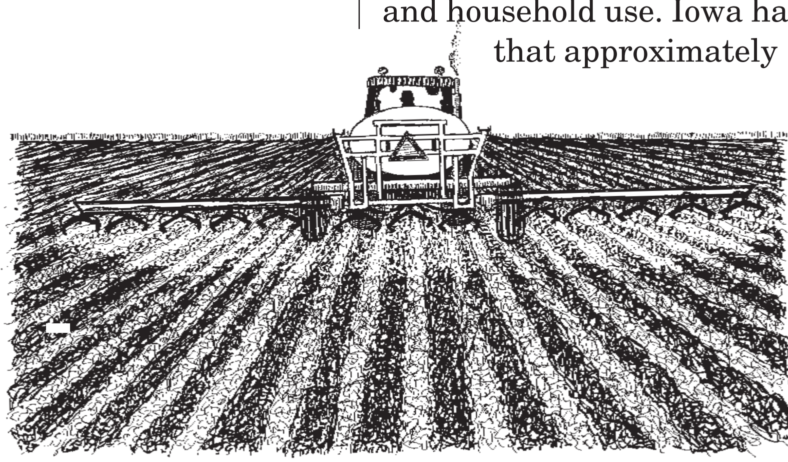
Obviously, some pesticides have had tremendous impact on the environment. The chemical DDT was found to build up in fish and subsequently in eagles, osprey, pelicans, and other birds as they ate the fish. The chemicals caused the birds' egg shells to be very thin and fragile and to break easily. Since the banning of DDT in the United States, populations of many of these birds are once again increasing.

However, for most pesticides used today, there is little research on the overall ecological impacts. The effects of pesticides vary widely depending on the species of plant and animal and the type of chemical. Pesticides break down into other, often harmless substances over time. However, the break-down rates depend on soil type, amount of light, temperature, and other conditions that change from location to location and year to year.

The chemical DDT was found to build up in the bodies of animals and nearly caused the extinction of bald eagles.

It is known that pesticides are found regularly in Iowa's surface water and groundwater supplies. A comprehensive study of the Midwest watershed was completed in 1989-1990 by the U.S. Geological Survey. It tested more than 130 streams and rivers and found that up to 98 percent of these waterways had detectable levels of the herbicides atrazine, metolachlor, and alachlor after spring and summer rainstorms.

Not only are pesticides found in some surface water, but they are showing up in groundwater supplies as well. This is particularly worrisome in rural areas where most residents rely on wells that tap into groundwater supplies for drinking and household use. Iowa has conducted studies indicating that approximately 14 percent of Iowa wells may be contaminated with various pesticides, the most common being the herbicide atrazine.



While groundwater contamination with pesticides tends to be at lower levels and less prevalent than surface water contamination, it is often of more concern. Pesticides found in surface water are exposed to more oxygen, light, and temperature changes that help break down the chemicals. However, pesticides are less likely to break down in groundwater and are much more difficult to trace to the source of pollution, to monitor, and to remove.

More recently, studies have shown that pesticides are also found in rainfall. The most common chemicals found were the same as those found in surface water—atrazine, metolachlor, and alachlor. However, some chemicals, especially insecticides, were found only in cities and might be attributed to chemical use for lawn and garden care.

Human health effects of these low levels of pesticide exposure are unknown, as is the effect of the interaction of different pesticides. However, since these are chemicals designed to kill living organisms, common sense would advise limited intake.

