Weed Prevention
(For Grain & Livestock Operations)

Plant residues and weed seeds can accumulate on flat equipment surfaces, such as this mower, and then be transported within and between fields. (Photo credit: Michael Flessner, Virginia Tech)

Overview

At a workshop on herbicide resistance, a Pennsylvania grower once said, "**The cheapest way to control Palmer amaranth is to never get it in the first place.**" Prevention is the foundation of all integrated weed management approaches, and is the most cost-effective weed management that a grower can implement. However, it is often not considered a priority until after a new species is identified in a field.

Stopping weeds from producing viable seed on-farm is a foundation of prevention. If seeds are not produced, the weed is not capable of entering the seedbank and producing new plants the next season. But it is also important to consider all the sources that new seeds can enter the field. Weed seeds have many routes that they can enter the soil; for example, directly as they are blown in from adjacent fields or deposited along with mud from dirty tires.

Overview (cont.)

Once a weed is present in the seedbank, stopping seed production in future seasons is the most effective method of stopping its spread. Species with high seed production, or with special structures to enhance spread, can rapidly spread in a field and it is difficult to keep an infestation localized.

Weed seeds can be dispersed from field to field and over long distances by environmental and ecological processes such as wind and water, or by human activities. Environmental and ecological processes are difficult to manage. For example, horseweed seeds have specialized structures (pappus, or tufts of hair) that allow them to be carried by the wind. Curly dock seeds have structures to assist floating on water surfaces and can therefore travel long distances through rivers and drainage channels.

Animals (wildlife and livestock) is another way seeds can be dispersed. Wildlife can carry seeds on their fur. Weeds like common cocklebur have bracts that can entangle in fur and be carried as the animal moves across the landscape. Or animals (including birds) can eat the seeds and then pass them through their digestive tract.

Seed movement by **environmental and ecological processes** can move seeds hundreds of miles; however, most seed movement is more localized (hundreds of feet to a few miles). So preventing weeds in field borders and along ditches from producing seeds can have a large impact on adjacent fields. It is important to scout fields regularly to detect those random plants that may have moved by environmental processes or wildlife and prevent them from producing seeds within the field.

Human activities are another source of weed seeds being introduced to a field. Seeds can be transported on farm equipment (on flat surfaces or in caked on mud), hitchhiking on boots or clothing, or in contaminated crop seed.

Some sources of weed seeds can result in only a few seeds, but if those seeds produce plants that are not effectively controlled the next season, they can quickly spread throughout a field. Other sources can contribute a large number of weed seeds. After a combine had been cleaned quickly with compressed air, an additional 35,000 weed seeds were recovered after a thorough cleaning and that did not include the 3 million seeds recovered from the rock trap. When surveying dairy manure, one sample had 400,000 seeds per ton of manure.

Risk of moving weed seeds with plant material, plant by-products, or manure requires that the weeds have reached reproductive stage and viable seeds are present. However, anytime mud or soil is moved from field to field, weed seeds can be transported, regardless of the time of year.

Many people consider preventive measures to be an inconvenience, but a small effort up front can pay big dividends for years to come. The sections to follow outline the many places you can scrutinize your operation for weed seed spread and prevention.

1. Ensure weed-free inputs to prevent weed seeds from entering the field

Prevention is the foundation of weed management. Preventative weed management means stopping weeds from entering a field, or once present, stopping the spread within a field and between fields. Eliminating seed production should be the goal of any weed management program for a troublesome species.

