WEED MANAGEMENT

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Using an integrated weed management strategy will provide the best weed control in potatoes. Integrated weed management makes use of all the cultural, mechanical, chemical, and biological tools available for weed control, rather than relying on any single weed control tool.

Cultural Controls

Cultural practices, such as growing competitive crops in the potato rotation, timely cultivation, using agronomic practices that promote vigorous crop growth, and growing a competitive potato variety, all contribute to an effective weed management program. As mentioned previously, the potato crop itself does a good job of suppressing weed growth once the rows are closed. Maintaining vigorous plants that close the rows rapidly and remain healthy until vine kill will also contribute to good weed control.

Crop Rotation

A good crop rotation can disrupt weed life cycles and prevent certain species from becoming dominant. The more dissimilar the crop and weed life cycles are, the more difficult it is for a weed species to develop into a severe problem.

In a potato rotation, including a winter annual crop, such as winter wheat or winter canola in the rotation, can reduce populations of common summer annual weeds. Including a vigorous alfalfa crop in the rotation also may help reduce annual weed populations. Diverse crop rotations allow growers to use a variety of herbicides and tillage practices, which further reduces the likelihood of a particular weed species becoming dominant.

Cultivation

There are both advantages and disadvantages to using cultivation alone for weed control. On the positive side, properly timed cultivations can control early germinating annual weeds, as long as weeds are small (two to three true leaf stage) at the time of cultivation. Under certain conditions, cultivation may be less expensive than herbicide application, and wind is not an issue as it is with herbicide application.

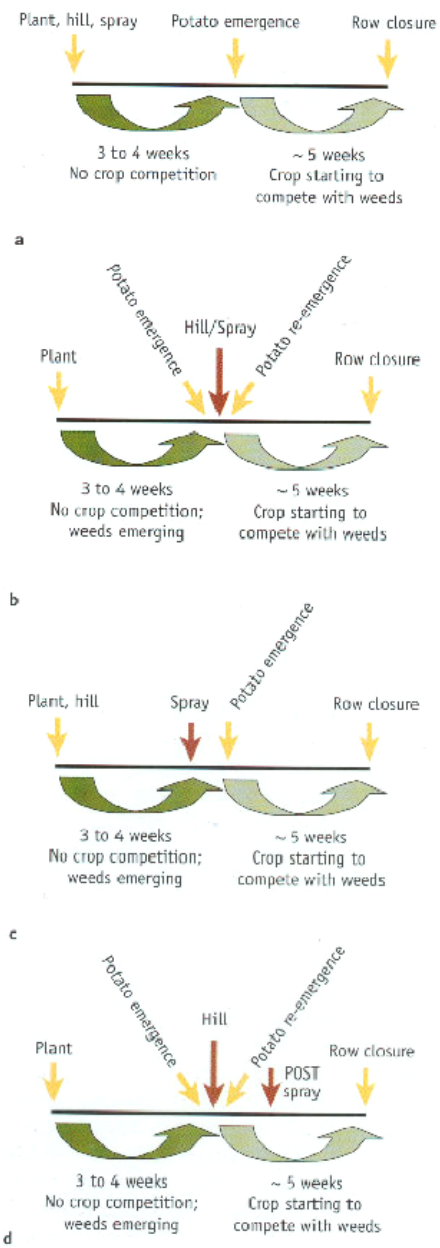
On the negative side, timely cultivation may be difficult on large acreages or in wet weather. Multiple cultivations may cause soil compaction, reducing aeration and potato growth and producing

clods that bruise potatoes at harvest. Late cultivation also may directly damage potato foliage and roots, resulting in lower tuber yields. Furthermore, in seed growing areas, cultivation after potato emergence may spread potato diseases. Moreover, multiple cultivations reduce yields.

Some important points to consider when cultivating include: (1) cultivated weeds die more readily in drier than in moist soil; (2) at least 1 day of lying uprooted in dry soil will kill most weeds in the two to three true leaf stage or smaller; and (3) less soil compaction occurs on drier soil, which minimizes yield reduction and reduces formation of clods that cause bruising.