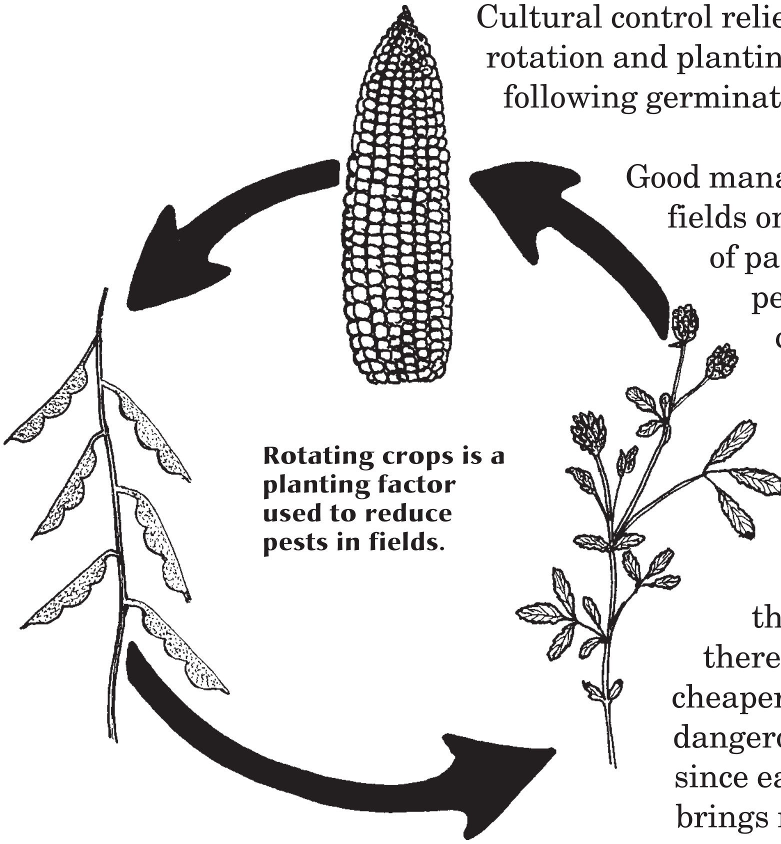
Farming practices make a difference

There is growing interest among farmers to decrease the use of pesticides. The main reason is economics. Reducing chemical treatments reduces costs to farmers and may increase profits. Careful management and balancing the cost of treatment with the possible loss of yield without treatment are vital. At the same time, Iowans are becoming increasingly concerned about the environmental impact of pesticides, and increased education and regulations have helped farmers realize that non-chemical solutions may be part of a comprehensive management strategy.

Today, good **pest management** depends on four methods of control: cultural, mechanical, biological, and chemical.

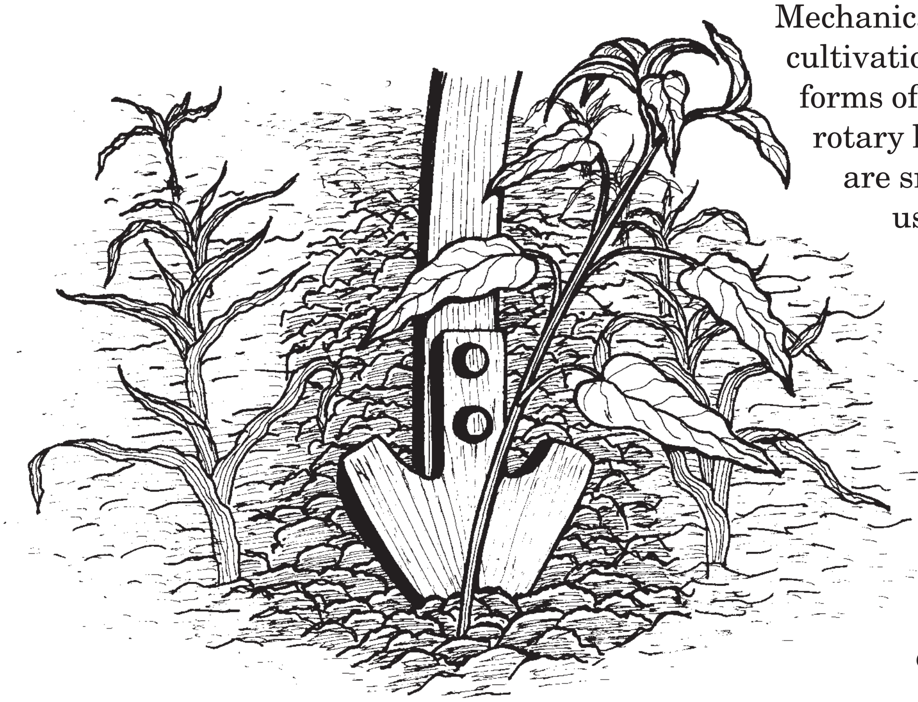
Cultural control

Cultural control relies on planting factors such as crop rotation and planting after weeds have been killed following germination.



Good management starts with scouting fields on a regular basis. Keeping records of past problem areas helps control pests, as well as the need for chemical means of controlling pests. The first step is to determine the seriousness of the infestation of weeds or insects. This is where trade-offs take place. Will the potential loss of crop yield be greater than the cost of chemical treatment? Are there other options that might be cheaper and less environmentally dangerous? There are no set answers since each farm is different and each year brings new challenges.

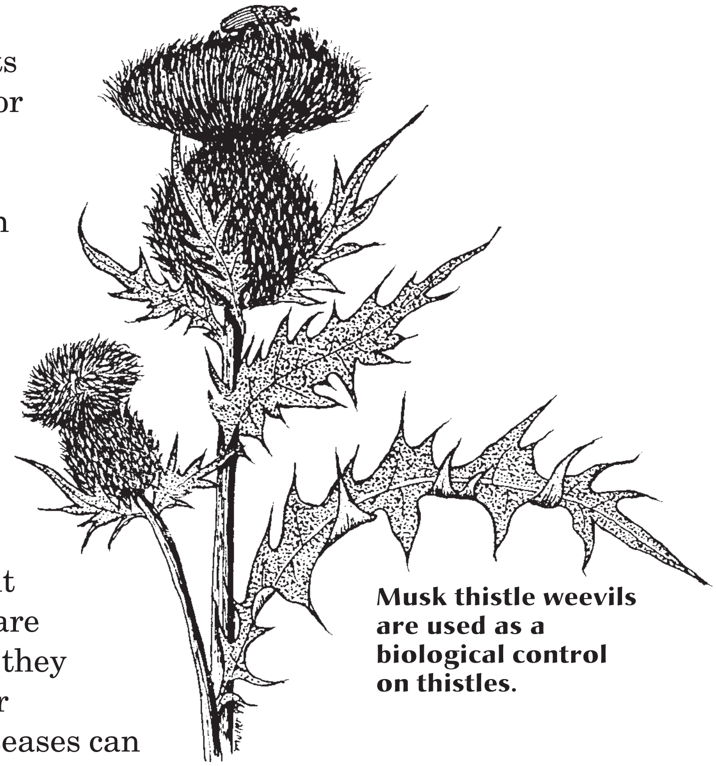
Mechanical control



Mechanical weed control or cultivation is one of the oldest forms of control. Tools like the rotary hoe are used when plants are small, while a cultivator is used on larger plants. Although mechanical control requires tractor fuel, it results in reduced chemical control. Most farmers substituting mechanical control for herbicides estimate that it costs them about half of what their neighbors spend on chemical control.