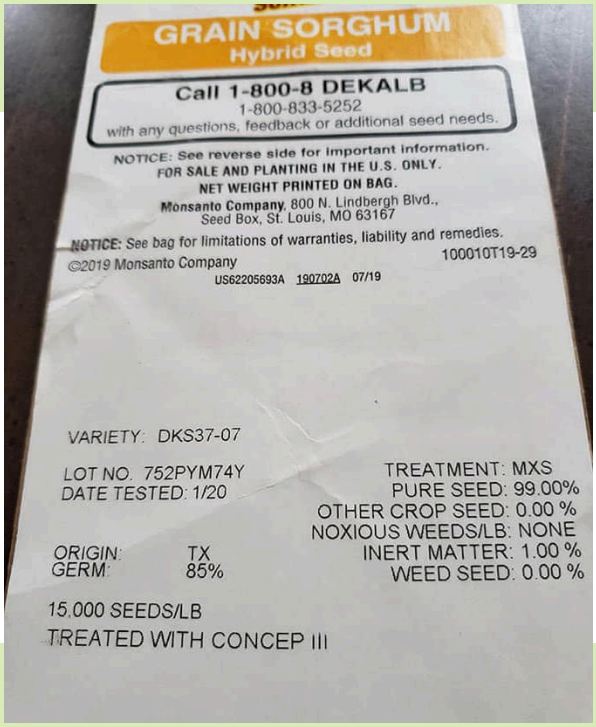
A good weed management program will help manage weeds because the plants are controlled before they complete their life cycles and produce seeds. To achieve a good foundational IWM program, see our section on best management practices: https://growiwm.org/a-b-cs-of-integrated-weed-management/.

Purchase weed-free inputs to prevent the introduction of weeds seeds, including:

- Seeds (grain crop and cover crop)
- Manure
- Hay/bales
- Compost/soil amendments

SEEDS

Farmers can decrease or prevent the entry of new weeds by purchasing and using selecting weed-free crop seeds. Crop seed has the potential to be contaminated with weed seeds. This includes grain crop seed, cover crop seed, and conservation seed mixes. In some cases, herbicide-resistant weed seeds have even been transported over several states in this way.



Grain sorghum certified seed. Photo credit: Claudio Rubione, GROW.

- Buy certified seeds.
- If saving seeds, be sure the fields where the seed is produced are weed-free at harvest time.

1. Ensure weed-free inputs to prevent weed seeds from entering the field (cont.)

HAY/BALES

Baling is a common practice, whether it is baling forages for hay or baling the remaining crop residue for animal feed. Baling will also gather any weed seeds present at haying time. Over 19,000 wild oat seeds have been found in a single straw bale. Baling equipment can also spread weed seeds to different fields. Furthermore, weed seeds in hay bales can be spread through the manure after livestock consume the hay.

Bale hay from weed-free fields or cut hay before weeds have produced seeds. Photo credit: Bill Johnson, Purdue University

- Avoid baling weeds after they have produced seeds.
- Thoroughly clean balers between fields.
- If hay or bales contain weed seeds, store them separately from weed-free ones and carefully identify them.
- If contaminated bales are used to feed livestock, isolate livestock for 3 to 4 days to avoid spreading weed seeds.
- Avoid purchasing feed or hay from areas where troublesome species are common.
- If weed seeds of troublesome species might be present, hay should be fed while animals are contained in paddocks where emerging weeds can be easily scouted.

MANURE/COMPOST

Manure is an important soil amendment, providing nutrients and organic matter. But, manure may contain viable weed seed that can be spread unto fields. A survey of dairy manure in New York found an average of 75,000 viable weed seeds per ton (Mt. Pleasant and Schlather, 1994). A Nebraska survey studied the top ten challenges to using manure in cropping systems and found that 48% of growers are concerned about weed seeds coming from manure.

Managing on farm manure will help to avoid unknown resources, thus preventing weed seed dissemination. Photo credit: Claudio Rubione, GROW

1. Ensure weed-free inputs to prevent weed seeds from entering the field (cont.)

MANURE/COMPOST (cont.)

A Tulare County, CA report shows that almost 22,000 viable weed seeds were collected per ton of manure. Ideally manure should be weed-free before spreading in the field, but there is not a simple way to test if manure is weed free or to buy certified manure. In the same study, composting the manure decreased viable seeds to less than 2,000 per ton of composted manure. The Nebraska study also shows that an important factor to help decrease the amount of viable weed seeds is moisture – weeds such as pigweeds, morninglories, cocklebur, foxtail, velvetleafs, and shattercane were killed when managed at 35% moisture when compared to dry compost.