Field Sanitation

Controlling weeds on field borders will help reduce spread into potato fields. This is especially important when new weed species or herbicide resistant weeds are present in field borders. In addition, some common annual weeds are hosts for several important potato insects and diseases, so keeping field borders weed-free can reduce these pest problems as well.



Common herbicide application strategies

Green Manure or Cover Crops

Green manure or cover crops that reduce weed problems in potatoes are currently being tested in Idaho. For more information, refer to Chapter 6, Management of Green Manures in Potato Cropping Systems, in the *Potato Production Systems* book. Local county extension educators can be contacted to get information on the most recent findings on cover crop/green manure efficacy in their production area.

Chemical Controls

Herbicides can be effective tools for weed management in potatoes. Developing an effective chemical weed control program requires careful consideration of such factors as the weed species present in the field, soil characteristics, tillage and irrigation practices, and crop rotation. Combining cultural and mechanical practices with appropriate herbicides gives more effective weed control than relying solely on herbicides.

Some herbicide mixtures are used to overcome the limitations of using a single chemical. Appropriate mixtures may control a broader spectrum of weeds, give more consistent performance under varying soil and weather conditions, reduce soil residue problems, give full-season weed control, reduce the

potential for crop injury, and reduce the selection pressure for herbicide resistant weeds.

Several of the herbicides commonly used for weed control in potatoes are soil-applied. Most soil-applied herbicides do not control emerged weeds, so it is important to incorporate the herbicide with the appropriate amount of water shortly after application to move it into the weed seed germination zone and activate it before weeds emerge.

Timing the hilling operation to take full advantage of the residual activity of soil-applied herbicides also is important for maximizing weed control. Building the hill at planting and applying herbicides shortly thereafter usually does not provide weed control as late into the season as building the hill 2 to 3 weeks after planting, then applying herbicides as soon after hilling as possible (See a and b in illustration).

Another alternative is to build the hill at planting, and 2 to 3 weeks later, just before potato emergence, apply a mixture of a non-selective herbicide that destroys emerged weeds, plus a preemergence herbicide that provides residual weed control (See c in illustration).

A fourth weed control strategy would be to hill just before potato emergence and follow with a postemergence herbicide application after potato and weed emergence and before row closure (See d in illustration). The herbicide would have to control emerged weeds and provide residual control until potato row closure.

SELECTIVE USE HERBICIDES REGISTERED FOR WEED CONTROL IN POTATOES

Seven selective use herbicides are currently registered for weed control in potatoes in Idaho: Eptam®, Treflan®, Prowl®, Dual Magnum®/Dual II Magnum®, Sencor®, Matrix®, and Poast®. Characteristics and uses of each of these herbicides are discussed below. For more detailed instructions on effective use of potato herbicides, see Chapter 13 in the *Potato Production Systems* book. (Order Potato Production Systems)

Eptam®

Eptam® (EPTC) is a thiocarbamate herbicide that controls many common annual grass weeds, such as wild oat, foxtail, and barnyardgrass, and some annual broadleaf weeds, including hairy and cutleaf nightshade. Eptam® also suppresses quackgrass.

Eptam® is effective when applied before weeds emerge because it prevents weed seedling establishment. It does not control emerged weeds nor does it kill ungerminated weed seeds. Eptam® is a lipid synthesis inhibitor and kills susceptible weeds by inhibiting cell division and elongation.

Treflan®

The dinitroaniline herbicide, Treflan® (trifluralin), is primarily an annual grass herbicide that is effective on foxtail, barnyardgrass, crabgrass, and other grassy weeds, and also controls some broadleaf weeds, including redroot pigweed, common lambsquarters, and kochia. Treflan® does not control hairy nightshade nor wild mustard and only suppresses wild oat.

