

Matrix in Weed Management Systems for Potatoes

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Matrix is a sulfonyleurea herbicide labeled for preemergence or postemergence use in potatoes to control many common broadleaf and grassy weeds, including hairy nightshade. Matrix also may be tank-mixed with other potato herbicides to broaden the spectrum of weed control.

This publication provides information on how Matrix controls weeds (its mode of action), its effectiveness on various weed species, and how to use it to maximize its strengths and avoid potential hazards of misuse.

Mode of action

Rimsulfuron, the active ingredient in Matrix, kills susceptible plants by inhibiting a key enzyme in amino acid synthesis. The enzyme, acetolactate synthase, is commonly abbreviated ALS. When ALS is inhibited, cell division ceases, plants stop growing, and they slowly die. Matrix is absorbed through plant roots and foliage. Potatoes are tolerant to Matrix because they rapidly detoxify (metabolize or break down) the herbicide before it reaches the ALS target site.

Susceptible weeds usually will not emerge from preemergence applications of Matrix. Some weeds may germinate and emerge a few days after a preemergence application; however, growth usually ceases and leaves become chlorotic 3 to 5 days after emergence. Leaf tissue and growing point death may follow in some species, while others remain green but stunted.

One to three weeks after postemergence applications of Matrix, initial symptoms appear on susceptible weeds. These include stunting and yellowing of the new growth. Plants then turn brown and die. As with preemergence applications of Matrix, leaf tissue and growing point death may occur in some weed species.

Although many weeds are susceptible to Matrix, some biotypes of kochia and of several other weeds in Idaho are resistant to ALS-inhibitor herbicides. These resistant biotypes will not be controlled by Matrix.

Potato varietal tolerance to Matrix

Research in the U.S. and Canada has shown that a number of commonly grown potato varieties have good tolerance to Matrix. However, growers should note that Matrix-tolerant varieties may not be tolerant to metribuzin (Sencor and others) (table 1). When using Matrix for the first time on an untested variety, limit the initial use to a small area. If no crop injury symptoms occur 7 days after treatment, the balance of the acreage may be treated.

Table 1. Potato variety tolerance to Matrix and Sencor applied preemergence.

Variety	Matrix	Sencor ¹
Alturas	Tolerant	Tolerant
Bannock Russet	Tolerant	Tolerant
Russet Burbank	Tolerant	Tolerant
Ranger Russet	Tolerant	Tolerant
Russet Norkotah	Tolerant	Tolerant
Umatilla Russet	Tolerant	Tolerant
Chipeta	Tolerant	Tolerant
IdaRose	Tolerant	Tolerant
Norland	Tolerant	Moderately tolerant
Red LaSoda	Tolerant	Moderately susceptible
Shepody	Tolerant	Susceptible
Atlantic	Tolerant	Moderately Susceptible

¹Tolerance to metribuzin applied preemergence (Love, S.L., R. Novy, D.L. Corsini, and P. Bain. 2003. Variety Selection Management in Potato Production Systems. ed. S.L. Love and J.C. Stark. Univ. of Idaho Ag. Comm. Moscow, ID 83844.)

Effectiveness on various weed species

Matrix controls a broad spectrum of weeds when applied either preemergence or postemergence (table 2). However, some weed species are controlled better with one application timing than the other. For example, common lambquarters control is much better when Matrix is applied preemergence rather than postemergence. In contrast, quackgrass and crabgrass control is better when Matrix is applied postemergence. A few common annual weeds are not effectively controlled by Matrix at all, including cut-leaf nightshade, Russian thistle, and wild buckwheat, and require the use of tank-mixtures for control (see tank-mixtures section).

Because Matrix does not control cutleaf nightshade but is effective on hairy nightshade, it is important to know which nightshade species infests your fields (figure 1). Hairy nightshade has smooth to wavy leaf margins with moderately to densely hairy leaves and stems. Cutleaf nightshade has deeply cleft lobes on its leaves even at the seedling stage and sparsely to moderately hairy leaves and stems.

Hairy nightshade control

Matrix may be used either preemergence or postemergence for hairy nightshade control. *Preemergence* tank-mixtures of Matrix with herbicides providing good control of hairy nightshade, such as Outlook, or even with other herbicides that may suppress hairy nightshade, such as Sencor, can provide better hairy nightshade control than Matrix applied alone (figure 2).

