

Maine





WEED MANAGEMENT IN POTATOES

University of Idaho

Pamela J.S. Hutchinson Potato Cropping Systems Weed Science **Research and Extension Specialist**







TIMING **NIGHTSHADES**



CULTIVATION AND HERBICIDE APPLICATION

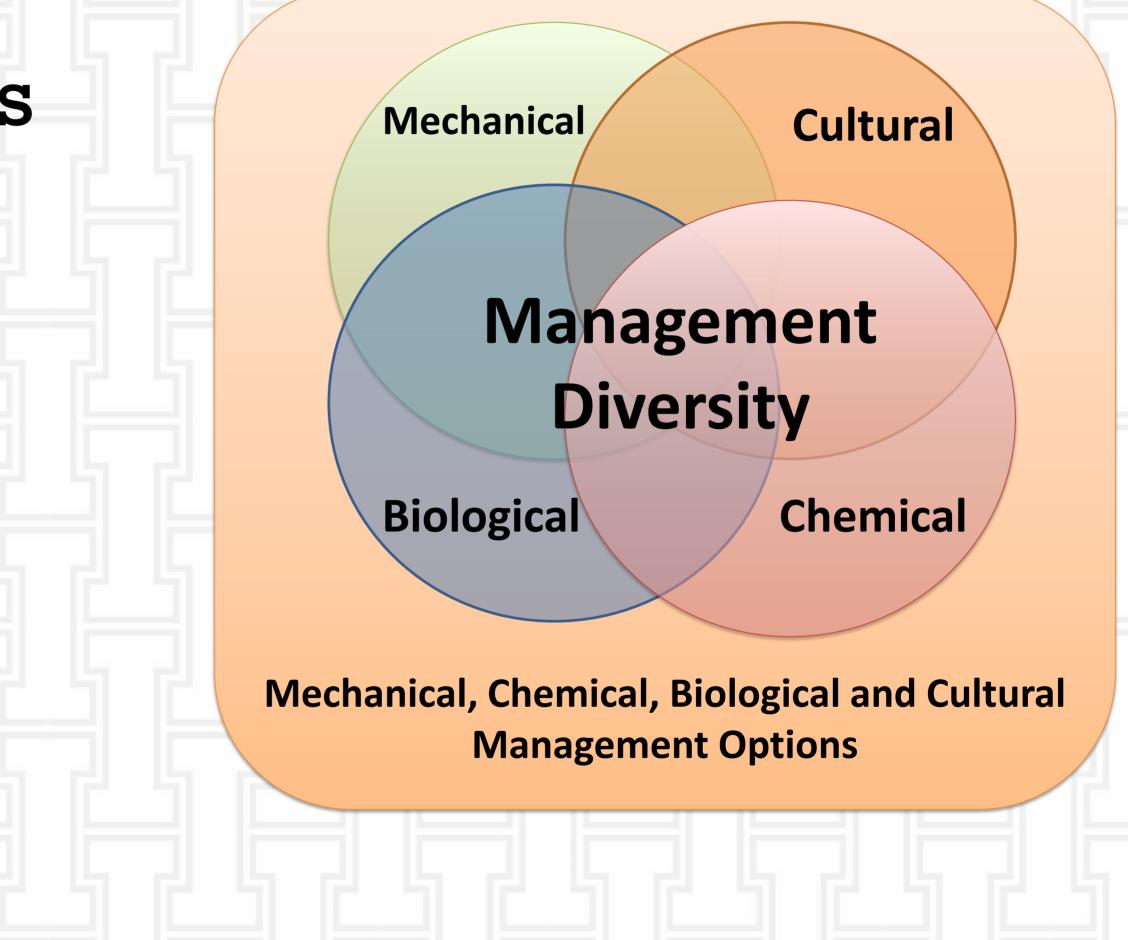
- **THREE SCENARIOS**
- **CUSTOMIZE YOUR TANK MIXTURE**



INTEGRATED WEED MANAGEMENT IN POTATO CROPPING SYSTEMS

Makes use of all tools available:

Biological
Cultural
Mechanical
Chemical



University of Idaho



INTEGRATED WEED MANAGEMENT IN POTATO **CROPPING SYSTEMS: MECHANICAL AND CHEMICAL**

Current practices in potatoes include:

Cultivation Herbicides

Combination often more effective than either alone

University of Idaho





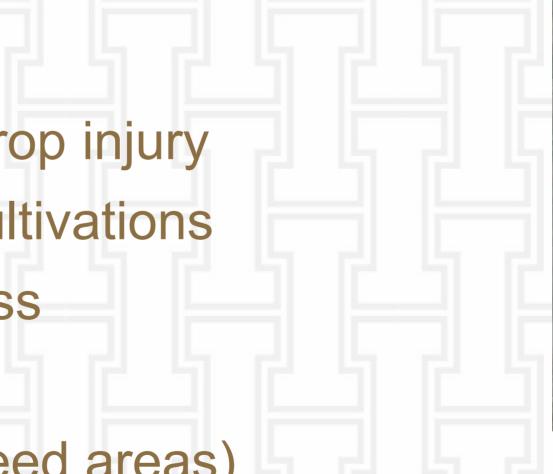
INTEGRATED WEED MANAGEMENT IN POTATO **CROPPING SYSTEMS: MECHANICAL**

Cultivation +'s

- Less expensive than herbicides
- No chemical residues
- Wind not an issue

Cultivation –'s

- Soil compaction, root pruning-crop injury
- Heavy infestations = Multiple cultivations
- Wet soil interferes with timeliness
- In-row weed control difficult
- Disease-spread (important in seed areas)





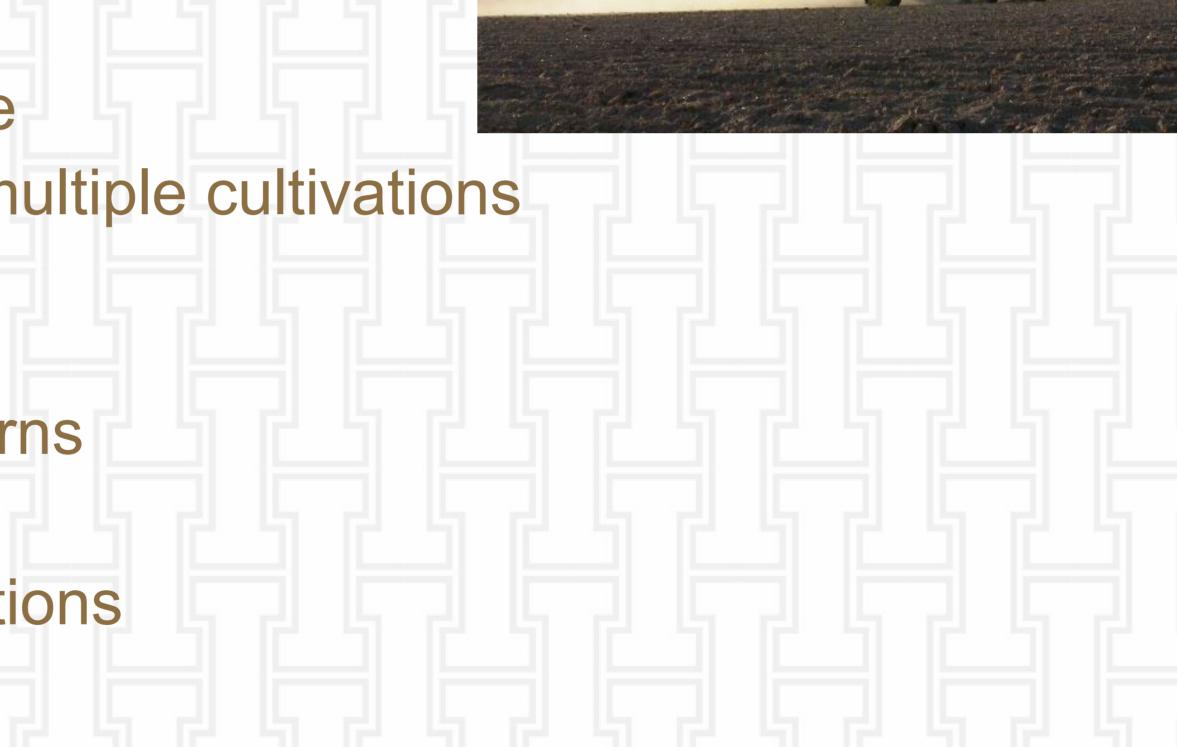
University of Idaho





INTEGRATED WEED MANAGEMENT IN POTATO CROPPING SYSTEMS: HERBICIDES

Herbicide +'s very effective faster to spray than cultivate •often single application vs multiple cultivations Herbicide –'s environmental/safety concerns potential for crop injury carryover/plant-back restrictions cost