- Avoid buying manure and hiring manure spreaders from unknown sources.
- Scout early and often in fields that potentially received contaminated manure.
- Either ensile or compost manure: For compost, create large, dense, hot piles and turn them regularly to prevent weed seeds being viable. Ideally, the compost pile needs to reach 160F and 50% moisture for four days. Compost needs to be turned to ensure all seeds are inside the pile where they will be exposed to this temperature.
- If doubt persists, collect manure samples from different layers and conduct a germination test with the help of an advisor whether necessary.
- Refer to your local extension agent to check for how long you need to compost or ensile manure as far as it might vary in different regions.
- Spread manure suspected of containing weeds seeds in fields that are more convenient to scout and treat.

Scout fields regularly for new weed infestations

What to do when new weeds are in the field:

- Identify the new species
- Prevent weedy patches from producing seeds
- Plan your harvest sequence in advance

Scout fields regularly to catch new weed infestations and work to prevent them from going to seed. Photo credit: Claudio Rubione, GROW.

2. Inspect and clean farming equipment

Planters, drills, air seeders and other planting tools

Planting green into a cover crop before it is terminated. Photo credit: Claudio Rubione, GROW

Planters, drills, air seeders, and other tools used for planting typically have many parts, such as disk openers, row cleaners, parallel arms, gauge wheels, closing wheels, and trash wheels. When it comes time for planting day, it is tempting to not stop to clean off/out planting equipment, particularly when moving from one field to another. However, it is better to prevent weed introductions into new fields than to need to manage newly-introduced weeds.

One simple preventative measure is to consider the role of planting equipment in introducing new weeds to fields and moving weeds among fields. Special care should be taken when using no-till planters, since they have more parts than a conventional planter on which weed seeds, stolons, and rhizomes could easily get stuck. Such propagules can then easily hitch a ride to new parts of a field and new fields on a farm. Taking a few minutes to remove these weed contaminants from planting machinery can prevent future headaches.

- Carefully check your planting equipment for weed hitch hikers before moving from one field to another.
- Use a power washer after each planting day when suitable.
- Store your planter under cover after washing and lubricating all the components, to prevent hidden weed seeds from lurking in wait for the next season. Weed seeds can live for a long time hidden in dry mud or plant debris.

2. Inspect and clean farming equipment (cont.)

Tillage and cultivation equipment

Tillage and cultivation equipment can spread weed seeds and move asexual propagules from perennial species, such as stolons and rhizomes. For example, a chisel plow was found to spread bermudagrass almost 20 feet from the original patch. Although it is easily overlooked, dirt and mud on equipment could contain weed seeds. If not cleaned, weed seeds can be spread from field to field and farm to farm.

Weed seeds and plant parts can be spread via field traffic. Field bindweed vines and rhizome fragments are dragged with a cultivator. Photo credit: Lynn Sosnoskie, Cornell University

Cleaning equipment is especially important after use in fields that contain difficult-to-control weeds as well as herbicide-resistant weeds. Make sure to thoroughly clean equipment before moving it to a new field to stop the spread of seeds. Additionally, if contractors are hired to perform tillage or other tasks, make sure their equipment is cleaned before use.

Risk of moving seeds with plant material requires that the weeds have reached reproductive stage and viable seeds are present. However, anytime mud or soil is moved from field to field, weed seeds can be transported, regardless of the time of the year.

- Clean any equipment when moving between fields.
- When using equipment in a field infested with perennial weeds, frequently remove asexual propagules from equipment to prevent spread within a field.
- Clean any previous owned purchased equipment before use.
- Ensure contractors clean their equipment before they arrive.
- A powerwasher is an efficient way to clean equipment and tires with dried on mud.
- Compressed air be used for dried, loose seeds and plant material.
- Equipment moving soil is a concern throughout the year, not just at harvest time.
- Use a power washer after each planting day when suitable.
- Weed seeds can live for a long time hidden in dry mud or plant debris.