Hairy nightshade control with Matrix applied preemergence may be greatly influenced by hairy nightshade populations. University of Idaho research has shown that in fields previously infested with light to moderate hairy nightshade populations, Matrix + Sencor provides season-long control. However, hairy nightshade control with a

Matrix + Sencor mixture may drop below 85 percent in fields moderately to heavily infested with this weed (figure 3). Tank-mixing Matrix + Sencor with a third herbicide having suppressive to good hairy nightshade control, such as Chateau, Dual Magnum, Eptam, Outlook, Prowl, Spartan, or Stalwart, may improve preemergence hairy nightshade control in heavily infested fields.

Best hairy nightshade control with *postemergence* applications of Matrix or Matrix + Sencor is achieved when the seedling nightshade is in the cotyledon to 4-leaf stage. Good coverage is essential for control.

Tank-mixtures for controlling weeds

Tank-mixtures broaden the weed control spectrum and reduce the potential for developing herbicide-resistant weed populations. Matrix can be tank-mixed with other herbicides registered for use in potatoes, including Chateau, Dual Magnum, Eptam, metribuzin (Sencor and others), Outlook, Prowl, Spartan, Stalwart, Roundup, and Gramoxone Max.

When applied *preemergence*, Matrix may be used in 2- or 3-way mixtures with each of these herbicides. When

Table 2. Effectiveness of Matrix and Matrix tank-mixtures on weeds in potatoes.

	Preemergence								Postemergence			
	Matrix	Tank-mix partners							Matrix	Tank-mix partners		
		Chateau	Dual ¹	Eptam	Outlook	Prowl	Sencor	Spartan		Eptam	Sencor	
Grasses and sedges												
barley, volunteer	G	G	G	G	G	G	G	G	G	G	G	G
barnyardgrass	G	G	G	G	G	G	G	G	G	G	G	G
crabgrass, large	F	F	G	G	G	G	G	F	F	F-G	G	G
foxtail, green	G	G	G	G	G	G	G	G	G	G	G	G
foxtail, yellow	G	G	G	G	G	G	G	G	G	G	G	G
nutsedge, yellow	N	N	F-G	F	F-G	P	P	F	F	F	F	F
oat, volunteer	G	G	G	G	G	G	G	G	F-G	G	G	G
oat, wild	F	F	F	F-G	F	F	F-G	F	F	G	G	G
quackgrass ²	P	P	F	F-G	P	F	F	P	F-G	F-G	F-G	F-G
wheat, volunteer	G	G	G	G	G	G	G	G	G	G	G	G
Broadleaves												
buckwheat, wild	P	P	P	F	P	P	F	F	P	P-F	F	F
cocklebur, common	P-F	P-F	P-F	P-F	P-F	P-F	F-G	F	P-F	P-F	F-G	F-G
kochia ³	G	G	G	G	G	G	G	G	G	G	G	G
lambsquarters, common	P-F	P-F	F	G	F	G	G	G	P-F	F-G	G	G
mustard, wild	F-G	F-G	F-G	F-G	F-G	F-G	G	G	G	G	G	G
nightshade, cutleaf	N	P-F	F	F-G	F-G	P	P	F	N	F-G	P	P
nightshade, hairy	F-G	G	G	G	G	G	G	G	F-G	G	G	G
pigweed, redroot	G	G	G	G	G	G	G	G	G	G	G	G
pigweed, prostrate	G	G	G	G	G	G	G	G	G	G	G	G
purslane, common	G	G	G	G	G	G	G	G	P-F	F-G	G	G
smartweed, Pennsylvania	P	P	P-F	P-F	P-F	F	G	G	P-F	F	G	G
thistle, Canada ⁴	N	N	N	P	N	N	P	N	F	F	F	F
thistle, Russian	P	P	P	P	P	G	G	G	P	P	G	G
velvetleaf	P-F	P-F	P-F	F	F	F	G	F	P-F	P-F	G	G

N = no control; P = poor, <80% control; F = fair, 80 to 90% control; G = good, >90% control.

¹ including s-metolachlor (Dual Magnum/Dual II Magnum), and metolachlor (Stalwart and others).

² For best quackgrass control, apply Matrix postemergence at 1 to 1.5 oz/A to quackgrass that is 4 to 8 inches tall. Quackgrass not emerged at application time will not be controlled or suppressed and will require a second postemergence Matrix application.

³ Matrix can provide good control of susceptible kochia biotypes but little or no control of ALS inhibitor herbicide-resistant biotypes.

⁴ For best Canada thistle control, apply Matrix postemergence at 1 to 1.5 oz/A to small, actively growing Canada thistle. Canada thistle not emerged at application time will not be controlled or suppressed and will require a second Matrix application.