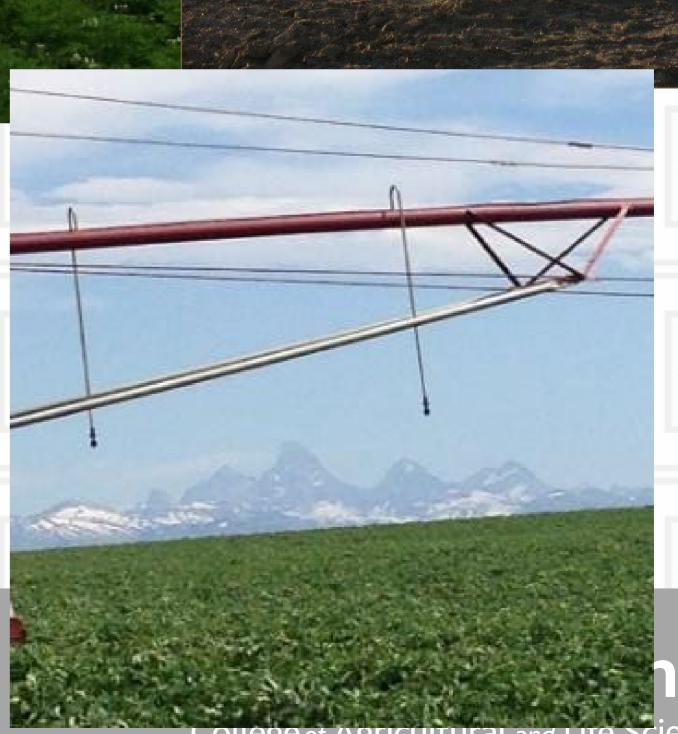


University of Idaho



HERBICIDE APPLICATION

- Application methods:
 - Aerial or ground then incorporated via sprinkler (rainfall) or mechanically
 - Chemigation
- Timing:
 - **PPI** = pre-plant incorporated
 - PRE = preemergence to crop and/or weed
 - POST = postemergence to crop and/or weed





Hilling - cultivation with equipment throwing soil out of the furrow up into the row area to form a hill Last tillage operation in the field because it would break the "herbicide barrier" bringing up nontreated soil and weed seeds





