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Perennial Weed Biology and Management

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Contents

Jed Colquhoun,
Extension weed specialist,
Oregon State University

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Perennial plants live at least 2 years; some live for decades. Most perennial weeds reproduce both by seeds and by the spread of energy-storing vegetative parts, such as roots or tubers. This combination of reproductive mechanisms makes management of perennial weeds difficult. By understanding how perennial weeds reproduce and spread, you will be better able to plan a successful weed management strategy.

Reproduction of perennial weeds

Reproduction by seed

Usually perennial weeds first infest an area by seed. Reproduction by seed is called sexual reproduction. It requires the fertilization of an egg by sperm, usually in the form of pollen. Pollination of the egg in a flower results in seed that is capable of producing a new plant.

Seed production varies greatly among and within weed species in part due to environmental variability between years, competition from neighboring plants, and genetic variability. For example, while Canada thistle has been observed to produce as few as 680 seeds per plant, curly dock often produces more than 30,000 seeds per plant.

Vegetative reproduction

The ability to reproduce vegetatively is a unique characteristic that promotes the survival of a perennial species. In vegetative (asexual) reproduction, a new plant develops from a vegetative organ such as a stem, root, or leaf. Several modifications of these organs are common in perennial weeds, such as underground stems (rhizomes), above-ground stems (stolons), bulbs, corms, and tubers.

Although vegetative structures generally do not survive as long in the soil as do seeds, very small structures can result in a new plant. Canada thistle, for example, can produce a new plant from as small as a ¼-inch section of root.

Figure 1.—Yellow nutsedge (*Cyperus esculentus*).

Vegetative reproduction can be as prolific as seed production. Yellow nutsedge (*Cyperus esculentus*, Figure 1) has been reported to produce more than 1,900 new plants and more than 6,800 tubers in 1 year. Whitetop (*Cardaria draba*) has been observed to spread over an area greater than 10 feet in diameter and produce more than 450 shoots in its first year.

Reproductive strategies

Perennial plants are classified based on their reproductive strategy as simple or creeping perennials.

Simple perennials. Simple perennials spread by seed and have no natural way to spread vegetatively. However, vegetative structures can

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Figure 2.—Common dandelion (*Taraxacum officinale*).

Figure 3.—Buckhorn plantain (*Plantago lanceolata*).

Figure 4.—Broadleaf plantain (*Plantago major*).

produce new plants when cut or injured. Curly dock (*Rumex crispus*), for example, can generate a new plant from a very small piece of cut root.

Roots of simple perennials often are large and fleshy. Common dandelion (*Taraxacum officinale*, Figure 2), buckhorn plantain (*Plantago lanceolata*, Figure 3), and broadleaf plantain (*Plantago major*, Figure 4) are examples of simple perennials.

Creeping perennials. Creeping perennials reproduce by creeping roots, rhizomes, or stolons. They often also reproduce by seed, and therefore are the most difficult perennial weeds to manage. Canada thistle (*Cirsium arvense*, Figure 5, page 4), quackgrass (*Elytrigia repens*, Figure 6, page 4), johnsongrass (*Sorghum halepense*), bermudagrass (*Cynodon dactylon*, Figure 7, page 4), and field bindweed (*Convolvulus arvensis*, Figure 8, page 6) are examples of creeping perennials.

Spread of perennial weeds

Seed dispersal

Seeds have no way to move on their own, but they are excellent travelers. Their ability to spread and remain viable in the soil for years makes eradication nearly impossible. Weed seeds are dispersed by:

- Wind
- Water
- Animals, including humans
- Machinery
- Crop seed, animal feed, hay, and straw

Wind. Many seeds are well adapted to wind travel. Cottony coverings and parachute-like structures allow seeds to float with the wind. Examples of wind-dispersed seeds include common milkweed (*Asclepias syriaca*), common dandelion, Canada thistle, and perennial sowthistle (*Sonchus arvensis*).

Water. Weed seed often moves with surface water runoff into irrigation water and ponds, where it is carried to other fields. Weeds growing in ditch banks along irrigation canals and ponds are the major source of weed seed contamination of irrigation water.

Weed seed often remains viable in water for several years, creating a “floating seedbank” and allowing weeds

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to disperse over large areas in moving water. Field bindweed seed, for example, remains over 50 percent viable after being submerged in water for more than 4 years.