Figure 1. Hairy nightshade (below) has smooth to wavy leaf margins, while those of cutleaf nightshade (above) are deeply cleft. Matrix provides good control of hairy nightshade but does not control cutleaf nightshade.



applied *postemergence*, however, Matrix can be mixed only with Eptam or Sencor, either because the other herbicides are not labeled for *postemergence* application in potatoes or because *postemergence* tank-mixtures with the other herbicides may cause unacceptable potato injury. Rates of other potato herbicides used in combination with Matrix can vary with soil type (table 3).

Knowing your field history is key to selecting the best tank-mix partner for Matrix because the choice depends on problem weeds present in the field. For example, some tank-mix partners may improve hairy nightshade control with Matrix but not control of common lambsquarters.

Matrix can be used in combination with Sencor when metribuzin-tolerant potato varieties are grown. The Matrix + Sencor tank-mix provides better control of weeds such as Russian thistle and wild buckwheat than Matrix applied alone (table 2). Furthermore, since Sencor has a different mode of action than Matrix and is effective on

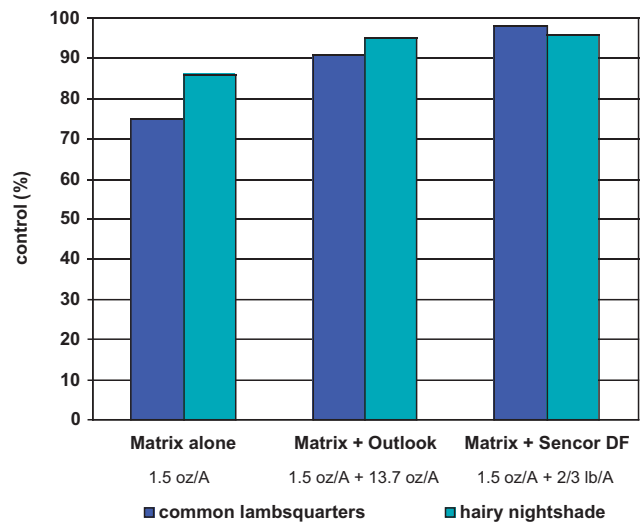


Figure 2. Preemergence hairy nightshade and common lambsquarters control with Matrix alone at 1.5 oz/A, or in combination with Outlook (13.7 oz/A) or Sencor 75 DF (2/3 lb/A).

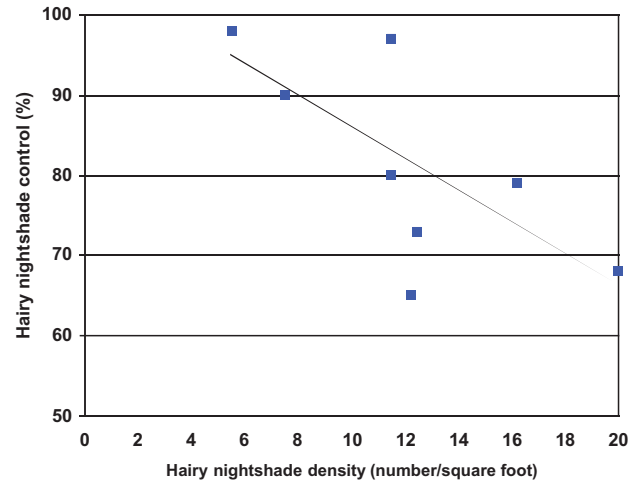


Figure 3. Preemergence hairy nightshade control with Matrix + Sencor decreases as hairy nightshade population density increases.

ALS inhibitor-resistant kochia, the Matrix + Sencor tank-mix is an effective resistance management tool.

Preemergence common lambsquarters control can be improved when Matrix is combined with other potato herbicides such as Outlook or Sencor (figure 2). Matrix applied *postemergence* does not provide acceptable common lambsquarters control. *Postemergence* common lambsquarters control was improved in University of Idaho research trials when Matrix was tank-mixed with Sencor or Eptam (figure 4). When metribuzin-sensitive varieties are grown, a Matrix + Eptam tank-mixture will provide good common lambsquarters control if weeds are very small (cotyledon to 2-leaf stage) at application time.

When cutleaf nightshade is known to infest a field and quackgrass or wild oat also is a major problem, Eptam

would be a logical partner because it has greater efficacy on these three weeds than other tank-mix partners. On the other hand, in fields infested with both hairy nightshade and yellow nutsedge, good control of both weeds should result from Matrix or Matrix + Sencor applied postemergence to the nutsedge following an application of Dual Magnum or Stalwart before planting, or a pre-emergence application of Dual Magnum, Stalwart, Outlook, or Spartan.