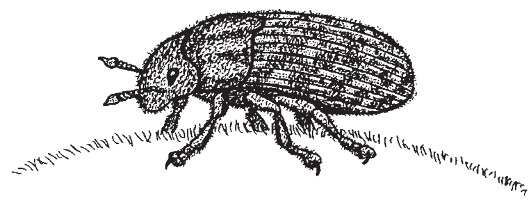
Biological control

Biological control involves introducing insects and plant diseases that target specific weed or other pest populations. One example of biological control in the Midwest is the introduction of the musk thistle weevil which feeds on musk thistles. Thistles are tough weeds to control, and the weevil appears promising in controlling pest populations. Insect control is best suited for pasture land rather than crop land since cultivation tends to disrupt the life cycle of the insects.



Musk thistle weevils are used as a biological control on thistles.

Researchers are also developing microbial controls. These microbes are essentially plant diseases that occur naturally. The microbes are cultured in labs and sprayed on fields where they select the weeds but not the crops. One major advantage of biological control is that the diseases can adapt to changing weeds so they can't build up resistance or tolerances that has occurred with herbicides and insecticides.

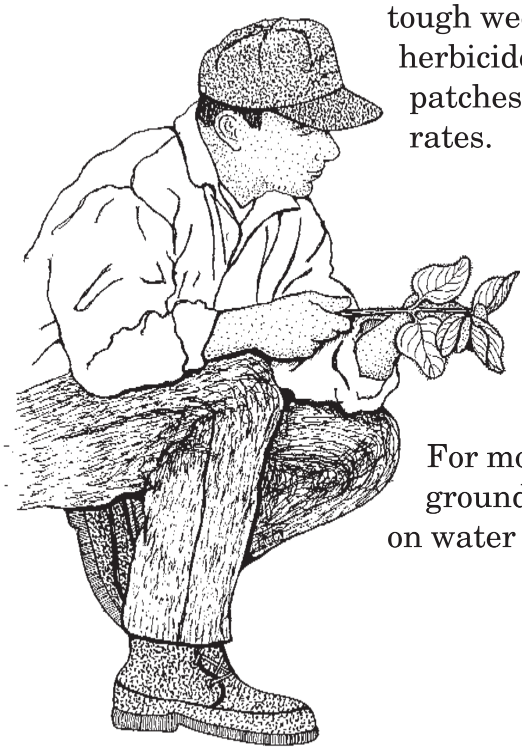


Chemical control

Farmers using control other methods must occasionally resort to chemical control for tough cases. However, even when chemical control is required, it is possible to reduce the amount of chemicals used. Careful calibration or setting of the sprayer is essential to not over-apply chemicals.

In addition, many farmers use banding techniques that spray chemicals in a narrow band over the crop row and rely on cultivation for weeds between rows. Research shows that this method reduces the amount of chemicals by 50 to 67 percent, while maintaining corn yields on 99 percent of the fields tested.

Finally, good record-keeping and scouting for weeds may result in lower dosages of herbicides. Some tough weeds require high rates of application. If a farmer knows those



tough weeds are not a widespread problem, a lower dose of herbicides may eliminate other weed problems while small patches of troublesome weeds may be sprayed at higher rates.

Used together, these methods may greatly reduce the need for expensive chemical control. Everyone wins when the farmer maintains yields, lowers costs, and carefully uses chemicals to reduce environmental risks.

For more information about chemicals and pesticides in groundwater and surface water, please refer to the booklet on water quality in this series.

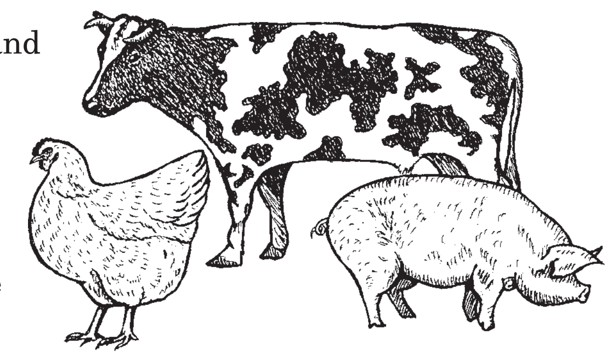
Safely turning animal waste products into agricultural resources

One very important part of Iowa's economy is production of feed grains and feeding animals for meat and dairy production. Even before the first farmers entered the state, large numbers of animals deposited manure on the land in a natural recycling process. As more farmers entered the state, wild species were replaced by domesticated animals, primarily horses, cattle, pigs, and poultry.