Some seeds have special adaptations that aid in water travel. The seedpod of curly dock, for example, is equipped with pontoons that carry the floating seed.

Animals. Several weed species produce seeds with barbs, hooks, spines, and rasps that cling to the fur of animals or to clothing and then can be dispersed long distances. Common cocklebur (*Xanthium strumarium*) produces seeds that adhere tightly to fur or cloth.

Weed seed often is ingested and passed through the digestive tracts of animals. Animal droppings provide an ideal nutrient and moisture environment for weed germination. While only a small percentage of the seed remains viable after exposure to an animal's digestive enzymes, keep in mind that a single weed might produce thousands of seeds!

Machinery. Weed seeds often are dispersed by tillage and harvesting equipment. Seeds move from field to field on the soil that sticks to tractor tires, and vegetative structures often travel on tillage and cultivation equipment. Disc-type cultivation equipment is less likely to drag vegetative plant parts than are shovels or sweeps.

Crop seed, animal feed, hay, and straw. Weeds probably are spread more commonly during the seeding of a new crop or in animal feed and bedding than by any other method. Seed labels often indicate a tiny percentage of weed seed, but consider this example. If a legume seed contains 0.001 percent dodder (a parasitic annual; *Cuscuta campestris*) seed by weight, there will be eight dodder seeds per pound of legume seed. If the legume is seeded at 20 lb/A, 160 dodder seeds will be sown per acre. Despite an extremely low dodder seed percentage by weight, the small size of the seed, combined with rapid early-season growth, could result in an infested legume field within a single season.

The weed seedbank and seed dormancy

Not only can weed seed and vegetative tissue travel great distances to infest new fields, but once in the soil, weed seed can remain viable for many years. In any given location, the weed seedbank contains a vast library of weed species and ecotypes that are adapted to a great range of environmental conditions and are ready to germinate given the proper signal. A Minnesota study reported that a square foot of soil, 6 inches deep, contained from 98 to 3,068 viable weed seeds. This represents between 4.3 million and 133 million viable seeds per acre.

The amount of time that a seed is capable of producing a seedling, or its viability, varies with weed species. In the extreme, lotus (*Nelumbo nucifera*) seeds found in a Manchurian lakebed were viable after 1,000 years. More commonly, the annual plant jimsonweed (*Datura stramonium*) has over a 90 percent germination rate after 40 years in the soil.

Additionally, many weed seeds remain dormant in the soil until the conditions for germination and survival are appropriate for that particular seed. Dormancy is the seed's resting stage and is the primary method of weed seed dispersal in time. Some weed seeds have seed coats that are impermeable to water and/or oxygen or are mechanically resistant. Others contain immature embryos or have a waiting period (called after-ripening) that must be completed before the seed will germinate. Seed dormancy is affected by environmental conditions, including temperature, light, oxygen, and the presence of chemical inhibitors (see "Allelopathy," page 5).

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Figure 5.—Canada thistle (*Cirsium arvense*).

Figure 6.—Quackgrass (*Elytrigia repens*).

Figure 7.—Bermudagrass (*Cynodon dactylon*).

Seedling establishment—the perennial advantage

Perennial weed seedlings are relatively easy to control with timely herbicides and cultivation. However, by 3 to 6 weeks after seed germination, most perennial weeds have begun to develop an extensive root structure that is capable of storing energy reserves. After this point, perennial weed control is a tedious process of depleting these stored energy reserves via a combination of tactics.

Root growth is rapid in the first year after seed germination. Roots of Canada thistle can penetrate 3 to 6 feet deep in the soil in the first year. By 14 weeks after emergence, one johnsongrass plant was observed to produce more than 85 feet of rhizomes.

Perennial weed interference with crops

Competition for resources

Weed and crop plants typically compete for three resources: water, nutrients, and light.

Water. Water often is the primary factor that limits crop production. Weeds often require more water than crops and are more efficient at capturing and using available moisture. Rooting depth and feeding area per plant often are greater for weeds than crops. For example, the annual barnyardgrass (*Echinochloa crus-galli*, Figure 9, page 6) requires more than 80 gallons of water to produce 1 pound of dry matter, compared to 60 gallons to produce 1 pound of wheat dry matter.