Table 3. Commonly recommended rates of Matrix tank-mix partners used preemergence on medium- textured soils with 1 to 1.5% organic matter in southern Idaho.

Tank-mix partner	Formulation	Rate (product/acre)
Chateau	51% WDG	1.5 oz
Dual Magnum	7.62 lb ai/gal	1 to 1.4 pt
Eptam	7 lb ai/gal	3.5 to 7 pt
Outlook	6 lb ai/gal	18 fl oz
Prowl	3.3 lb ai/gal (EC)	1.8 to 2.4 pt
	3.8 lb ai/gal (H ₂ O)	2.1 pt
Sencor	75% DF	½ to ¾ lb
	4 lb ai/gal	½ to 1 pt
Stalwart	8 lb ai/gal	1 to 2 pt

When metribuzin-sensitive potato varieties are grown, Matrix should be mixed with other potato herbicides depending on the weed species present in the field. A Matrix + Prowl tank-mix will be more effective on Russian thistle and ALS inhibitor-resistant kochia than Matrix + Eptam or Matrix + Dual Magnum, for instance.

Herbicide-resistant weeds

Resistance management strategies must be employed when using Matrix because ALS inhibitor-resistant biotypes of kochia, prickly lettuce, and Russian thistle are present in Idaho potato production areas. These resistant biotypes cannot be controlled by Matrix. Thus, it is particularly important to always use tank-mixtures of Matrix and a herbicide with a different mode of action that is effective on the resistant species (see tank-mixtures section). In addition, cultural practices such as tillage, preventing weed escapes from going to seed, and good sanitation can help delay the development of herbicide-resistant weed populations.

Using herbicides with different modes of action each growing season (rotating among herbicides) also can aid in delaying the selection, buildup, and possible dominance of herbicide-resistant weed biotypes. In crops grown in rotation with potatoes, reduce the use of ALS inhibitors to avoid selection of resistant weed biotypes. See table 4 for a list of ALS inhibitor herbicides used in some of the crops grown in potato rotations.

For a complete discussion of the development of herbicide-resistant weed populations and resistance management strategies, see *Herbicide-Resistant Weeds and Their Management*, PNW bulletin 437, available online at info.ag.uidaho.edu.

Table 4. Common ALS inhibitors used in some crops grown in potato rotations.

Crop	Herbicide family	Common name	Trade name(s)
Alfalfa	imidazolinones	imazethapyr	Pursuit
		imazamox	Raptor
Corn	sulfonylureas	halosulfuron	Permit
		nicosulfuron	Accent
		rimsulfuron + thifensulfuron	Basis
		flumetsulam	Python
Dry bean	imidazolinones	imazethapyr	Pursuit
		imazamox	Raptor
Small grain	imidazolinones	imazamethabenz	Assert
		imazamox*	Beyond
	sulfonylureas	chlorsulfuron	Finesse
		metsulfuron	Ally, Escort
		prosulfuron	Peak
		sulfosulfuron	Maverick
		tribenuron	Express
		thifensulfuron + tribenuron	Harmony
		tribenuron	Extra
		triasulfuron	Amber
Sugar beet	sulfonylamino-carbonyltriazolinones	flucarbazon	Everest
		propoxycarbazone	Olympus
	sulfonylureas	triflusulfuron	UpBeet

*Beyond is labeled for use in Clearfield wheat (imidazolinone-resistant wheat).

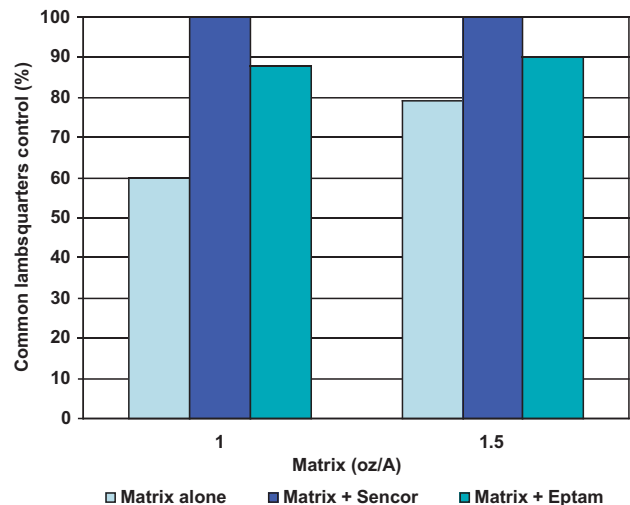


Figure 4. Postemergence common lambsquarters control with two rates of Matrix alone and in combination with Sencor 75 DF (½ lb/A) or Eptam (3.5 pt/A).