The use of animal manures to fertilize fields is a centuries-old practice that has helped increase farm production by adding essential nutrients and minerals to the soil. Primary among these nutrients is nitrogen, along with other minerals and trace elements that plants need.

However starting around 1960, several inexpensive forms of nitrogen became popular amendments to the soil. This increased use of nitrogen increased yields, but it also increased the possibility of nitrogen in the nitrate form flowing off fields and leaching out of the soil and into water supplies. Today, both synthetic and natural fertilizers cause nitrate problems.

As farming changed through the decades, many farming operations grew in both the amount of land farmed and in the numbers of animals raised. By the mid-1990s, there was a marked increase in the number of very large cattle feedlot operations and confinement hog and poultry operations in the state. Two major problems are associated with large-scale animal production. First, a large number of animals produce a large amount of manure that must be disposed safely and economically, and secondly, this manure has an objectionable odor that impacts the quality of life in surrounding areas.



Amount of fresh manure produced by mature farm animals

Animal	Daily pounds produced	Annual tons produced per animal
Beef cattle*	58	10.5
Dairy cattle*	86	15.7
Growing pig	5.5	1.0
Sow and litter**	39.5	N/A

*Influenced by size and age of animal; based on 1,000-pound animal; figures from Pm-1428b ISU Extension Publication. See publication for complete assumptions and details.

**Sow would not have litter all year

Increased amounts of manure must be treated, broken down into biologically safe and usable materials, and disposed in a safe way. For human waste, sewage treatment plants are used. However, one hog produces about twice the waste of one person. So when a single confinement operation feeds 5,000 pigs or more, the volume of waste produced is the equivalent of a typical Iowa town of 2,500 people. In reality, however, few livestock operations use formal sewage treatment plants to process animal waste products.

Livestock manure treatment is generally accomplished by moving manure into either large manure-holding structures or earthen holding areas called lagoons. In the pond-like lagoons, bacteria break down the manure into two products: a clear water called effluent that can be drained off and a sludge that is generally applied to surrounding land.

With large operations, several problems may arise. Poorly designed lagoons have been known to leak nitrates into the ground if they are not properly sealed or if cracks develop in the seal at the bottom of the lagoon. This allows manure products to leach into the soil and possibly contaminate nearby wells or groundwater supplies.

Additionally, lagoons have overflowed or ruptured during periods of unexpected heavy rains and farmers have accidentally pumped untreated manure into nearby streams and rivers causing surface water pollution.

Finally, the manure may exceed the amount that the surrounding land can absorb without causing environmental problems and long-term damage to the land itself. When too much nitrogen is applied to the land, either in the form of nitrogen fertilizers or animal manure or a combination of the two, plant life does not absorb the nitrogen and it is subject to leaching and run-off into nearby watersheds.

Methods of control

Four general management practices may help ease the problems. They also on trade-offs that protect both the economic interests of the farmer and the natural environment.

Economically and environmentally sound manure management plan

Animal manure contains high fertilizer and nutrient value. However, the cost of transporting the manure to the field and spreading it can cost more in labor and fuel than the value of the nutrients. Operators must determine the maximum amount of manure that may be disposed efficiently and safely over a long period of time.

Proper selection of application areas

Some soils due to their soil structure are better suited than others to handle large amounts of manure. Flat lands with few erosion problems are better choices than areas near streams and rivers. Operators must use caution when applying manure in areas susceptible to erosion and contamination.

Method of application

Smaller operations may remove and spread manure and animal bedding daily in small quantities. This poses less risk for serious pollution and run-off. Larger operations that store manure usually spread material several times a year, generally in the early spring and late fall. Manure left on the land surface is more likely to run off in rain and pollute nearby streams and rivers. Incorporating the manure into the soil through injection into the soil or disking the material into the soil will help bind the nutrients to the soil.

Timing of application

Manure should be applied close to the time when plants need the nutrients and when tillage operations are planned to best incorporate the manure into the soil. Spreading manure on frozen ground should be avoided since it greatly increases the chance for run-off.

In addition to these simple management practices, vegetative filterstrips, vegetative waterways, and other erosion control practices should be established to decrease run-off into nearby waterways.

The decline in diversity

The decline of the wetlands

It is estimated that Iowa had more than six million acres of wetlands located mainly in the northwest and north central parts of the state nearly 150 years ago. This vast area, ranging from the Iowa Great Lakes to north of Clear Lake and south to Des Moines, was home to large and diverse wildlife populations.

The Federal Swamp Land Act of 1850 granted 1.2 million acres of wetlands to the state for swamp reclamation. Some land was sold to immigration companies for as little as 25 to 50 cents an acre if they encouraged farmers to work the land. Other portions were sold to railroad companies. Drainage ditches were dug to drain away excess water and to prepare the soil for planting. Iowa's wetlands began to disappear.

Approximately six million acres of wetlands existed in Iowa 150 years ago.

It is impossible to calculate the exact number of wetlands destroyed since no accurate records were kept. But by 1906, an early USDA survey listed 930,000 acres of wetlands. By 1922, that figure decreased to 368,000 acres. By 1938, only 50,000 acres of marsh land remained. It is estimated that more than 95 percent of Iowa wetlands were drained to be used for farm land, roads, towns, and industry. Today only 26,000 acres of native marsh land remain in the state.