2. Inspect and clean farming equipment (cont.)

Combines

Cleaned combine ready to be stored to wait for the upcoming harvest season. Photo credit: Claudio Rubione, GROW

Combines are a very efficient way that weeds, including herbicide-resistant weeds, are introduced to new fields. There are numerous examples of troublesome weed seeds being brought to a farm when a used combine was purchased. Factors that make combines a spreader of weed seeds: 1) they come in to contact weeds within a field to be harvested and after producing viable seed; 2) there are many small spaces within a combine where weed seeds can hide; and 3) combines are time-consuming to clean. The movement of a few seeds of a troublesome species into a new field can cause a serious and costly infestation within a couple of seasons.

- Know whether the combine entering a field has recently been in a field containing herbicide-resistant or troublesome weeds. If so, take the time needed to clean it.
- Harvest herbicide-resistant weed-infested fields last. Plan your harvest ahead of time.
- When purchasing a used combine, clean it thoroughly before use.
- Utilize an air compressor to remove weed seeds from the exposed surfaces of a combine.
- Clean the rock trap, as weed seeds and debris can be easily caught there.
- Open access doors to clean the grain auger and tailings processor with an air compressor.
- Once finished the steps above, deep clean the combine using straw bales or wood shavings as shown in this video: “The Straw Bale Methodology” for deep combine weed seed cleaning: https://growiwm.org/the-straw-bale-methodology-for-cleaning-weed-seeds-out-of-a-combine/.

2. Inspect and clean farming equipment (cont.)

Mowers

Mowers are frequently used in fields after weeds have set seed. Mowing pastures, corn stalks, and ditch banks late in the year are common examples. Consequently weed seeds and weed reproductive structures can be carried by the mower and spread within a field and from one field to another. Mowers are one of the easiest pieces of equipment to clean. A leaf blower or air compressor can be used to clean a mower.

Plant residues and weed seeds can accumulate on flat surfaces and can be transported within and between fields. Photo credit: Michael Flessner, Virginia Tech

- Prevent weed seed spread by cleaning mowers with a leaf blower or compressed air.
- Mow weed-free areas of a field first and weedy areas last to limit in-field spread.

Equipment tires

Tires, fenders, and wheel wells from trucks, trailers, tractors, combines, and other large equipment can hold large amounts of mud. The mud could contain weed seeds that will travel within fields or to other fields. Cleaning tires and other places where dirt and mud buildup before leaving each field is important to prevent weed spread.

Large machinery tires could carry large amounts of weed seeds when muddy. Photo credit: Claudio Rubione, GROW

- Power wash tractors, grain carts, trucks, tillage equipment, and combine tires and other places mud can accumulate after working muddy fields.
- Tires are picking up soil that contains weed seeds, so this is an issue throughout the year, not just as harvest time.
- Scout fields for new weeds frequently.

2. Inspect and clean farming equipment (cont.)

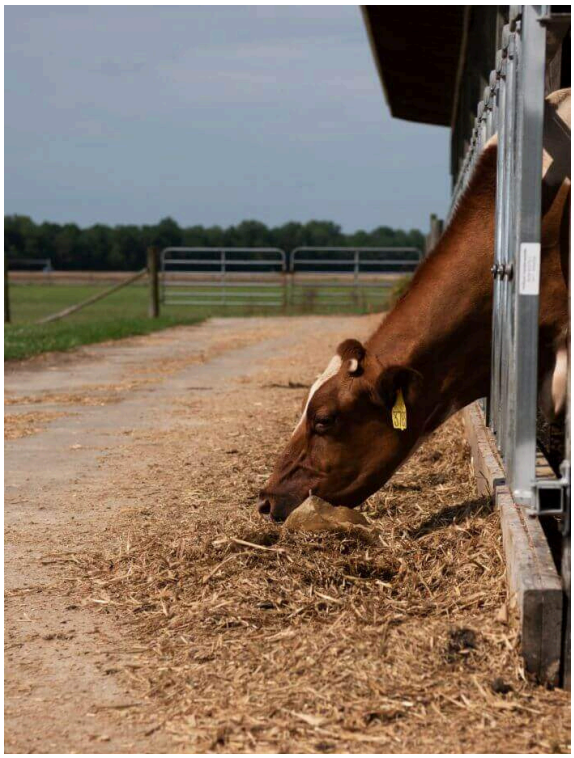
Storage and transportation of grain or forages