Application methods

Matrix is registered for use on commercial potatoes and can be used on potatoes grown for seed in Idaho and a few other states (see the label). It can be applied by ground, air, or through sprinkler irrigation systems. Always avoid spray drift to adjacent crops. Matrix is very active even at low doses, and many crops, such as small grains, canola, sugar beet, pea, onion, and others, are sensitive to Matrix drift.

Ground application

- Apply Matrix in 10 to 40 gallons total spray per acre at 20 to 40 pounds per square inch using either flat-fan or flood-jet nozzles.
- When using flood nozzles, the spray pattern should overlap 100 percent for optimal product performance.
- Because Matrix is active at very low rates (1 to 1.5 oz/A), it is important to carefully calibrate sprayers before application.

Chemigation

- Apply Matrix in $\frac{1}{2}$ to 1 inch of water per acre depending on soil type (table 5) as a continuous injection in center-pivot and self-propelled, wheel-move systems.
- For hand-line and solid-set sprinkler irrigation systems, inject Matrix at the beginning of the set and apply water for activation (i.e., $\frac{1}{2}$ to 1 inch) (table 5).
- Research in Idaho has shown that when Matrix is chemigated, weed control generally is more consistent when the herbicide is applied before weeds emerge and when the maximum labeled rate of 1.5 oz/A is used.
- If Matrix is chemigated after weeds emerge, it is very important to make the application when weeds are small (less than 1 inch), in the cotyledon to two-leaf stage, in order to achieve acceptable weed control.
- Add a nonionic surfactant (NIS) containing at least 80% active ingredient in the spray mix at 1 to 2 pt/A if weeds are present at chemigation time.

Table 5. Water needed for proper Matrix incorporation.

Soil type	Water (inches)
Sand	0.33
Sandy loam	0.50
Silt loam	0.75
Clay	1.00

Aerial

- Use at least 5 gal/A spray mixture and nozzle types and arrangements that provide optimal spray distribution and maximum coverage.
- Do not apply during a temperature inversion, when winds are gusty, or when conditions favor poor coverage and/or off-target movement.
- See the label(s) for states/areas where aerial application of Matrix is prohibited.

Application timing

Matrix may be applied *preemergence* (before weeds emerge), *postemergence* when weeds are small (i.e., less than 1 inch tall for most species), *split preemergence plus postemergence*, or *split postemergence plus postemergence*. Matrix application timing depends on several factors, including other management practices employed.

Preemergence

- Matrix can be used at 1 to 1.5 oz/A when applied pre-emergence in commercial potatoes and at 1.5 oz/A in seed potatoes.
- Apply Matrix after hilling or drag-off before potatoes and weeds emerge. Unless $\frac{1}{2}$ to 1 inch rainfall in a single event

occurs within 5 days after application, incorporate Matrix with $\frac{1}{2}$ to 1 inch of sprinkler irrigation water per acre depending on soil type (table 5) as soon as possible after application, but no later than 5 days after application.

- Proper incorporation of Matrix is key to obtaining good weed control. Matrix is not volatile, but needs to be moved into the weed seed germination zone and activated by water for best control.
- If any weeds are present, use NIS at a rate of 0.125 to 0.25% v/v (1 to 2 pt/100 gal spray solution) when applying Matrix with a ground rig.

Postemergence

- Matrix can be used at 1 to 1.5 oz /A when applied post-emergence.
- Apply Matrix to actively growing weeds.
 - Small weeds less than 1 inch in height or diameter are controlled best.
 - Certain grasses such as quackgrass and wild oat may be controlled better when they are larger (4 to 6 inches tall).
- Always use an adjuvant when Matrix is applied alone.
 - NIS at 0.125 to 0.25% v/v (1 to 2 pt/100 gal of spray solution).
 - Methylated seed oil (MSO) at 1% v/v (1 gal/100 gal of spray solution).
 - Crop oil concentrate (COC) at 1% v/v (1 gal/100 gal of spray solution).
 - A silicone polymer type surfactant is not recommended as decreased weed control may result.
 - When air temperature is greater than 85°F, the use of NIS is recommended since the use of MSO or COC with Matrix in these high temperature conditions may result in crop injury.
- University of Idaho studies have shown that hairy nightshade, kochia, and common lambsquarters control often was better when MSO was used with Matrix than when COC or NIS were used.
- When Matrix is mixed with Sencor or Eptam, use NIS at 0.125% v/v (1 pt/100 gal of spray solution).
 - Apply Matrix + Eptam before potatoes exceed 4 to 6 inches in height.
- For maximum postemergence activity with Matrix or Matrix mixtures, wait 4 to 6 hours but no more than 5 days to apply $\frac{1}{2}$ to 1 inch water depending on soil type (table 5).
- Cultivation up to 7 days before a postemergence application of Matrix may decrease weed control by pruning weed roots and placing the weeds under stress or by covering the weeds with soil and preventing good spray coverage.
- Cultivation is not recommended for 7 days after post-emergence application of Matrix in order to allow full control of treated weeds.
 - Optimal cultivation timing is 7 to 14 days after a post-emergence application of Matrix.