University of Idaho



Foliar activeSoil activeSoil active only***Both Soil and Foliar activeAim and others (carfentrazone-ethyl)Chateau (flumioxazin)*Dual Magnum (s-metolachlor)Matrix and others (rimsulfuron) Magnum in CanadaPrism (rimsulfuron) Only as a pre-plant Linex or Lorox (linuron)*Prism (rimsulfuron) Magnum in CanadaMatrix is and others (rimsulfuron) Matrix is not labeled as Dual II Magnum in CanadaPrism (rimsulfuron) Only for use in Car Titus Pro (co-pack metribuzin + rimsu Only for use in Carglyphosate (various trade names)Outlook and others (dimethenamid-p)Eptam (EPTC)Matrix is not labeled for use in Canada (see Prowl H2O and others (pendimethalin)Prowl H2O and others (pendimethalin)Poliar Active Will only controlparaquat (various trade names)Reflex (fomesafen)Treflan HFP (trifluralin)metribuzin (various trade names)*Select (Clethodim) others (metolachlor)Sequence (pre-mix of glyphosate + s-metolachlor)sulfentrazone (various trade names)*Me-Too-Lachlor and others (metolachlor)Poast Plus, Poast U and others (pre- sulfentrazone MTZ (pre-mix of Sulfentrazone MTZ (pre-mix of sulfentrazone MTZ (pre-mix of sulfentrazone MTZ (pre-mix ofBoundary and others (pre- metolachlor)Venture (fluazifop-	Pre-plant and/or PRE	PRE ONLY	PRE and/or POST**		POST only
(carfentrazone-ethyl) Only as a pre-plant burndown In Canada(flumioxazin)*(s-metolachlor) Labeled as Dual II Magnum in Canadaothers (rimsulfuron) Matrix is not labeled for use in Canada (see Prowl H2O and others (parious trade names)Only for use in Can Titus Pro (co-pack metribuzin + rimsu Only for use in Can Duly for use in Can Duly for use in Canada (see Prowl H2O and others (pendimethalin)Only for use in Can Titus Pro (co-pack metribuzin + rimsu Only for use in Can Duly for use in Can Duly for use in Can Duly for use in Can Prowl H2O and others (pendimethalin)Only for use in Can Titus Pro (co-pack metribuzin + rimsu Only for use in Can Duly for use in Can Duly for use in Can Prowl H2O and others (pendimethalin)Only for use in Can Titus Pro (co-pack metribuzin + rimsu Only for use in Can Duly for use in Can Duly for use in Can Powl H2O and others (pendimethalin)Only for use in Can Titus Pro (co-pack metribuzin + rimsu Only for use in Can Duly for use in Can Duly for use in Can Duly for use in Can Posst Plus, Post Duly Posst Plus, Post Du and others (pre- mix of s-metolachlor)* Tas foliar activity on weeds AND potates somust be applied only preemergence (PIL) to potates.Boundary and others (pre- metribuzin) metribuzin)Only for use in Can Post Plus, Post Duly* Tas foliar activity on weeds AND potates somust be applied only preemergence (PIL) to potates.Post Plus, Post Plus POSI - POSI + POSI - FOIL Follow the label for your area.				Both Soil and Foliar active	
burndown In Canada Linex of Lorox (Infuron)** Magnum in Canada Matrix is not labeled for use in Canada (see (various trade names) Titus Pro (co-pack metribuzin + rimsu Only for use in Can (various trade names) paraquat (various trade names) Outlook and others (dimethenamid-p) Eptam (EPTC) In Canada (see Prism) FOLIAR ACTIVE Will only control paraquat (various trade names) Reflex (fomesafen) Treflan HFP (trifluralin) metribuzin (various trade names)* Select (Clethodim) Sequence (pre-mix of glyphosate + s-metolachlor) (s-metolachlor only has soil activity) sulfentrazone (various trade names)* Me-Too-Lachlor and others (metolachlor) metribuzin (various trade names) Select (Clethodim) Sulfentrazone MTZ (pre-mix of sulfentrazone + metribuzin)* Labeled as Sencor STZ (a co- pack) in Canada Boundary and others (pre- mix of s-metolachlor + metribuzin) Venture (fluazifop- Only for use in Can * Has foliar activity on weeds AND potatoes somust be applied only preemergence (PRE) to potatoes. Setup to potatoes. **	(carfentrazone-ethyl) Only as a pre-plant		(s-metolachlor)	others (rimsulfuron) <i>Matrix is not</i> <i>labeled for use</i> <i>in Canada</i> (see	Prism (rimsulfuron) Only for use in Can
glyphosate Outlook and others Eptam (EPTC) Indeled for use in Canada (see in Canada (see prism) Only for use in Canada (see prism) paraquat Reflex (fomesafen) Prowl H2O and others (pendimethalin) Prism) FOLIAR ACTIVE Will only control NOT FOR USE IN CANADA Sonalan HFP (ethalfluralin) Treflan HFP (trifluralin) metribuzin (various trade names) Select (Clethodim) NOT FOR USE IN CANADA sulfentrazone (various trade names)* Me-Too-Lachlor and others (metolachlor) Poast Plus, Poast Rando others (premix of glyphosate + s-metolachlor) Sulfentrazone MTZ (pre-mix of sulfentrazone 4 metribuzin)* Boundary and others (premix of s-metolachlor) Venture (fluazifop-Only for use in Canada * Has foliar activity on weeds AND potatoes somust be applied only preemergence (PRE) to potatoes. ** Somalan HFE POST or POST + POST. Follow the label for your area. Venture and others (premix of s-metolachlor) Not for use in Canada		Linex or Lorox (linuron)*			Titus Pro (co-pack) metribuzin + rimsu
paraquat (various trade names) NOT FOR USE IN CANADA Reflex (fomesafen) Prowi H2O and others (pendimethalin) Prism) FOLIAR ACTIVE Will only control Sequence (pre-mix of glyphosate + s-metolachlor) (s-metolachlor) (s-metolachlor only has soil activity) Sonalan HFP (ethalfluralin) Treflan HFP (trifluralin) metribuzin (various trade names)* Select (Clethodim) Suffentrazone (various trade names)* Me-Too-Lachlor and others (metolachlor) mames) Poast Plus, Poast U and others (sethox Suffentrazone MTZ (pre-mix of sulfentrazone + metribuzin)* Labeled as Sencor STZ (a co- pack) in Canada Boundary and others (pre- mix of s-metolachlor + metribuzin) Venture (fluazifop- Only for use in Car * Has foliar activity on weeds AND potatoes so must be applied only preemergence (PRE) to potatoes. Foetatoes.	glyphosate (various trado namos)		Eptam (EPTC)		Only for use in Cana
NOT FOR USE IN CANADA Sonalan HFP (ethalifluralin) Irefian HFP (trifluralin) metribuzin (various trade names) Select (Clethodim) Sequence (pre-mix of glyphosate + s-metolachlor) (s-metolachlor only has soil activity) sulfentrazone (various trade names)* Me-Too-Lachlor and others (metolachlor) Poast Plus, Poast Q and others (sethor) Sulfentrazone MTZ (pre-mix of sulfentrazone + metribuzin)* Labeled as Sencor STZ (a co- pack) in Canada Boundary and others (pre- mix of s-metolachlor + metribuzin) Venture (fluazifop- Only for use in Car metribuzin) * Has foliar activity on weeds AND potatoes somust be applied only preemergence (PRE) to potatoes. **	p araquat (various trade names)				FOLIAR ACTIVE Will only control
Sequence (pre-mix of glyphosate + s-metolachlor) (s-metolachlor only has soil activity) sulfentrazone (various trade names)* Me-Too-Lachlor and others (metolachlor) names) Poast Plus, Poast Rual and others (sethors) Sulfentrazone MTZ (pre-mix of sulfentrazone + metribuzin)* Labeled as Sencor STZ (a co- pack) in Canada Boundary and others (pre- mix of s-metolachlor + metribuzin) Ne-Too-Lachlor and others (metolachlor) Names) Poast Plus, Poast Rual and others (sethors) * Has foliar activity on weeds AND postores so must be applied only preemergence (PRE) to potatoes. Me-Too-Lachlor and others (metolachlor) Names) Poast Plus, Poast Rual and others (sethors) * Has foliar activity on weeds AND potatoes so must be applied only preemergence (PRE) to potatoes. Me-Too-Lachlor and others (metolachlor) Names) Names) Poast Plus, Poast Rual and others (sethors) * Has foliar activity on weeds AND potatoes so must be applied only preemergence (PRE) to potatoes. Me-Too-Lachlor and others (metolachlor) Names) Names)<		Sonalan HFP (ethalfluralin)	Treflan HFP (trifluralin)		Select (Clethodim)
(s-metolachlor only has soil activity) Sulfentrazone MTZ (pre-mix of sulfentrazone + metribuzin)* Labeled as Sencor STZ (a co- pack) in Canada Metribuzin) * Has foliar activity on weeds AND potatoes so must be applied only preemergence (PRE) to potatoes. * Some of these herbicides may be applied PRE + POST or POST + POST. Follow the label for your area.	(pre-mix of glyphosate + s-metolachlor) (s-metolachlor only has			names)	Poast Plus, Poast U and others (sethoxy
soil activity) Suffentrazone IVITZ (pre-mix of suffentrazone VITZ (pre-mix of suffentrazone + metribuzin)* mix of s-metolachlor + Only for use in Car Labeled as Sencor STZ (a co- metribuzin) metribuzin) Metribuzin) Metribuzin) * Has foliar activity on weeds AND potatoes so must be applied only preemergence (PRE) to potatoes. Venture (Inda2nop- ** Some of these herbicides may be applied PRE + POST or POST + POST. Follow the label for your area. Venture (Inda2nop-		Zidua (pyroxasulfone)			
** Some of these herbicides may be applied PRE + POST or POST + POST. Follow the label for your area.		sulfentrazone + metribuzin)* Labeled as Sencor STZ (a co-	mix of s-metolachlor +		Venture (fluazifop-p Only for use in Can
			· ·		
AUTIONED AT A SULACIVE, ANTALOES CALLATE THESE DELATIONES ADDREA FOST, SOME STORATOR FOR OTAL OTAL	·		-		

READ AND FOLLOW THE LABEL – SOME PRODUCTS ARE NOT LABELED FOR USE IN BOTH THE U.S. AND CANADA OR IN ALL STATES/PROVINCES, OR FOR APPLICATION TIMINGS SHOWN IN THIS TABLE. Product names are registered trademarks. Products may have tradenames not shown.



Three scenarios: 1) Plant- Hill- Spray same operation Plant 2) Potato Emergence 3) Plant Drag-off Potato emergence