Loss of wildlife

As the land was cleared, drained, and cultivated, many wildlife populations declined. Only those animals that could adapt to modern agriculture survived, and most of that

Only about 26,000 acres of native marsh land exist in Iowa today.

wildlife was forced into woodlots, fence rows, and ditches to find cover.

During the past several decades, agricultural practices have continued to adversely effect wildlife. Draining wetlands and straightening meandering rivers and streams allowed more land to be farmed, clearing the land of trees, brush, and other wildlife cover.

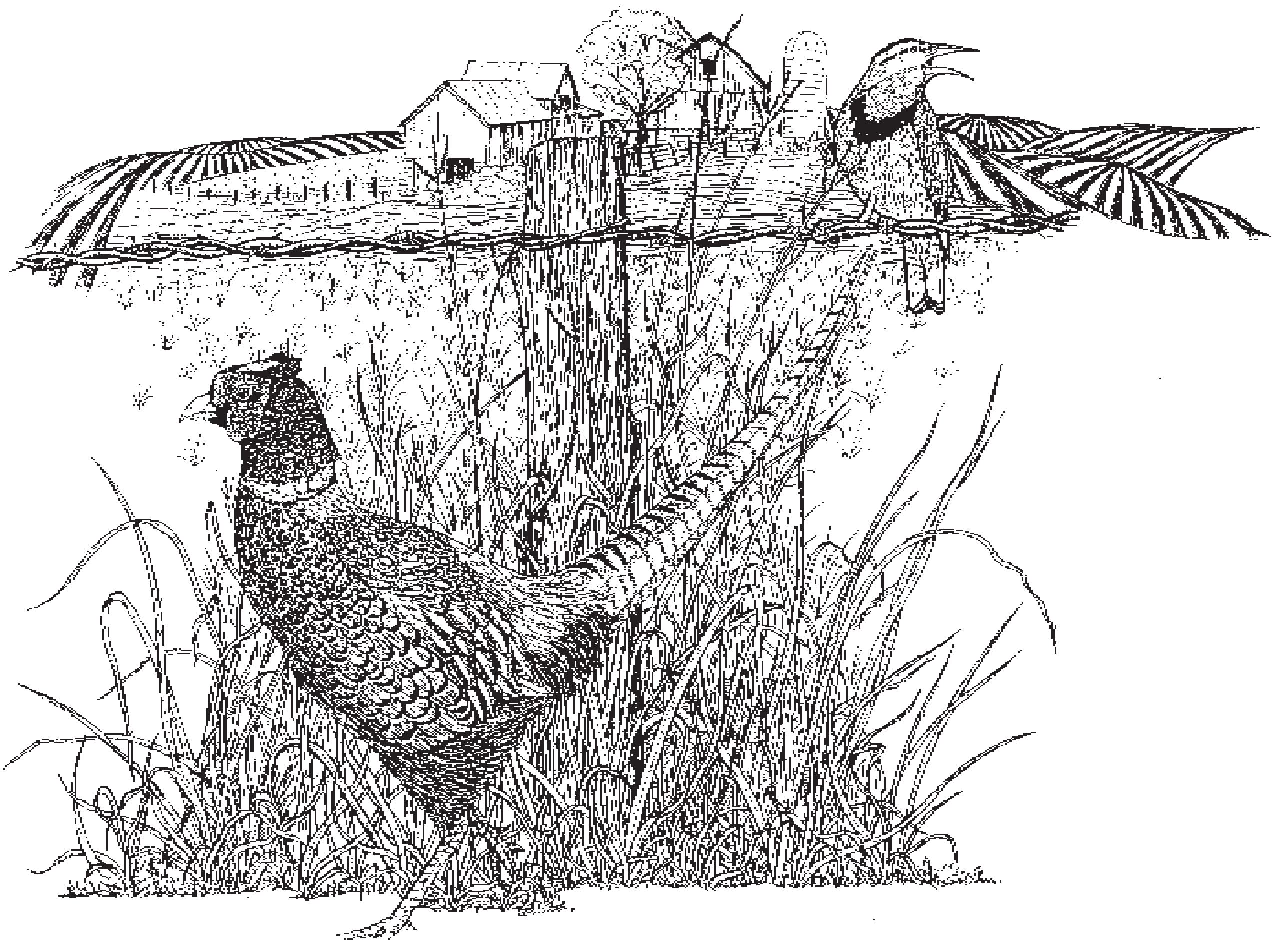
The patchwork of small, diversified fields that once was common in Iowa also disappeared as livestock pastures decreased. Larger equipment led to the destruction of fencerows, and long expanses of unbroken monocultures of corn or beans today are common practice. The habitat left for wildlife has steadily decreased over the years.

Protecting the diversity of plants

Today, our agricultural system is based on intensive agriculture with many prime growing areas concentrating on producing several crops. In Iowa, these crops are primarily corn, soybeans, and forage crops for animal feed. Many of today's seed varieties are hybrids to ensure uniform crops with reliable plant characteristics. Unfortunately, this uniformity can lead to disastrous outbreaks in diseases, vulnerability to pests, and stress from the environment.