Postemergence Matrix applications can cause a temporary, mild, mottled yellowing of potato foliage, especially on newer growth (figure 5). Under stressful environmental conditions, such as cool, wet weather or hot or humid weather, postemergence applications of Matrix also may cause leaf malformations, including leaf crinkling and/or a

pinched appearance to the leaves (figure 6) and stunted growth. Plants typically recover from this injury within 7 to 10 days after treatment, with no effect on U.S. Number 1 yield (figure 7).

Later applications to taller potatoes often cause more injury than early applications to smaller potatoes. To reduce the potential for Matrix injury to potatoes, *apply the herbicide after at least 3 successive days of sunny weather.*

Split application

Depending upon rainfall or other environmental conditions, the health of the potato crop, and the density of the potato foliage, annual weeds may have a second flush of germinating seedlings and treated perennials may produce new growth. It may be necessary to apply Matrix a second time in these situations.

- Matrix may be applied preemergence followed by a postemergence application 14 to 28 days later.
 - The total Matrix amount applied can not exceed 2.5 oz/A in commercial potatoes
 - In seed potatoes, Matrix can be applied preemergence at 1.5 oz/A followed by a postemergence application at 1 oz/A.
- Matrix may be applied early postemergence followed by a second postemergence application 14 to 28 days later.
 - The total Matrix amount applied can not exceed 2.5 oz/A in commercial potatoes.
 - In seed potatoes, Matrix can be applied early postemergence at 1 oz/A followed by a second postemergence application at 1 oz/A.
- Do not exceed 2.5 oz/A during the same growing season.
- When Matrix + Sencor is used in the split application strategy (preemergence plus postemergence or postemergence plus postemergence), it is very important for the postemergence application(s) to be made when there have been at least 3 consecutive sunny days in order to avoid the potential for substantial injury from both Sencor and Matrix.

Low-rate applications

A supplemental label allows Matrix application at ½ oz/A before July 15th on sprinkler-irrigated potatoes to control redroot pigweed and partially control wild oat, barnyard-grass, and green foxtail. Sugar beet, alfalfa, and onion grown under irrigation may be planted 10 months after using the ½ oz/A rate of Matrix.

This reduced rate only is recommended for use in the following areas:

- Southwestern Idaho
- South-central Idaho including the counties of Ada, Canyon, Adams, Washington, Valley, Gem, Owyhee, Payette, Boise, Elmore, Gooding, Jerome, Lincoln, Camas, Twin Falls, Blair, Minidoka, and Cassia
- Malheur County in Oregon
- Humboldt and Elko counties in Nevada



Figure 5. Matrix applied postemergence to potatoes may cause a mottled yellowing of potato foliage, especially on newer leaves.



Figure 6. Under stressful environmental conditions, Matrix applied postemergence also may cause leaf crinkling and/or a pinched appearance to leaves.

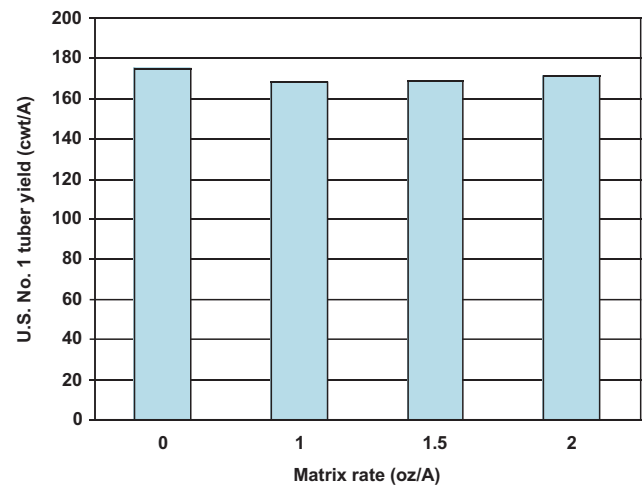


Figure 7. Effect of Matrix applied postemergence on Russet Burbank U.S. No. 1 tuber yields in weed-free trials when foliar injury was observed after application.