HERBICIDE AND CULTIVATION TIMING

- **Hilling and Herbicide Application**

Hilling and Herbicide Application





Plant

3-4 weeks No competition



Potato emergence



Row close

~ 5 weeks to row close Crop starting to compete





Plant, Hill, Spray

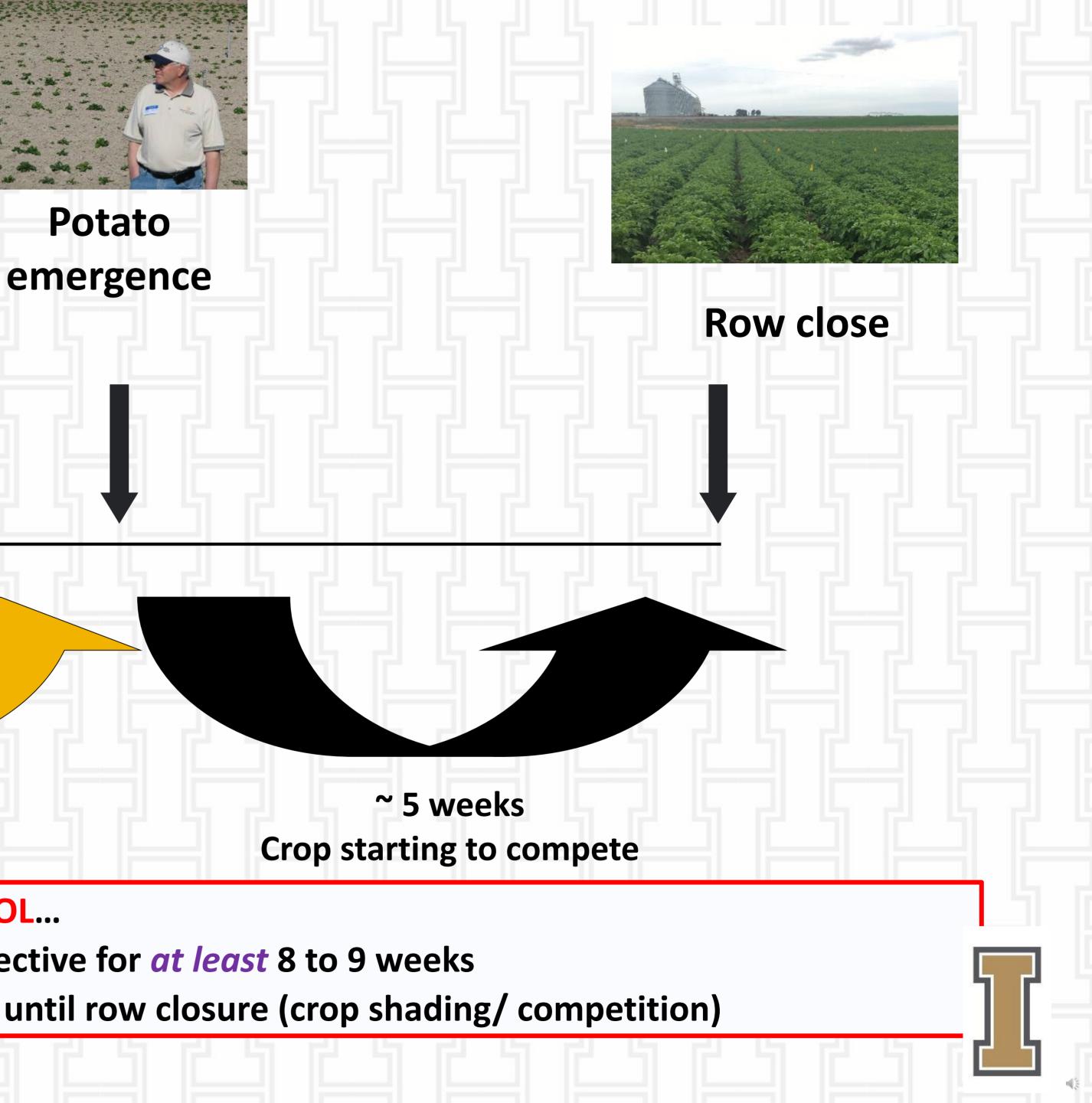
Hill at planting (or fall-bed) then apply soilresidual herbicides immediately ALL ARE LABELED for this TIMING)

> 3-4 weeks No competition

Shooting for SEASON-LONG CONTROL...

However, herbicides must be effective for *at least* 8 to 9 weeks \bullet from application time at planting until row closure (crop shading/ competition)

Scenario 1







A spray w/ foliar active herbicides may be needed If weeds emerge before potatoes emerge (all labeled* AND Roundup or Aim!) Tillage would be a no-no

Plant, Hill, Spray

Hill at planting (or fall-bed) then apply soilresidual herbicides immediately (ALL ARE LABELED for this TIMING)

3-4 weeks

What if weeds come up after herbicide application???

Scenario 1



Potato emergence If weeds come up after potato emergence herbicides w/ foliar activity may be necessary (Mat and/or Met*) Tillage would be a no-no

~ 5 weeks



Row close



In order for the foliar-active herbicides to be effective, weeds should not be >2 inch

Just about right

If foliar herbicides are needed before and/or after potato emergence

Plant,

Scenario 1

w close **TOO BIG!!!**





Plant

"Drag off" after planting but before potato emergence

3-4 weeks

Scenario 2



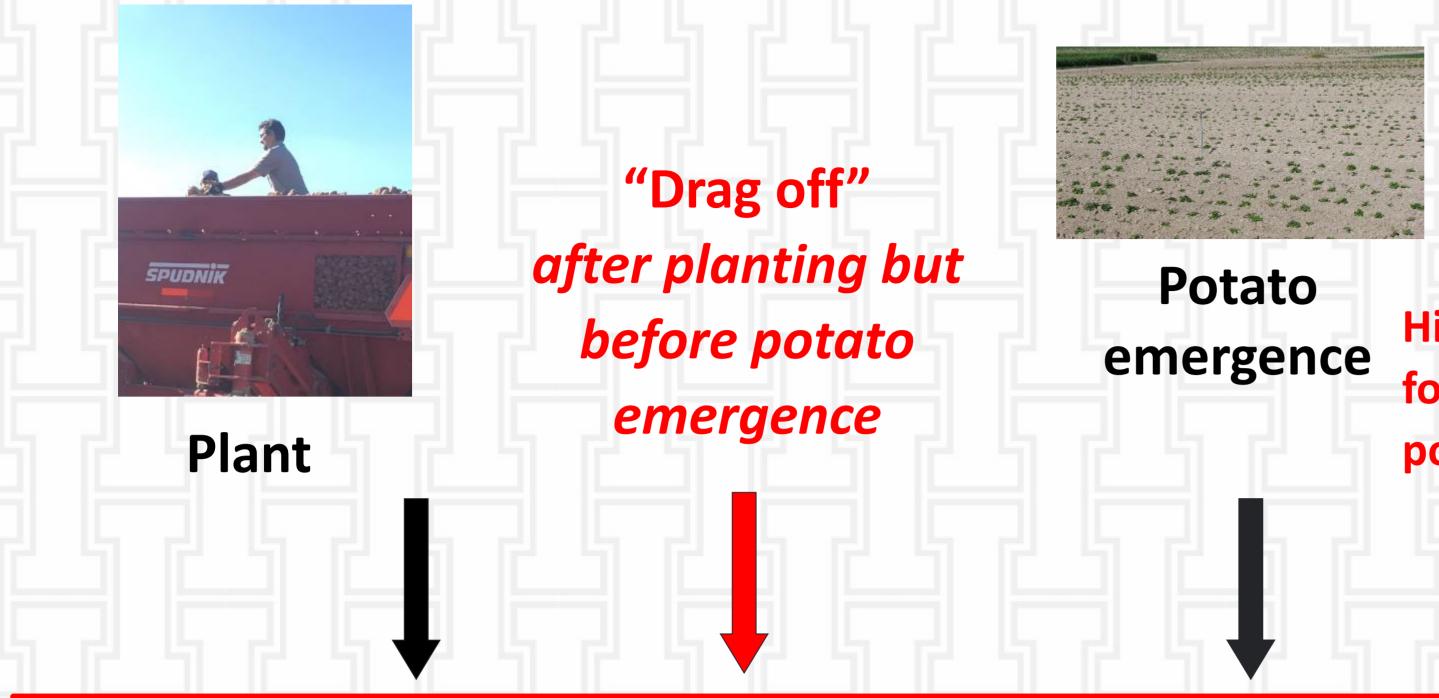
Potato
emergenceHilling after emergence
followed by planned
postemergence spray



Row close

~ 5 weeks





Now only herbicides which do not injure the emerged potatoes can be used

- Only two have foliar activity on broadleaf and grassy weeds Matrix and metribuzin
- The others have soil residual but will not control emerged weeds (Prowl H2O, Dual Magnum, Eptam)

Do not wait too long to hill!