Efficacy of labeled potato herbicides for controlling common weeds

Weeds	Eptam® (EPTC)	Treflan® (triflur-alin)	Prowl® (pendi-methalin)	Dual Magnum® / Dual II Magnum® (s-meto-lachlor)	Sencor® (metri-buzin)	Matrix® (rim-sulfuron) Preemer-gence	Matrix® (rim-sulfuron) Postemer-gence	Poast® (seth-oxydim)
Barley, volunteer	G-F	P	—	—	P	G	G	G
Barnyardgrass	G	G	G	G	F	G	G	G
Bindweed, field	P	P	P	—	P	—	P	N
Buckwheat	F	F	—	—	F	P	P	N
Clover, sweet	P	P	—	—	G	N	—	N
Cocklebur	P	P	—	—	F	N	F	N
Crabgrass	G	G	G	G	F	—	F	—
Dodder	P	P	P	P	P	N	—	N
Foxtail	G	G	G	G	F	G	G	G
Knapweed, Russian	P	P	—	—	P	N	—	N
Knotweed	G	G	G	—	G	N	—	N
Kochia	F-P	G-F	G-F	F	G	N	G	N
Lambsquarters	G	G-F	G-F	F	G	N	F-G	N
Mallow	P	P	F	F	G	N	—	N
Mustard	P	P	—	—	G	N	G	N
Nightshade, cutleaf	F-G	P	P-F	F-G	P	N	N	N
Nightshade, hairy	G	P	F-P	F	F	N	F-G	N
Nutsedge, yellow	F	P	P	G-F	P	N	—	N
Oat, volunteer	G-F	G	—	—	G-F	G	G-F	G
Oat, wild	G-F	F	F-P	F-P	F-G	G	F	G
Pigweed	G-F	G	G-F	G	G	N	G	N
Purslane	G	G	G	G	G	N	—	N
Quackgrass	G-F	—	—	—	F-P	F	N	F
Sandbur	G	G	—	G	P	G	—	G
Smartweed	P	P	F	P	F	N	—	N
Sowthistle	F	—	P	—	G	N	—	N
Sunflower	P	P	P	P	F	N	G	N
Thistle, Canada	P	—	—	—	F	N	—	N
Thistle, Russian	P	P	G	P	G	N	P	N
Wheat, volunteer	G-F	—	—	—	P	G	G	G

G = good, F = fair, P = poor, N = none, — = no information available

Response of weeds to any of the listed herbicides may be altered by growing conditions, weed populations, type of irrigation, genetic variations, soil type, pH, organic matter, time of application, and application rate. Ratings may vary from season to season and from site to site. Weed control generally decreases as the season progresses.

Source: 2003 PNW Weed Management Handbook

Treflan® kills weeds by inhibiting cell division (mitosis) and cell elongation. As with Eptam®, Treflan® should be applied before weeds emerge to be effective. In potatoes, Treflan® can be applied after planting but before potatoes and weeds emerge (post-plant, premergence).

Prowl®

Prowl® (pendimethalin) is another dinitroaniline herbicide. It is used primarily for control of annual grasses and certain broadleaf weeds, such as redroot pigweed, common lambsquarters, and kochia. Prowl® provides fair hairy nightshade control and poor cutleaf nightshade control. As with Treflan®, Prowl® kills weeds by inhibiting cell division (mitosis) and cell elongation.

Prowl® may be used either before or after crop emergence (up to 6-inch tall potatoes), but must be applied before weeds emerge for effective weed control. The potential for crop injury is greater when Prowl® is applied after potato emergence than when it is applied before potato emergence. Typical injury symptoms include brittle stems and some leaf malformation.

Dual Magnum®/Dual II Magnum®

Both Dual Magnum® and Dual II Magnum® (s-metolachlor) are chloroacetamide herbicide formulations that contain the same active ingredient, s-metolachlor. Dual II Magnum® has a safener (benoxacor) included in the commercial formulation. Dual Magnum® does not have the safener. The safener is used to protect corn from s-metolachlor injury that may occur when conditions are abnormally wet during corn germination and emergence. Either product may be used in potatoes, and crop safety and weed control are similar.

The exact mechanism of action for Dual Magnum®/Dual II Magnum® is unknown, but the herbicides kill germinating weeds. They are not effective on emerged weeds. Dual Magnum®/Dual II Magnum® are primarily annual grass herbicides, but both also control certain broadleaf weeds, such as redroot pigweed, common lambsquarters, hairy nightshade, and cutleaf nightshade, and provide fair to good yellow nutsedge control.

Dual Magnum®/Dual II Magnum® must be applied before weed emergence for the herbicides to be effective. Applications are typically before planting (preplant incorporated) for yellow nutsedge control and after planting but before crop emergence (preemergence) for annual weed control. Dual Magnum®/Dual II Magnum® are much safer to potatoes when applied before crop emergence. Application of Dual Magnum®/Dual II Magnum® after potato emergence can cause fairly serious leaf malformations, especially when the herbicides are sprayed rather than chemigated.