Advantages and limitations of various application timings

Preemergence	Postemergence	Split
<p><i>Advantages</i></p> <ul style="list-style-type: none"> • Little to no injury to potatoes. • More tank-mix options than with postemergence treatments, especially when metribuzin-sensitive varieties are grown (table 2). • Better common lambsquarters control than with postemergence application, especially when metribuzin-sensitive varieties are grown. • More consistent performance under chemigation than with postemergence application. <p><i>Limitations</i></p> <ul style="list-style-type: none"> • In a wet spring, heavy rainfall may move some soil-applied herbicide out of the weed seed germination zone, allowing some weeds to escape control. • May not control deep-germinated wild oat. • The earlier Matrix is applied, the more the herbicide will break down before row closure when the potato crop itself becomes competitive and contributes substantially to weed control. 	<p><i>Advantages</i></p> <ul style="list-style-type: none"> • Allows Matrix application when and where needed for weed control. • Provides consistently good control of seedling hairy nightshade. • Gives better control of quackgrass, crabgrass, and wild oat than preemergence application. • Allows less time for herbicide breakdown before row closure. <p><i>Limitations</i></p> <ul style="list-style-type: none"> • May cause temporary injury to potatoes, especially under stressful environmental conditions. • Weather conditions may interfere with proper application timing. • Has fewer tank-mix options compared with preemergence application (table 2). • May be less effective on weeds stressed from adverse environmental conditions, such as extreme temperatures or moisture, abnormal soil conditions, or cultural practices. • Weeds hardened off by drought stress are less susceptible to Matrix. • A dense crop canopy can intercept spray application and reduce weed control. 	<p><i>Advantages</i></p> <ul style="list-style-type: none"> • Provides excellent control of a broad spectrum of weeds and is particularly effective on quackgrass. • Allows postemergence control of escaped weeds. • May be particularly useful for growers who build hills when planting and do not wish to cultivate again. <p><i>Limitations</i></p> <ul style="list-style-type: none"> • Higher cost due to extra Matrix applied and second trip across field. • Timing of postemergence application(s) may be difficult in reservoir tillage (dammer-diked) fields. • If control with first application lasts until just before row closure, potatoes will be large and more susceptible to injury from the second Matrix application. • Greater potential for crop injury than with a single preemergence or postemergence application, especially when Matrix is tank-mixed with Sencor at each application. • Greater difficulty in timing the second Matrix application to avoid injury associated with stressful environmental conditions, especially when Matrix is tank-mixed with Sencor at each application.

See “Rotational Crop Intervals” in this bulletin and read and follow the Matrix supplemental label allowing the low-rate use for more information.

Preemergence low-rate application

- Apply by ground or air immediately after hilling, drag-off, or reservoir tillage (dam/dike operation) to a clean, newly prepared seedbed.
- Supply $\frac{1}{3}$ to 1 inch sprinkler irrigation depending on soil type (table 5) within 5 days after application *if $\frac{1}{2}$ to 1 inch rainfall in a single event* has not occurred within that time period.
- Control of weeds with an established root system before rainfall or sprinkler activation/incorporation of Matrix may not be adequate.
- If weeds are present at application, add NIS at 0.125 to 0.25% v/v (1 to 2 pt/100 gal spray solution).

Postemergence low-rate application

- Postemergence Matrix application can be made by ground or air.
- Redroot pigweed height should not exceed 3 inches at application time. Wild oat, barnyardgrass, or green foxtail height should not exceed 2 inches or the 3-leaf stage at application time.
- Always use an adjuvant when Matrix is applied postemergence alone. See page 5 for adjuvant recommendations and rates.
- Tank mixtures
 - Matrix $\frac{1}{2}$ oz/A + Sencor. The metribuzin rate should be $\frac{1}{4}$ to $\frac{3}{8}$ lb/A. Use NIS at 0.125% v/v (1 pt/100 gal spray solution). The use of COC or MSO is not recommended

for tank-mix combinations of Matrix and metribuzin. Read and follow the metribuzin product label for sensitive potato variety information.