In 1970, a disease called southern corn leaf blight broke out in the southeastern portion of the U.S. and spread up through the Midwest. This epidemic destroyed an estimated 700 million bushels of corn – about 15 percent of the total harvest. It happened because nearly all the corn bred at the time was susceptible to the fungus that caused the blight.

Fortunately, plant breeders used other strains of corn to create new hybrids that were resistant to the blight. This



outbreak was a wake-up call to how vulnerable our crops and food sources may be.

In response, the National Germplasm System was established. Organizations and individuals committed to preserving the diversity of plants work to collect and store seeds for future use and research. Wild ancestors of modern plants and important hybrids are grown and seeds are saved. Iowa plays an important role in this process. Iowa State University is a regional plant introduction station and storage facility. They work with amaranth, Jerusalem artichokes, asparagus, bent grass, cantaloupes, carrots, clover, collard, corn and maize, cucumbers, dill, endive, gourds, kale, mustard greens, parsley, pumpkins, soybeans, spinach, squash, sunflowers, turnips, and zucchini. This is just a partial list of the many agricultural products well suited to growing in Iowa.

Unfortunately, the amount of land where plants grow wild continues to shrink. Some plant varieties may have special adaptations to local conditions or pests, and once the land is cleared, these genetic mutations may be lost forever. The only solution is to protect, preserve and, if possible, restore native areas to encourage their genetic diversity.

Restoring the native prairie

Walnut Creek National Wildlife Refuge is located near Prairie City, Iowa. More than 8,000 acres of land, once intended as home for a nuclear power plant, will be reconstructed as a tallgrass prairie and oak savanna. The original tallgrass prairie ecosystem covered parts of 14 states, including most of Iowa. The oak savanna was a community of hickory, oak, and walnut trees that grew in pockets in the prairie and hosted a carpet of wildflowers and shorter grasses. The refuge's goal is to re-create the native plant and animal communities that existed before the land was developed by intensive farming.

Within the area, existing roads are being "un-built" and fences removed to create an unbroken expanse of prairie. Small prairie and savanna remnants have been discovered and restored. Seeds from these areas are harvested and used to restore other portions of the land to native plants. As the plots of native plants continue to expand, the seeds are harvested and more land is planted. However, no one knows for sure what plant species once part of the prairie may have disappeared forever. This is the first time such a large prairie restoration project has been attempted, and research conducted on-site will document the process so that more prairie areas may be restored.

For more information about this prairie restoration and reconstruction project, contact Walnut Creek National Wildlife Refuge, Box 399, 9981 Pacific Street, Prairie City, IA 50228, or visit their WEB page at http://www.fws.gov/~r3pao/walnut/ or phone (515) 994-2415.

Using biotechnology and genetic engineering to modify agricultural products

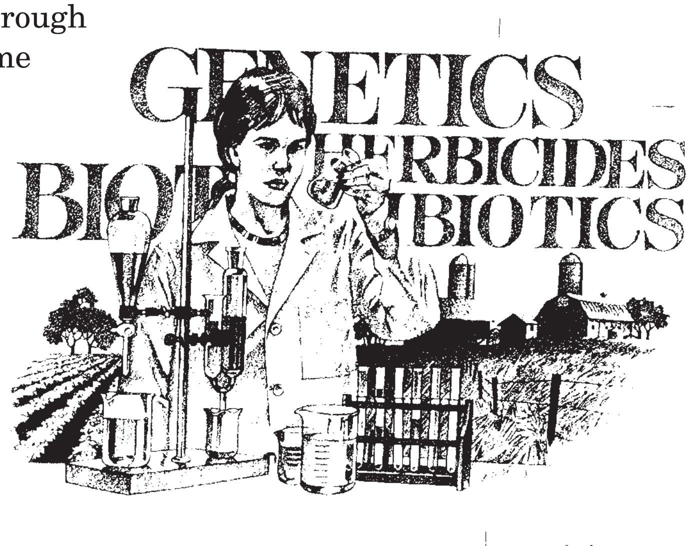
Biotechnology and genetic engineering are the newest efforts to improve agricultural products. There are two basic goals of biotechnology: to improve desirable traits of plants and animals to make them more productive or to emphasize a particular characteristic such as leaner hogs or higher oil content corn; and to help the plant become more resistant to particular pesticides or, in some cases, even produce substances toxic to insect pests.

The success of *Bt*

Bacillus thuringiensis (Bt) is a bacterium found naturally in soil. Since 1911, it has been known that a protein crystal produced by the bacterium killed certain types of moth larvae. It was first officially registered as a biopesticide in the U.S. in 1961. Bt is not known to be harmful to people or most other animals.

Different strains of Bt attack different types of caterpillars and are quite selective in their host target. When a caterpillar eats the bacterium on plant material, the protein crystal causes cells in the caterpillar's digestive system to collapse. The caterpillar soon dies from starvation.

Unfortunately, Bt must be available exactly when the caterpillar starts to eat. But since Bt is damaged by sunlight or can be washed off by rain, it is difficult to apply it to the plant at exactly the right time. And some insects, such as corn borers, burrow to the inside of the plant. Bt has been found to be effective on other plants and animals, especially spruce budworms, gypsy moths, cabbage worms, and some cotton and tobacco pests. Fairly recently, through genetic engineering, it has also become useful for corn.