Hilling after emergence followed by planned postemergence spray





INTEGRATED WEED MANAGEMENT IN POTATO CROPPING SYSTEMS: MECHANICAL



Ideal weed stage for control with cultivator is ≤ 2 leaf



INTEGRATED WEED MANAGEMENT IN POTATO CROPPING SYSTEMS: MECHANICAL

 3 to 4 inch tall weeds can still be eliminated sometimes, however, when > 4 inch, then cultivation is not effective
 If cultivator is not set up properly, weeds may be left on side of hills

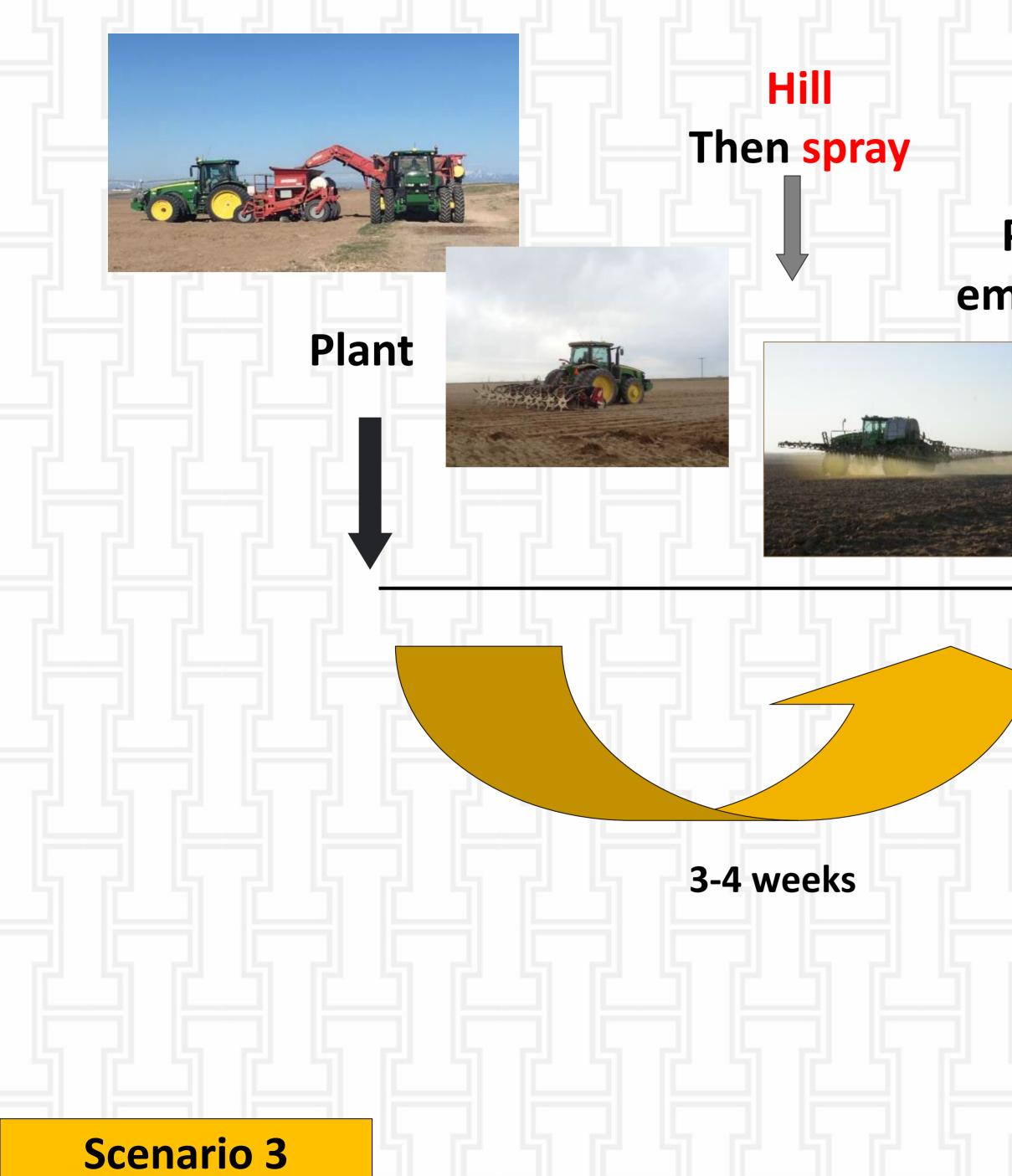
Even though large weeds are initially covered with soil during a cultivation, they can survive and re-emerge Time irrigation before cultivation so that weeds are not stressed because it is too dry; delay after cultivation so that compaction does not occur because its too wet, and weeds can't "re-root

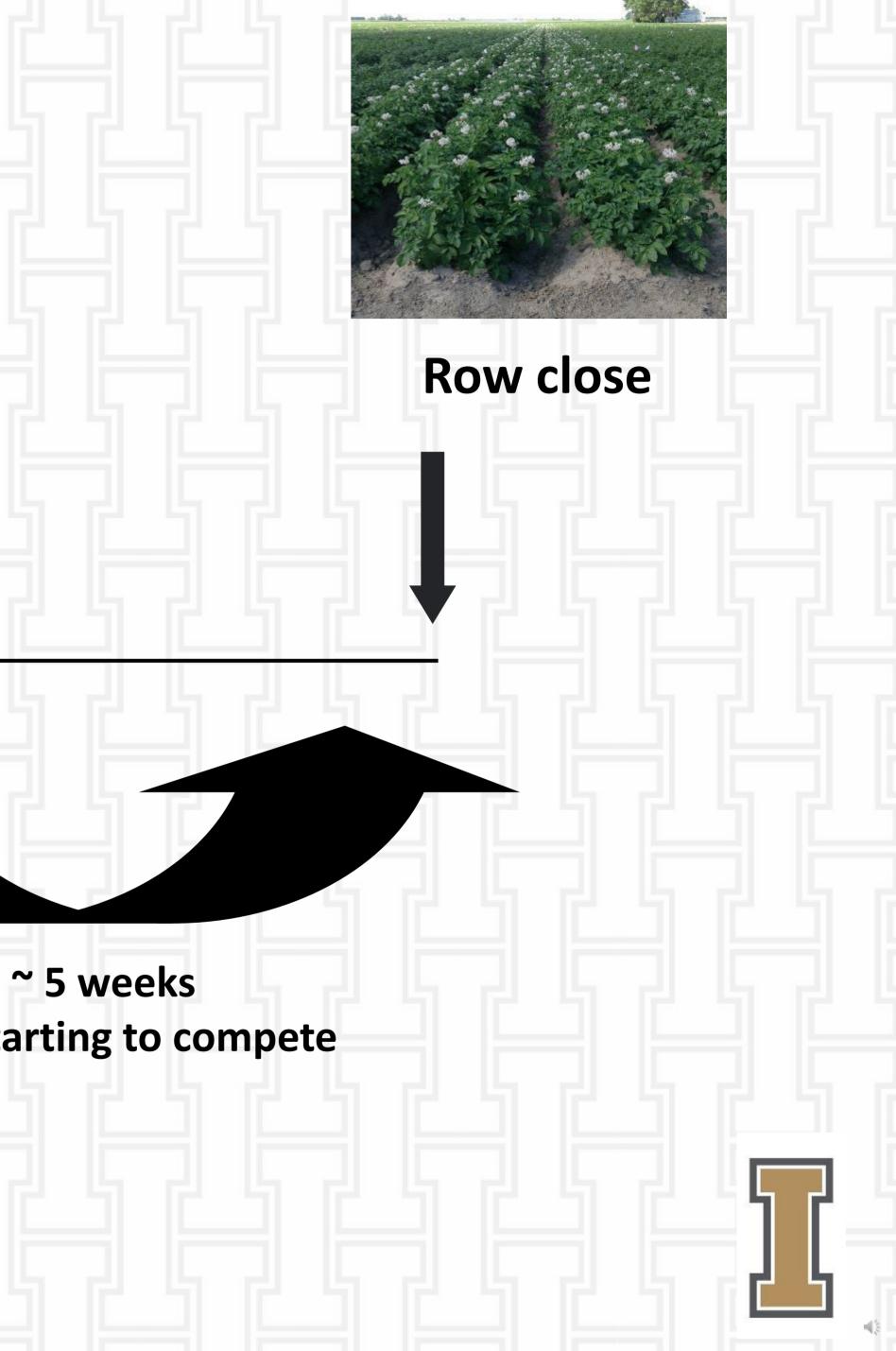


INTEGRATED WEED MANAGEMENT IN POTATO CROPPING SYSTEMS: MECHANICAL Cultivation of potatoes larger than 8 to 10 inches tall may result in root pruning and reduced tuber yields and quality