Sencor®

Sencor® (metribuzin), a triazine herbicide, kills weeds by inhibiting photosynthesis, specifically photosystem II (PS II). Typical injury symptoms include leaf chlorosis (yellowing) and necrosis (death). Symptoms show up on older leaves first.

Sencor® may be applied either before or after weed or potato emergence. If weeds have emerged, the herbicide should be applied before weeds are 1 inch tall.

Sencor® controls many annual broadleaf weeds, including redroot pigweed, common lambsquarters, kochia, Russian thistle, and wild mustard, but provides only fair hairy nightshade control and poor cutleaf nightshade control. Sencor® also controls some annual grasses, such as wild oat, foxtail, and barnyardgrass.

Sencor injury on potaotes

Potato varieties vary in their tolerance to Sencor®. As a general rule, the red-skinned varieties are susceptible to injury, the round-white varieties are susceptible to moderately tolerant, and the russet varieties are tolerant.

Because there are exceptions, Sencor® should be applied on a new variety only after the injury response is known. Among commonly grown varieties, Russet Burbank, Ranger Russet, Russet Norkotah, and Chipeta are tolerant, and Shepody is very susceptible.

In Idaho Sencor® may be applied preplant incorporated, preemergence, postemergence, or as a split preemergence-plus-postemergence or postemergence-plus-postemergence. Sencor® should be applied preplant only on russetted or white skinned varieties that are not early maturing. Sencor® **cannot** be applied postemergence on early-maturing, smooth-skinned white- or red-skinned varieties.

Response of common varieties to Sencor and Matrix injury

Variety	Matrix® tolerance	Sencor® tolerance[a]
Russet Burbank	Tolerant	Tolerant
Ranger Russet	Tolerant	Tolerant
Russet Norkotah	Tolerant	Tolerant
Gem Russet	Tolerant	Tolerant
Alturas	Tolerant	Tolerant
Shepody	Tolerant	Very susceptible
Atlantic	Tolerant	Susceptible
Chipeta	Tolerant	Tolerant
Norland	Tolerant	Moderately tolerant
Red LaSoda	Tolerant	Moderately tolerant

[a] Tolerance to metribuzin applied preemergence.

Source: Characteristics of Potato Varieties in the Pacific Northwest, PNW 454.

Sencor® usually is safest when applied before potato emergence, even with tolerant varieties. When using a split application strategy, the timing of postemergence application(s) is key to reducing injury potential. In University of Idaho studies, Sencor® applied postemergence after 3 successive sunny days (label recommendation) did not reduce U.S. No. 1 tuber yields. However, when Sencor® was applied postemergence under cool, wet, cloudy conditions, U.S. No. 1 yields were reduced.

The incorporation recommendations for Sencor® are:

- If applied preplant, **do** incorporate mechanically.
- If applied preemergence or postemergence, **do not** incorporate mechanically (potential for decreased weed control and increased potato injury). *If applied post-plant, **do** chemigate or incorporate via sprinkler irrigation. (Note that when Sencor® is applied postemergence with a ground sprayer, overhead irrigation or rainfall within 24 hours after application may decrease weed control.)

Matrix®

Matrix® (rimsulfuron) is a sulfonylurea herbicide that kills susceptible plants by inhibiting acetolactate synthase (ALS), which is a key enzyme in amino acid synthesis.When ALS is inhibited, cell division ceases, and plants stop growing and slowly die.

Initial symptoms include stunting and yellowing of the new growth; plants then turn brown and die, usually within 7 to 21 days after treatment. Potatoes are tolerant to Matrix® because they rapidly detoxify (breakdown) the herbicide before it reaches the ALS target site. Commonly grown potato varieties have good tolerance to Matrix®.

Although many weeds are susceptible to Matrix ®, biotypes of kochia and several other weeds that are resistant to ALS-inhibitor herbicides are present in Idaho. These resistant biotypes are **not** controlled by Matrix®.