Weed-free grain eliminates weed seed dissemination as well as commanding better prices at the elevator. Photo credit: Claudio Rubione, GROW

When harvesting a weed contaminated field, consider separating weed seeds from the grain through mechanical cleaning or other means before storing the grain. When grain or forage bales are transported outside the farm, there is an increased chance for weed seeds to drop off or out of vehicles and be distributed across fields and to non-cultivated areas such as roadsides.

- Evaluate whether your harvested grains are contaminated with weed seeds. Weed seeds can raise a silo's temperature when their moisture content is higher than that of the grain.
- If grain is contaminated with weed seeds, store grain (commodities) in different silos or clean the grain with screens before storing.
- Clean the grain before moving it to a different farm or grain facility.
- Prevent seeds from being dispersed (blown from grain trailers) as grain or forage bales are transported off farm by covering the trailers.
- Do not spread tailings, screenings, or storage bin clean-out on fields.
- Avoid feeding livestock recently harvested commodities if you are not sure they are weed-free.

3. Prevent livestock from spreading weed seeds



Livestock ingest many weed seeds when grazing pastures or consuming hay, silage, or grain products. One study investigated the percentage of viable weed seeds that was recovered after passing through cattle, horses, hogs, and chicken. It found that 24% of weed seeds were still viable after passing through hogs, while 23% of weed seeds remained viable after passing through cattle, and 3% for chickens. When buying new livestock, it is sound practice to isolate the animals in a paddock until their digestive system has been cleared. It typically takes 10 to 12 days, depending on the kind of weed seeds eaten, for livestock to pass any weed seeds that they might have previously consumed.

Weeds seeds can spread when grazing animals eat infested forage or feed and then the manure containing the seeds is spread throughout a field. Photo credit: Claudio Rubione, GROW

- Isolate new livestock for 10-12 days before introducing them to your fields.
- Feed new livestock with weed-free inputs.

Some weed species have special structures which help livestock transport seeds in their fur. Common cocklebur and burdock are two species with burs adapted to cling unto fur.

Common cocklebur is an example of a weed species with structures that can get tangled in the fur of livestock or wildlife and can be moved from field to field. Photo credit: Claudio Rubione, GROW

- Maintain weed control for hay fields and pastures.
- Prevent weeds in non-cropped areas from producing seeds.
- Scout livestock fur for weed seeds.

3. Prevent livestock from spreading weed seeds (cont.)

If a mixer is used to feed livestock in the field, be sure that it contains weed-free components to prevent weed seed contamination. Photo credit: Claudio Rubione, GROW

Use weed-free feed for your livestock.

Since livestock manure is used as a soil amendment, it is important that the feed consumed by livestock is not a source of troublesome weed species. Scouting and keeping grain and forage fields free of weed seeds is important. It is important to purchase off-farm inputs that are free of weed seeds to prevent the spread of weeds through animals and into fields. And prevent the mixer from contaminating weed-free fields.

- Use weed-free feed ingredients.
- If mixed components are used in the fields, be sure grains and hay are weed-free and the mixer is well cleaned before and after use.

Prevent weed seed movement through contaminated crop byproducts

Cotton gin trash is the crop waste from the ginning process. It contains leaf fragments, lint, stems, immature cotton seeds, and weed seeds. Cotton gin trash and cottonseed hulls are usually used as soil amendments, bedding material for dairy cattle, or to feed livestock. A 2009 survey in Arkansas showed that gin trash contained seeds from several troublesome weed species including Palmer amaranth, redroot pigweed, johnsongrass, morningglory species, and a large number of grasses.