Potato emergence

Crop starting to compete

Hilling-reservoir tillage before potato emergence Hilling operation "takes out" any emerged weeds

Must be <2 inch tall

Scenario 3



- **Apply soil residual herbicides** preemergence to the potatoes ASAP
- after hilling

Coordination between hilling and herbicide application is very important

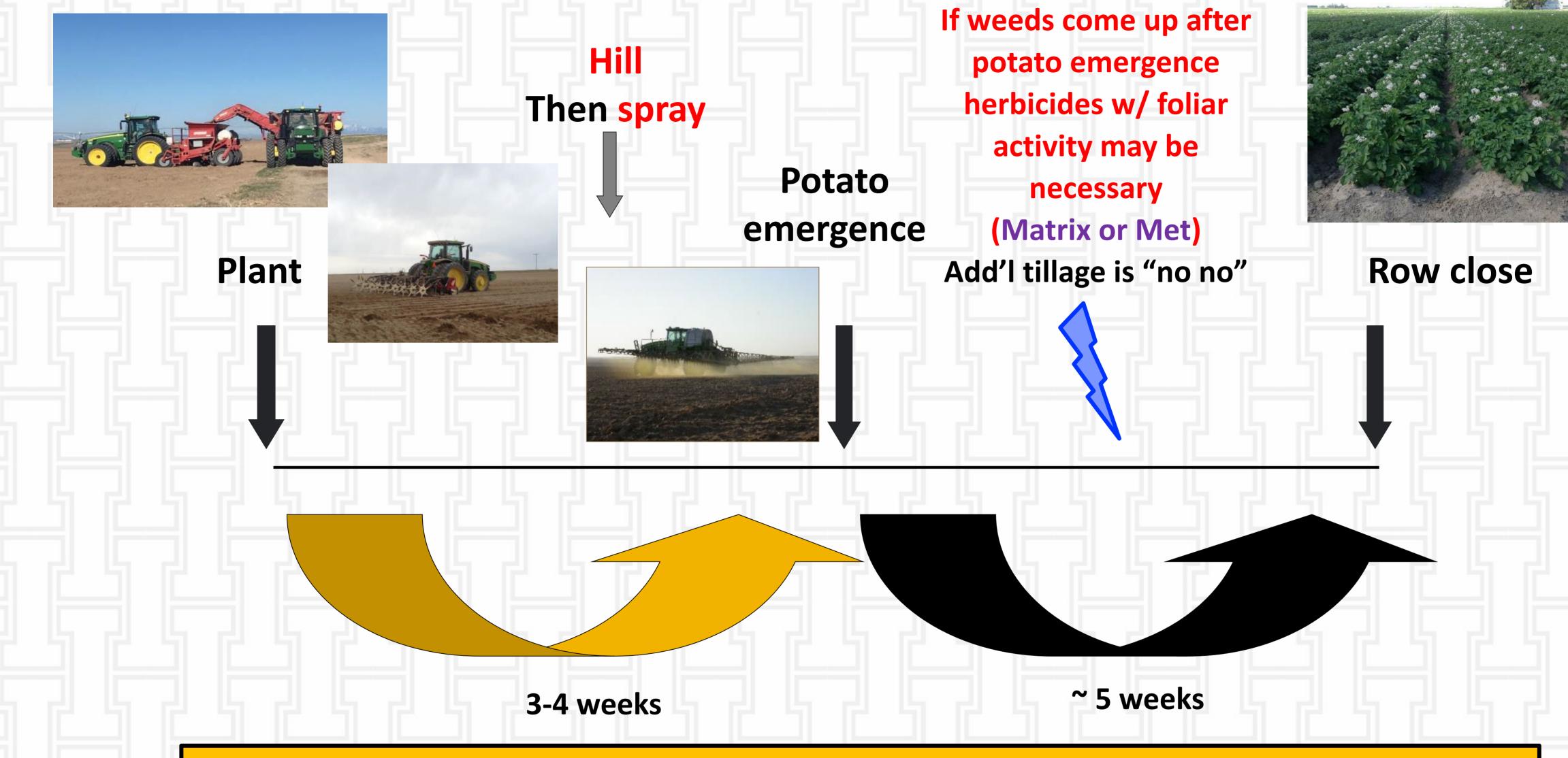
Don't want any weeds to emerge before herbicide

application, otherwise a herbicide with foliar activity

must be included in the tank mixture







Better setup for season-long control

Scenario 3

Now the interval between application and row close is not as long



SOLUBILITY OF HERBICIDES LABELED FOR USE IN POTATO

Herbicide Matrix Metribuzin Outlook Sulfentrazone Dual Magnum Eptam Lorox/Linex Reflex Zidua Chateau Sonalan Treflan Prowl H2O

water solubility ppm (pH 7 25° C) 7,300 1,220 1,174 pH 7.5 160,000 488 370 81 50 3 1.78 0.3 0.3 0.2

The greater the value (ppm) relative to that of the other herbicides, the more soluble.

Solubility high to low

Matrix > metribuzin, Outlook > Sulfentrazone* >

Dual Magnum, Eptam > Linex, Reflex >

Zidua, Chateau, Sonalan, Treflan, Prowl H2O

What happens to these herbicides after excess spring rainfall?

Depending upon soil characteristics, the more soluble the herbicide, the more available it is for uptake AND the further it can move down in the soil profile.



INTEGRATED WEED MANAGEMENT IN POTATO **CROPPING SYSTEMS: HERBICIDE – SANDY SOILS**

Herbicides are in the weed germination zone longer into the season

Highly soluble herbicides may be leaching below the weed-seed germination zone which in turn allows weed breaks Matrix, metribuzin

Herbicides not as soluble may be more effective in sandy soils Zidua, Chateau, Linex, Prowl H2O

Chemigation and sprinkler incorporation

- Follow label instructions
- Coarse- to medium-textured soils use less than 0.5 inches especially if dry

- Timing hilling and herbicide application closer to potato emergence

University of Idaho College of Agricultural and Life Sciences













NIGHTSHADE SP





Black nightshade





Eastern black nightshade





Hairy nightshade



 \sum

Solanum physalifolium The weed formerly known as Solanum sarrachoides

S. Physalifolium Rusby var. *nitidibaccatum*





SOLANUM PHYSALIFOLIUM RUSBY...

Solanum physalifolium

Rusby

var. physalifolium









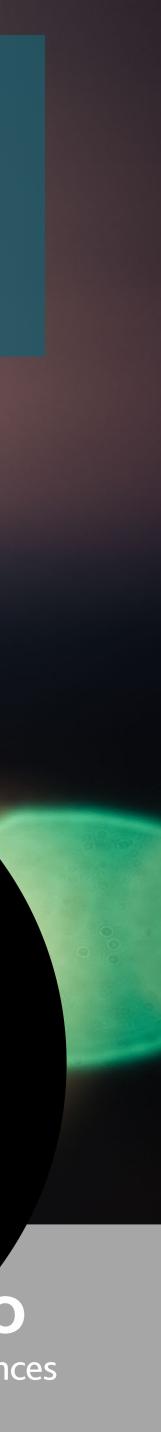
Solanum Physalifolium Rusby var. nitibaccatum



dentate leaf margin





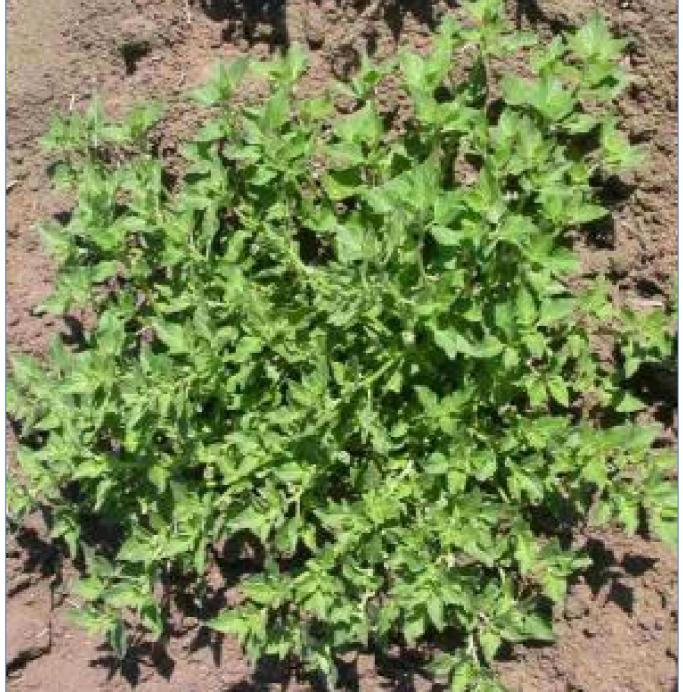


HAIRY NIGHTSHADE



Annual – 12 to 24 inches However, hairy nightshade with spreading growth is common