Nutrients. Weed and crop plants compete for limited supplies of nitrogen, phosphorus, and potassium. Although the quantity of nutrients required by weeds and crops is similar at the same stage of growth, weeds are more successful in obtaining nutrients. As the superior competitor accumulates nutrients, it uses them to build larger, more expansive root systems to acquire additional nutrients and water, and to build a larger leaf canopy to capture light. Therefore, competition for a single resource has broad implications for the complex competition for other limiting resources. In general, the

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more competitive plant is the first to capture resources in quantities necessary for growth and to use them most efficiently.

Light. While nutrient and water resources can be captured by plants and stored for later use, light must be used as it is captured. Light competition is most severe when nutrients and water are supplied in excess, resulting in large leaf canopies. Plants that are good competitors for light have a leaf arrangement in which one leaf does not shade another and a tall or erect stem that allows them to intercept light over the canopy of neighboring plants.

Allelopathy

Allelopathy is a form of plant interference that occurs when one plant, through living or dead tissue, produces a chemical that interferes with the growth of another plant. Quackgrass, nutsedges, and johnsongrass are examples of perennial weeds that produce allelopathic chemicals that might inhibit crop growth. For example, yellow nutsedge reduces corn growth.

Chemical inhibitors can be produced and released during the growing season or released during plant decomposition. In an effect similar to herbicide carryover, these chemicals might remain active in the soil and suppress future crop germination and seedling emergence. Allellopathic chemicals often are produced in response to stress or competition from neighboring plants, and therefore add to the complexity of competition for limited resources.

Perennial weed management

Prevention

The most basic and effective of all methods to control perennial weeds is prevention. As discussed earlier, there are several means of weed seed dispersal, most of which can be prevented. Ensuring clean crop seed, animal feed, and hay is the most important measure in preventing seed dispersal. Other methods of prevention include cleaning field machinery and harvest equipment when moving between fields, proper long-term manure storage to reduce seed viability after passing through animals' digestive tracts, and maintenance of weed-free irrigation water.

Crop rotation can be another effective method to prevent the establishment of perennial weeds. The most effective crop rotations for this purpose include not only crops that compete well with perennial weeds, but also those that allow the use of herbicides to control perennial seedlings.

Mechanical weed control

Cultivation, when combined with other management tactics, can be used to control seedlings before energy-storing vegetative tissue has accumulated. Mechanical control no longer is effective after energy has been stored in underground vegetative tissue. In fact, cultivation of established perennials can spread weeds by cutting roots and moving them to new areas.

Perennial weeds are more common in reduced-tillage fields, where there is little soil disturbance to disrupt the development of below-ground storage organs. Once perennial weeds are established in reduced-tillage fields, cultivation is ineffective and might increase the spread of vegetative roots.

In pasture and forage crops, frequent mowing or cutting can prevent weed seed production and reduce the amount of energy stored in below-ground structures. Most important, maintenance of a vigorous crop stand through proper fertility and water management, seeding density, and variety selection will allow the competitive ability of the crop to suppress perennial weed growth. This simple "hands-off" approach requires little additional input or management, but can greatly reduce weed seed production and root growth.

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Figure 8.—Field bindweed (*Convolvulus arvensis*).

Figure 9.—Barnyardgrass (*Echinochloa crus-galli*).

Chemical weed control

Perennial weed control with herbicides must be repeated for 2 to 3 years and combined with other management tactics such as mowing. The key is to get the herbicide into the roots. Herbicide activity relies on foliar absorption and transport from the leaves to the root system. Young leaves move nutrients from the root in an upward, above-ground direction, while more mature leaves transport photosynthetic products to the root system for storage. Thus, the most effective herbicide activity occurs as the product is transported to the roots with the products of photosynthesis.

Herbicides are most effective on perennial weeds in the early fall, when weeds are transporting energy to the roots before winter dormancy. Treatment just before and during flower bud initiation also is effective, as the herbicide will be carried with photosynthetic products to the roots. To ensure the presence of sufficient mature foliage, apply postemergent herbicides either 1 to 2 weeks before cultivation or mowing, or after weed regrowth is at least 8 inches tall.

Herbicide control is least effective during times of rapid foliar growth, such as in the early spring, when energy that was stored in roots for the winter is transported above-ground to support new growth, or during a period of rapid regrowth after mowing.

Current herbicide recommendations for perennial weed control are included in the *Pacific Northwest Weed Management Handbook*. Before using any product, be sure to read the updated label provided by the manufacturer. No herbicide may be used on a crop or site for which it is not labeled, but the absence of a particular perennial weed on the label does not prevent the use of the herbicide on that weed.