Through special bio-engineering techniques, scientists have made corn strains that actually produce the Bt protein in the corn plant itself. As the corn grows, is naturally resistant to the European corn borer larvae. As the larvae feeds, it ingests the Bt protein crystal and soon starves. Bt does not have to be applied and doesn't wash off or break down since the protection is now provided within the corn plant.

A similar program is researching the Asian corn borer using a different strain of Bt. In Indonesia, it is estimated that this single insect pest reduces corn yields 40 percent. Successful bio-engineering may help feed a growing world population.

Seeking solutions

Integrated Farm Management

Many of the farming practices described in this booklet are part of what is known as Integrated Farm Management (IFM). IFM uses the best management practices to control crop pests, use fewer pesticides, and save time and money.

Weed management is accomplished by scouting for weeds and keeping careful records to map out problem areas. Mechanical and biological control is used when possible and herbicides used only when necessary.

Pesticide use is reduced. Scouting for insects is done on a weekly basis and treatment occurs only when the economic threshold is reached where damage or yield reduction may cost more than the cost of treatment.

Soils are tested for nutrients such as nitrogen and phosphorus, and animal manures are applied at levels that are optimal for plant growth. Nutrients are not over-applied to avoid contaminating water supplies.

One of the most effective methods of control is crop rotation. Some plants such as beans and alfalfa actually add nitrogen back into the soil. Cover crops such as grasses and forage crops can be tilled under to improve soil structure and add nutrients. By alternating crops, the insect that feeds on a particular food source is removed for one to several years, breaking up reproductive cycles. This practice also controls weeds that may harbor insects and improves soil fertility.

Biological control is also used. One particularly effective control is the bacterium *Bacillus thuringiensis*. It is used primarily against caterpillar pests such as cutworms. Although it may take some time to kill the caterpillar, the caterpillar will not feed on the crop.

However, the most efficient and profitable method of farming is the high-management, low-input method. This involves the best management practices previously described to scout fields on a regular basis for weed or insect problems. Rather than automatically spraying, pesticides are used only when absolutely necessary.

Sustainable solutions for the future

As we have seen, there isn't one easy solution. Rather there are trade-offs every step of the way. Reduced chemical control of weeds requires more mechanical control. More mechanical control uses more trips across the field which in turn uses more fuel for equipment and can potentially lead to increased soil erosion and soil compaction. Planting cover crops, often called green manure, adds natural soil fertility and provides wildlife cover but takes land out of production and reduces profits for the farmer. Animal manure can be an important addition to help soil fertility and increase production, but excessive quantities may cause water and air pollution problems. In nearly all cases, there are short-term and long-term benefits and potential problems.

During the past decades, Iowans have realized that intensive agricultural practices may lead to environmental problems. Fortunately, Iowans have reacted with concern and sought solutions to these tough problems. Because of the concern of farmers, citizens, and legislators, the future looks promising to strike a balance that will allow Iowa farmers to compete and profit economically and still provide a safer environment.

In 1980, Iowa passed legislation commonly referred to as the Iowa Soil 2000 program. This legislation requires every farm to develop a soil erosion management plan. Working at the local level, soil conservation district commissioners and farmers determine a plan that will keep soil loss within acceptable limits. This program will help ensure the long-term productivity of Iowa soils and safety of Iowa's waters.

In 1987, the Iowa State Legislature passed the Groundwater Protection Act to ensure clean water in the state. This act protects Iowa's groundwater supplies from contamination from hazardous chemicals, pesticides, and other pollutants.

More and more farmers realize that many modern farming practices are not always cost-effective. Ever-increasing inputs of fuel, energy-derived fertilizers, and expensive herbicides and insecticides add up to marginally-profitable operations.

Many of the newer agricultural practices attempt to deal effectively with tough problems. In agriculture, the common link is good management and crop diversity, achieved through effective crop rotation and interplanting several crops. This avoids pest problems encountered with monoculture farming, while maintaining natural soil fertility.

Beyond economics, the payoff is our quality of life. Establishing filterstrips of native grasses and trees and creating woodlots and other habitats attract and provide cover and food for native wildlife that has been squeezed out by modern farm practices.

Today, many farmers find themselves at a crossroads. What legacy will they leave to their children and grandchildren? Many are choosing sustainable, more natural agricultural practices rather than synthetic and chemical dependency. And that's a legacy that benefits not only farmers, but all Iowans.

Useful resources

Iowa State University Extension Publications
http://www.exnet.iastate.edu/Pages/pubs/
Hundreds of bulletins and brochures dealing with sustainable agriculture, farm practices, pest management, and more.

Conservation Technology Information Center
http://www.ctic.purdue.edu/
Includes: Crop Residue Maps; Ag Management Practices; Best Management Practices; Know Your Watershed (interactive clickable maps); Urban Management Practices; News and Latest Information

ESCAN: The Environment. Science, Communication, Activities and News
http://www.public.iastate.edu/~jlmc/escan/ESCANHome.html
Includes sections on Iowa: Prairies; Woodlands; Wetlands; Rivers, Lakes and Streams
(Many of the booklets in the Iowa Association of Naturalist series are the basis for this on-line service.)