Matrix® controls a broad spectrum of weeds when applied either preemergence or postemergence. However, application timing does affect control of some weed species. For example, common lambsquarters control is much better when Matrix® is applied preemergence rather than postemergence. In contrast, quackgrass and crabgrass control are better when Matrix® is applied postemergence rather than preemergence.

Some common annual weeds are not effectively controlled by Matrix®, including cutleaf nightshade, Russian thistle, and wild buckwheat. These annuals require the use of tank-mixtures for control.

Matrix is effective in controlling hairy nightshade

Poast®

Poast® (sethoxydim) is a postemergence, cyclohexanedione herbicide. It controls grass weeds by inhibiting acetyl co-enzyme A carboxylase (ACCase), a key enzyme in fatty acid synthesis. Meristemmatic growth at the base of young leaves and in the crown region is inhibited by Poast®. Typical injury symptoms include chlorosis (yellowing) of the new growth; young leaves are easily pulled from the plant, and the base of the leaf is often brown and necrotic (dead).

Poast® controls many annual grass weeds, including foxtail, barnyardgrass, volunteer grain, and wild oat. It also suppresses quackgrass, a perennial weed. Poast® must

always be used with a nonphytotoxic oil concentrate in order to get effective weed control. Poast® plus oil concentrate is safe on all potato varieties.

Herbicide Resistance Management Strategies

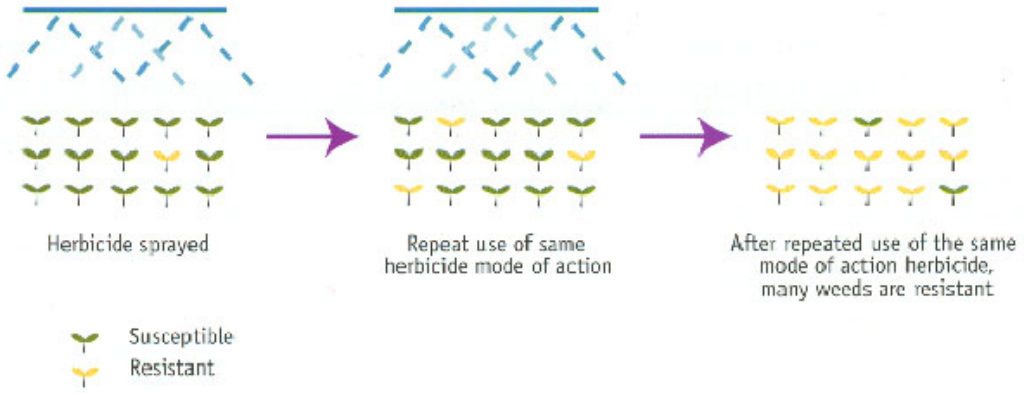


Illustration of resistant weed population development under conditions of repeated use of herbicides with the same mode of action.

Integrated weed management uses all tools available to control weeds and is important for managing herbicide-resistant weeds. The greater the variety of weed control tools used, the lower the risk of selecting resistant weeds. Some useful resistance management strategies include:

- Rotate herbicides and/or crops in order to avoid or delay the onset of herbicide resistance.
- Cultivate row crops and employ different cultural practices each year to reduce the risk of developing resistant populations.
- Avoid sequential applications of the same herbicide within the same growing season.
- Tank-mix herbicides with different modes of action to prevent or delay herbicide resistance as well as to help control existing resistant weeds.
- Use tank mixtures that include herbicides with overlapping weed spectrum so that multiple modes of action are used to control the same weed. If weeds present in the field are resistant to one of the herbicides in the tank mixture, the other herbicide(s) should provide control of that weed.
- Scout fields before and after herbicide applications in order to facilitate decisions about subsequent applications.
- Make proper herbicide applications and control weed escapes as soon as possible.
- Keep herbicide and weed control histories for each field in order to track and rotate herbicide modes of action, and to track weed control in each field. Shifts in weed populations should be noted to guide future control strategies.
- Plant competitive crops and varieties to enhance weed control.
- Use certified seed for rotational crops because planting seed from fields contaminated with resistant weeds spreads those resistant weeds to other fields.
- Prevent weed seed spread from field to field with sanitation methods, such as cleaning equipment before moving, and screening irrigation water, when possible.