HAIRY NIGHTSHADE

Begins germination in early spring and continues germinating throughout the summer

- Doesn't need light to germinate
- Germinates under wide temperature range

Produces flowers and fruit until the end of the growing season in PNW: Can produce viable seed as soon as 4 to 5 weeks after flowering and as late as 6 to 7 weeks before a killing frost



A light frost does not kill













HAIRY NIGHTSHADE

A large plant can produce 1700+ berries

10 to 35 seeds per berry

Innate dormancy for 4+ months after maturity Seed buried in the field can develop dormancy when

exposed to high temperatures

Longevity in soil:

- 5 yrs = 90% germination
- 8 yrs = 2% germination

Reports of germination after 39 years in soil

If seed production is allowed, hairy nightshade control becomes even more difficult next time potatoes are planted in a 3 or 4 year









University of Idaho hairy nightshade competition and critical interference research:



One hairy nightshade/ m row present from emergence to harvest reduced Russet Norkotah total ylds 16% Two per m row in **R. Burbank reduced yields 10% R. Norkotah must be totally** weed-free from 7 to 22 days after emergence or a or greater yield loss will occur







Black nightshade (Solanum nigrum L.)

- Introduced from Europe
- Annual grows up to 3 feet tall and are usually erect
- Shallowly lobed, egg-shaped leaves that may reach 4 inches long
- Stems and leaves are not generally hairy, although the upper surface of the leaves may bear some rough, sparse hairs
- Berries are first green then turn black/purple as they ripen 15 to 60 seeds per berry











Eastern black nightshade (S. ptycanthum Dunal)

- Native to Europe or the Americas?
- Annual, highly branched, 1 to 3 ft tall
- Germinates from May through July
- Eastern black nightshade leaves are dark green, not hairy, and are often reddish-purple on underside
- Eastern black nightshade leaves often are covered with holes from flea beetle feeding





- Similar to black nightshade, berries are first green then turn black/purple as they ripen
- Can produce 1,000 or more berries per plant
- 50 to 100 seeds per berry
- Ackley says EBN susceptible but not Black
- ALS resistance in Midwest states

Millman et al. 2000

- Rimsulfuron did not control E Black nightshade in a 1997-1999 ND study – they siid naturally tolerant
 - **Greenland and Howatt 2005. Hort science**

Eastern black nightshade (S. ptycanthum Dunal)





Hairy nightshade

Black nightshade





Hairy nightshade More drought tolerant than EBN

Cutleaf nightshade





Hairy nightshade emerges earlier than EBN and grows faster first 21 days HNS ht max mid-July EBN ht max mid-August

Nightshade sp







Eastern black nightshade More shade tolerant than HNS







University of Idaho







REALITY CHECK... THERE'S MORE THAN ONE WEED SPECIES IN A FIELD!



CHANGES FROM FIELD TO FIELD... SO THE SAME TANK MIXTURE WILL NOT WORK FOR ALL FIELDS!

...AND THE MIX OF SPECIES

CREATE AND USE A HERBICIDE TANK-MIX PARTNER TEMPLATE TO CUSTOMIZE MIXTURES DEPENDING UPON WEED SPECIES IN A FIELD.

TARGET THE WEED SPECIES PRESENT IN A FIELD : CHANGE THE HERBICIDES FOR A DIFFERENT FIELD WITH DIFFERENT WEEDS.



University of Idaho Extension Bulletin 950

Managing weeds in potato fields with an integrated approach—using all available cultural, mechanical, chemical, and biological tools—is critical. In fact, University of Idaho (UI) research shows that cultural and mechanical practices in potatoes combined with applications of the appropriate berbieldes is much

Targeted Tank Mixtures for Weed

UniversityofIdaho

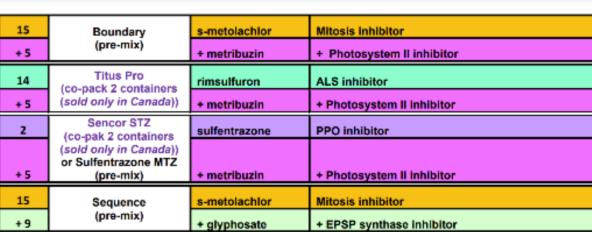
Pamela J. S. Hutchinson

Control in Potatoes

Table 1. Herbicides labeled for use in potatoes: group number/classification, site/mechanism of action, and chemical family

-				
Trade Names ¹	Active Ingredient	Chemical family ²	Site of Action (SOA)	
Poast Plus or Ultra	sethoxydim	Cyclohexapedione		
Select	clethodim	(DIMs)	Acetyl CoA carboxylase	
Venture			(ACCase) inhibitor	
(sold only in Canada)	fluazifop-butyl	propionate (FOPs)		
Matrix (Prism in Canada)	rimsulfuron	sulfonylurea (S.U.s)	Inhibits Acetolactate synthase (ALS) (aka Acetohydroxyacid synthase (AHAS))	
Prowl H2O	pendimethalin			
Sonalan HFP	ethalfluralin		Microtubule assembly inhibitor	
Treflan HFP	trifluralin	(DINA S)	innipitor	
			Inhibits photosynthesis at	
TriCor 4F and others	metribuzin	triazinone	Photosystem II (PS II) Site A	
Linex Lorox	linuron	urea	Inhibits photosynthesis at Photosystem II (PS II) site A; different behavior from Group 5	
Eptam	EPTC	ghiocarbamate	Lipid synthesis inhibitor (not ACCase)	
Roundup PowerMax, Touchdown, and others	glyphosate	glycine	EPSP synthase inhibitor	
Rely	glufosinate (for vine kill only	phosphinic acid	Glutamine synthetase inhibitor	
Chateau	flumioxazin	N-phenylphthalimide		
Sulfentrazone	sulfentrazone	triazolinone	1	
Rely	fomesafen	diphenylether	Protoporphyrinogen	
Aim EC	carfentrazone-ethyl	triazolinone	oxidase (PPO) inhibitor	
Vida	pyraflufen ethyl			
	())			
Dual II Magnum	s-metolachlor			
metolachlor (various trade names)	metolachlor	chloroacetamides	Mitosis inhibitor	
Outlook	dimethenamid-p			
Zidua	pyroxasulfone	isooxazoline		
Zidua Gramoxone and others	pyroxasulfone Paraquat	isooxazoline	Photosystem I (PSI)	
	Poast Plus or Ultra Select Venture (sold only in Canada) Matrix (Prism in Canada) Prowl H2O Sonalan HFP Treflan HFP Treflan HFP Treflan HFP Consc Linex Lorox Linex Lorox Chateau Sulfentrazone Rely Chateau Sulfentrazone Rely Vida Dual Magnum/ Dual II Magnum	Poast Plus or UltrasethoxydimSelectclethodimVenture (sold only in Canada)fluazifop-butylMatrix (Prism in Canada)rimsulfuronProwl H2OpendimethalinSonalan HFPethalfluralinTreflan HFPmetribuzinTriCor 4F and othersmetribuzinLinex LoroxilinuronEptamEPTCRoundup PowerMax, Touchdown, and othersglufosinate (for vine kill onlyChateauflumloxazinSulfentrazonesulfentrazoneRelyfomesafenAim ECcarfentrazone-ethyl (for vine kill only)Vidapyraflufen ethyl (for vine kill only)Dual Magnum/ Dual II Magnums-metolachlor metolachlor (various trade names)	Poast Plus or Ultrasethoxydim (DIMS)Cyclohexanedione (DIMS)Selectclethodim(DIMS)Venture (sold only in Canada)fluazifop-butylAryloxyphenoxy- propionate (FOPs)Matrix (Prism in Canada)pendimethalin ethalfluralindinitroanilines (DNA's)Prowl H2Opendimethalin trifluralindinitroanilines (DNA's)Sonalan HFPethalfluralintriazinoneTreflan HFPtrifluralintriazinoneTriCor 4F and othersmetribuzintriazinoneLinex LoroxglyphosateglycineRoundup PowerMax, Touchdown, and othersglyphosateglycineRelyfomesafenHimloxazinN-phenylphthalimideSulfentrazonesulfentrazonetriazolinoneRelyfomesafendiphenyletherAim ECcarfentrazone-ethyl (for vine kill only)triazolinoneVidapyraflufen ethyl (for vine kill only)phenylpyrazoleDual Magnum/ Dual II Magnums-metolachlorchloroacetamides	