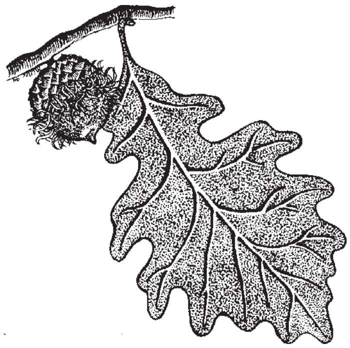
Internet Resources for Environmental Journalists
http://www.sej.org/env_home.htm
Links page to hundreds of resources on environmental issues including agriculture; A searchable database for specific topics.

Planning for the Future. Pest Management in Iowa (Publication IFM 17; June 1996)
Iowa State University Extension
Ames, IA 50011
90 page booklet. Technical in content.

Sustainable Agriculture and Wildlife: Piecing Together a Habitat Puzzle. A Curriculum for Teachers (# EDC-3; December 1992)
Iowa State University Wildlife Extension, Ames, IA 50011
Curriculum guide for teachers

Sustainable Agriculture Manager (SAM). A computer Program for Agricultural Education in Secondary Schools
Department of Agricultural Education and Studies, Iowa State University, Ames, IA 50011
Computer Program on disk and accompanying 3-ring binder of curriculum materials and activities

Earthworm Empire: The Living Soil (175 page book)
Eldon Weber, Iowa State University, Ames, IA 50011
Cross disciplinary look at soils including history, science, agriculture, music, and literature with hands-on problem solving activities for teachers of grades 6-12.



Iowa Association of Naturalists

The Iowa Association of Naturalists (IAN) is a nonprofit organization of people interested in promoting the development of skills and education within the art of interpreting the natural and cultural environment. IAN was founded in 1978 and may be contacted by writing the Conservation Education Center, 2473 160th Rd., Guthrie Center, IA 50115, 515/747-8383.

Iowa Environmental Issues Series

In order to make wise decisions, people need a basic understanding of the factors involved in current environmental issues. They need to understand how their lifestyle is tied to these issues and how changes in lifestyle can impact the environment. The Iowa Association of Naturalists has created this series of booklets to offer a basic understandable overview of Iowa environmental issues. These booklets will assist educators in teaching students about topics that affect the Iowa environment. The seven booklets in this series are:

Iowa Habitat Loss and Disappearing Wildlife (IAN-101)
Iowa Air Pollution (IAN-102)
Iowa Water Pollution (IAN-103)
Iowa Agricultural Practices and the Environment (IAN-104)
People, Communities, and Their Iowa Environment (IAN-105)
Energy In Iowa (IAN-106)
Iowa Waste Management (IAN-107)

The *Iowa Environmental Issues Series* is published by IAN with major funding from the REAP Conservation Education Board (September 1998).

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Design and Layout: Ames Best Communications
Published by: Iowa Association of Naturalists

Iowa Agricultural Practices and the Environment is one in a series of seven booklets that are part of the *Iowa Environmental Issues Series*. The booklets in the series include:

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People, Communities, and Their Iowa Environment	(IAN-105)
Energy In Iowa	(IAN-106)
Iowa Waste Management	(IAN-107)

The Iowa Association of Naturalists also has produced five other booklet series that provide readers with a clear, understandable overview of topics concerning the Iowa environment and conservation. The booklets included in each of the other five series are listed below.

Iowa Wildlife Series

Iowa Mammals	(IAN-601)
Iowa Winter Birds	(IAN-602)
Iowa Nesting Birds	(IAN-603)
Iowa Reptiles and Amphibians	(IAN-604)
Iowa Fish	(IAN-605)
Iowa Insects and Other Invertebrates	(IAN-606)

Iowa's Natural Resource Heritage

Changing Land Use and Values	(IAN 501)
Famous Iowa Conservationists	(IAN 502)
Iowa's Environmental Laws	(IAN 503)

Iowa Wildlife and People

Iowa Wildlife Management	(IAN-401)
Keeping Iowa Wildlife Wild	(IAN-402)
Misconceptions About Iowa Wildlife	(IAN-403)
State Symbols of Iowa	(IAN-404)
Iowa Food Webs and Other Interrelationships	(IAN-405)
Natural Cycles In Iowa	(IAN-406)
Iowa Biodiversity	(IAN-407)
Adapting To Iowa	(IAN-408)

Iowa Plants

Iowa's Spring Wildflowers	(IAN-301)
Iowa's Summer and Fall Wildflowers	(IAN-302)
Benefits and Dangers of Iowa Plants	(IAN-303)
Iowa's Trees	(IAN-304)
Seeds, Nuts, and Fruits of Iowa Plants	(IAN-305)
Iowa's Mushrooms and Other Nonflowering Plants	(IAN-306)
Iowa's Shrubs and Vines	(IAN-307)

Iowa's Biological Communities

Iowa's Biological Communities	(IAN-201)
Iowa Woodlands	(IAN-202)
Iowa Prairies	(IAN-203)
Iowa Wetlands	(IAN-204)
Iowa Waterways	(IAN-205)

These booklets are available to download via PDF on the ISU Extension Store:

store.extension.iastate.edu

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