- Avoid using gin trash or grain screenings coming from areas with Palmer amaranth or other troublesome species.
- Compost gin trash, screenings, and tailings before spreading them onto fields; keeping in mind that compost needs to be managed properly to kill all the weed seeds.
- Scout fields where gin trash, screenings, or tailings were applied as soil amendment or where manure from livestock fed these by-products was spread.
- Act quickly to manage weeds if any troublesome weeds are detected.

Cotton gin trash contains leaf fragments, lint, immature cotton seeds, and weed seeds. Photo credit: Rodrigo Werle, University of Wisconsin

4. Waterfowl and weed seed dispersal

Photo credit: Claudio Rubione, GROW

Waterfowl have been documented to spread agronomically important weeds, including Palmer amaranth and waterhemp. Scientists have concluded that weed seeds can remain viable after passage through the digestive tract of mallard ducks and that Palmer amaranth, waterhemp, common lambsquarters, giant foxtail, and smartweed have the potential to be dispersed over long distances.

- Prevent weed seed set in non cropped areas such as ditches, fences, and corners.
- Prevent weed seed set within fields.

5. Minimize movement of weed seeds through water

Many weed seeds, due to their low density, are capable of floating on water until surface tension is broken including pigweeds, barnyardgrass, horseweed, foxtail, and lambsquarters. Some weed species' seeds, such as curly dock, have specific structures that allow seeds to be carried long distances by running water. Farmers who rely on surface water for irrigation could be increasing weed problems when using weed seed-infested irrigation water. Seed movement with drainage water can also contribute to the spread of weeds, as can the movement of water and weed seeds in the field when heavy rains run along furrows between crop rows or across fields.

Curly dock fruits have a papery 3-winged structure that surrounds the triangular achene. The structure helps fruits to float and spread seeds within the farm. Photo credit: Claudio Rubione, GROW

- Drainage structures should be altered such that the transport of weed seed across fields is discouraged. Use screening devices along irrigation laterals to help prevent weed seeds going to the field from irrigation water.
- Prevent weeds within the field from producing seeds.
- Prevent seed production of weeds along irrigation channels.

6. Manage field borders and ditches with different tactics than in the field

While weeds in the field in this photo are well-controlled to prevent yield loss, the ditch is managed to encourage the growth of native species that support pollinators at Harborview Farms, MD. (Photo credit: Claudio Rubione, GROW)

Uncropped areas, such as ditch banks and field margins, are typically not managed intensively and can be colonized by weeds. The weeds in these areas can be a source of weed infestation; wind, water, and wildlife are all ways seeds in these areas can be carried into a field. Surveys have shown that while ecological and environmental processes can move weeds for miles, most of the seed is deposited within only a few hundreds of feet from the source. While managing these areas may be difficult due to time constraints and additional costs, long-term benefits need to be considered.

- Maintain non-invasive plants in ditches to prevent erosion and limit establishment of weeds.
- Integrate ditch and border management into your farm weed management program.
- Stop weed seed production with mowing, herbicides, or other methods.

7. Prevent weed set

Weeds that escape season-long management need to be prevented from producing seeds. This can be achieved through mechanical and cultural tactics, such as hand weeding and tillage. If seeds return to the soil seedbank, then a continual weed infestation occurs. Plants that have produced viable seeds (within 2 to 3 weeks of flowering) need to be removed from the field.

- Control escaped weeds before they produce viable seeds.
- Seeds are viable within 2 to 3 weeks of flowering.
- If viable seeds are on the plant, physically remove the plant from the field
- Do not use tillage equipment to remove weedy patches after viable seeds have formed.

Palmer amaranth infestation in a cotton field which has expanded along the harvester path and between crop rows where heavy rainfall spread the seeds of the initial infestation. Photo credit: Jason Norsworthy, University of Arkansas

Authors, Resources and Citations

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