- Matrix $\frac{1}{2}$ oz/A + Eptam. Read and follow the Eptam label for use rate. Apply before potatoes exceed 4 to 6 inches height. Use NIS at 0.125% v/v (1 pt/100 gal spray solution) or MSO at 1% v/v (1 gal/100 gal spray solution).
- Read and follow the companion product label(s) for your area. If the label recommendations conflict with the low rate use Matrix supplemental label, do not use the companion product with Matrix.

Rotational crop intervals

Matrix usually has a half-life (time for half of the chemical in the soil to degrade) of 8 to 20 days, depending on temperature and moisture conditions. Matrix degradation is faster under warm, moist conditions than under cool, dry conditions. Rotational crop intervals are given in table 6. Intervals may need to be extended under certain conditions:

- If drought conditions prevail after Matrix application in potatoes, rotation intervals may need to be extended to 18 months unless *supplemental sprinkler irrigation has been applied and totals greater than 15 inches* during the potato growing season.
- When Matrix is used in *seed potato production fields*, the rotational crop intervals may need to be extended to 18 months for all crops other than potatoes, if *seed potato production practices* decrease water and/or time for Matrix

Table 6. Interval between Matrix application and planting of a subsequent crop.

Rotation crop	Interval (months)
alfalfa	18*
barley, spring	9**
beans, dry	10
beans, succulent	10
carrot	18*
corn, field	anytime
corn, popcorn or sweet	10
cover crops (erosion control)	4
oats, spring	9
onion	18*
potato	anytime
sugar beet	18*
sunflowers	10
soybean	4
tomatoes	1
wheat, spring	9
wheat, winter	4
crops not listed	18

*Exceptions:

- Morrow and Umatilla counties in Oregon and Benton, Franklin, Klickitat, and Walla Walla counties in Washington—10-month interval to carrots and onions when these crops are grown in sand, loamy sand, or sandy loam soils with less than 1.5% organic matter and the previous potato crop received at least 18 inches of sprinkler irrigation.
- Southwestern and south-central Idaho, Malheur county in Oregon, and Humboldt and Elko counties in Nevada when the ½ oz/A rate is used on sprinkler-irrigated potatoes before July 15th (allowed by supplemental label)—10-month interval to sugar beet, alfalfa, and onion grown under irrigation. Deep tillage using a moldboard plow before planting these rotation crops is recommended. Rotation intervals may need to be extended to 18 months if drought conditions prevail unless supplemental irrigation is applied and totals greater than 15 inches during the potato growing season.

**Exceptions:

- Colorado—18-month interval in Alamosa, Conejos, Costilla, Rio Grande, and Saguache counties if greater than 1.5 oz/A Matrix has been used per season.
- Idaho—18-month interval in Teton County, Caribou County, Madison County east of Highway 20, and Fremont County east of Highway 20.
- In seed potatoes, extend the spring barley rotational crop interval to 18 months regardless of geography.

breakdown. Practices that shorten breakdown include late planting and less-frequent irrigation as compared with commercial potato production practices.

Precautions

- Avoid spray drift to adjacent crops.
- Thoroughly clean sprayer after Matrix use as spray tank residues may injure crops other than potatoes.
- Do not contaminate any body of water, including irrigation water, that may be used on other crops.
- Do not permit any run-off during chemigation.
- Do not use on potatoes grown for seed from microtubers or transplants. Depending on geography, these may be referred to as Generation 1, Nuclear, Elite 1, or Pre-Elite.
- When Matrix has been used for weed control in a seed potato field, consider informing the state seed certification agency or inspector assessing the crop since the temporary chlorosis/leaf mottling, leaf crinkling, and/or leaf pinching that can occur after Matrix application under certain growing conditions may appear similar to virus symptoms. These symptoms will usually disappear by 10 days after application.
- Crop injury may occur following a Matrix application if there is a prolonged period of cold weather and/or cold weather in conjunction with wet soils caused by poor drainage or excessive use of sprinkler irrigation for frost protection.
- Do not apply Matrix within 60 days of harvest.
- Re-entry interval (REI) following a Matrix application is 4 hours.
- Always study the label directions before using Matrix or companion herbicides. If recommendations for the companion herbicide conflict with the Matrix label, do not use it as a tank-mix with Matrix. Remember, the label is the law.

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ALWAYS read and follow the instructions printed on the pesticide label. The pesticide recommendations in this UI publication do not substitute for instructions on the label. Due to constantly changing pesticide laws and labels, some pesticides may have been cancelled or had certain uses prohibited. Use pesticides with care. Do not use a pesticide unless both the pest and the plant, animal, or other application site are specifically listed on the label. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock. Trade names are used to simplify the information; no endorsement or discrimination is intended.



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