Biological weed control

Biological control is the action of parasites, predators, or pathogens in maintaining an undesired organism's population at a lower average density than otherwise would occur. The goal is not to eradicate the pest, but to reduce the population density to a level below that which causes economic damage.

Biological control, when working ideally, is self-perpetuating and therefore economical after the initial release of the control agent. Once the organism is released, it maintains a population level appropriate to the amount of available food in the form of the undesired weed.

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Biological control of perennial weeds has had limited success to date for several reasons:

- Successful survival of the control agent sometimes is a problem.
- Biological control agents can be used only if they feed strictly on the target weed. Unfortunately, potential biological control agents often cannot distinguish weedy species from their valuable relatives.
- Weeds must be controlled early in the growing season, prior to reproduction or crop yield reduction.

Biological control is a slow process, and results are not guaranteed. Therefore, it is used most appropriately as a component of an integrated weed management system that relies on multiple tactics for perennial weed control. For example, the fungus *Concholiobolus lunatus* kills barnyardgrass seedlings with fewer than two leaves, but growth of larger plants is only slowed and plants recover. However, when the fungus is combined with a sublethal dose of atrazine (a dose that injures but does not kill the barnyardgrass), larger barnyardgrass plants can be controlled better than when atrazine is used alone.

Integrated weed management

As the previous example demonstrates, management of perennial weeds is most successful when multiple tactics are employed, such as the combination of chemical, mechanical, and cultural control. The use of multiple modes of action enhances control and might prevent or delay resistance to a single control tactic, such as herbicides. Integrated weed management, when combined with prevention and control of weeds outside of crop production areas, provides the best long-term management of perennial weeds.

References

Control of Perennial Broadleaf Weeds in Missouri Field Crops. 1993. M.S. DeFelice and A. Kendig. Agricultural publication G4875. University of Missouri, Columbia.

Handbook of Weed Management Systems. 1995. E.A. Smith, ed. New York, NY: Marcel Dekker, Inc. 741 pp.

Fundamentals of Weed Science. 1999. R.L. Zimdahl. San Diego, CA: Academic Press. 556 pp.

Perennial Weeds: Characteristics and Identification of Selected Herbaceous Species. 1999. W.P. Anderson. Ames, IA: Iowa State Univ. Press. 228 pp.

Principles in Weed Management. 1997. R.J. Aldrich. Ames, IA: Iowa State Univ. Press. 455 pp.

Weed Ecology: Implications for Management. 1997. S.R. Radosevich, J.S. Holt, and C. Ghersa. New York, NY: J. Wiley and Sons, Inc. 589 pp.

Weed Science: Principles and Practices. 1991. F.M. Ashton and T.J. Monaco. New York, NY: J. Wiley and Sons, Inc. 466 pp.

Use herbicides safely!

- Wear protective clothing and safety devices as recommended on the label. Bathe or shower after each use.
- Read the herbicide label—even if you've used the product before. Follow closely the instructions on the label (and any other directions you have).
- Be cautious when you apply herbicides. Know your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from herbicide use.

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What makes a perennial weed a strong competitor?

In general, competitive plants have:

- Dormancy that is broken when environmental conditions favor survival and reproduction
- Rapid early growth and expansion of a leaf canopy to intercept light
- An efficient photosynthetic system to convert light into energy
- Early and fast root penetration of a large area for uptake of nutrients and water
- High root density and many long root hairs to contact available resources
- Efficient uptake and processing of nutrients and water into building blocks of growth
- The ability to reproduce early in their life cycle
- Prolific seed production with minimal energy invested
- The ability to absorb resources in excess, as well as the ability to tolerate low levels of resources
- Chemical inhibitors that interfere with the growth of neighboring plants (allelopathy)
- High genetic and environmental adaptability (able to reproduce in various environmental conditions)
- The ability to develop resistance or tolerance to control measures

Unfortunately, perennial weeds exhibit many, or in some cases, all of these competitive characteristics. As a result, perennial weeds can be very persistent, and they require a management system that integrates the repeated and timely use of several methods.

For more information

A wide variety of publications related to identification and management of specific weeds is available from the OSU Extension Service. Visit our Web site **(eesc.orst.edu)** for a list of titles and ordering information. Or call 1-541-737-2513 to request a catalog.

The *Pacific Northwest Weed* ***Management*** *Handbook* is available for $25 from:

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