Formulated pre-mixes/



¹ Not all trade names are listed. Mention of a trade name in no way endorses that product.

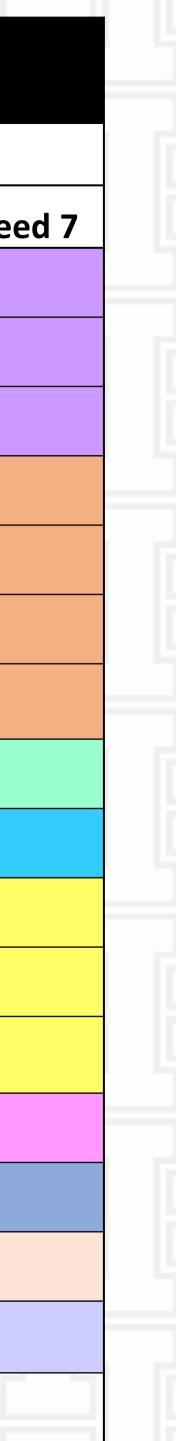
² Only the chemical families for the potato herbicides are listed. Visit <u>www.weedscience.com</u> for information on more chemical families that may be included in each Group.

Adapted from information in the 2021 PNW Weed Management Handbook, Potato chapter; PNW No. 437, Herbicide-Resistant Weeds and Their Management, and other sources such as The International Survey of Herbicide Resistant Weeds available at www.weedscience.com.



Create a Herbicide Tank Mix Partner Choice Chart

SOA			WEE	O SPECIE	S PRESEN	IT IN THE	AREA	
Group #	Herbicides	Weed 1	Weed 2	Weed 3	Weed 4	Weed 5	Weed 6	Wee
14	Chateau (flumioxazin)							
14	Sulfentrazone (various names)							
14	Reflex (formesafen)							
15	Outlook (dimethenamid-p)							
15	Dual Magnum (s-metolachlor)							
15	Metolachlor (various names)							
15	Zidua (pyroxasulfone)							
2	Matrix (and others) (PRE or POST)							
8	Eptam (EPTC)							
3	Sonalan HFP (ethafluralin)							
3	Treflan HFP (trifluralin)							
3	Prowl H2O (and others) (pendimethalin)							
5	Metribuzin (various names)							
7	Linex/Lorox (linuron)							
15 + 5	Boundary (and others)							
14 + 5	Sulfentrazone MTZ							
1	Poast Plus (sethoxydim)/Select (clethodim)							



Create a Herbicide Tank Mix Partner Choice Chart

SOA				WEED) SPECIE	S PRESEN	T IN THE	AREA	
Group #	Herbicides		Weed 1	Weed 2	Weed 3	Weed 4	Weed 5	Weed 6	Weed
14	Chateau (flumioxazin)		Th	is chart	t has su	bace for	up to s	seven w	eed
14	Sulfentrazone (various name	es)			•	est acros	•		
14	Reflex (formesafen)							potato	
15	Outlook (dimethenamid-p)			produc					
15	Dual Magnum (s-metolachle	or)							
15	Metolachlor (various name	Potato herbio	cides o	n the la	eft gro	ouped k	y herb	oicide Si	ite o
15	Zidua (pyroxasulfone)	Action (SOA)	-						
2	Matrix (and others) (PRE o	• The specific	proteir	or bio	chemic	al site i	n the pl	lant to w	vhich
8	Eptam (EPTC)	the herbicid	e binds	(some	times r	eferred	to as M	1echanis	sm o
3	Sonalan HFP (ethafluralin)	Action).							
3	Treflan HFP (trifluralin)	• The SOA Grou	up #'s ai	re inclua	led in tl	his chart	for exp	lanation,	, only
3	Prowl H2O (and others) (p	and are not r	needed i	n the ac	tual Ta	nk Mix F	Partner (Choice Cl	hart.
5	Metribuzin (various names	Color groupir	ng by SC	A would	d be he	lpful.			
7	Linex/Lorox (linuron)		R	rndown	andvi	ne kill pr	oducts	are not	
15 + 5	Boundary (and others)					s chart b			
14 + 5	Sulfentrazone MTZ					n other of			
1	Poast Plus (sethoxydim)/Sel	ect (clethodim)							



Create a Herbicide Tank Mix Partner Choice Chart

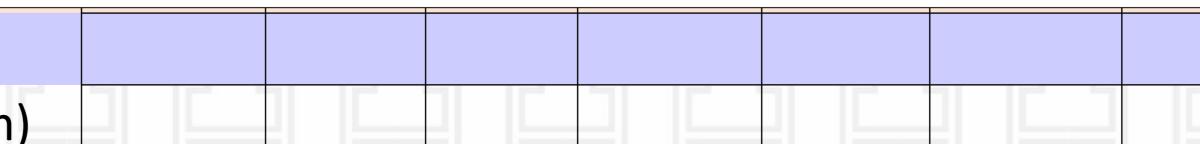
SOA Group #	Herbicides	
14	Chateau (flumiox	azin)
14	Sulfentrazone (v	\checkmark
14	Reflex (formesaf	
15	Outlook (dimeth	
15	Dual Magnum (s	
15	Metolachlor (var	
15	Zidua (pyroxasul ⁻	
2	Matrix (and othe	\checkmark
8	Eptam (EPTC)	•
3	Sonalan HFP (eth	
3	Treflan HFP (trifl	
3	Prowl H2O (and	
5	Metribuzin (vario	
7	Linex/Lorox (linu	
15 + 5	Boundary (and o	
14 + 5	Sulfentrazone M	TZ

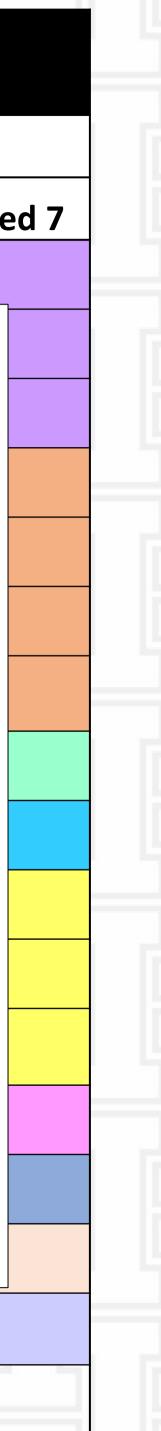
✓ Appropriate tank mixtures and sequential application of herbicides with <u>different SOA</u> can provide control of the <u>multiple weed species</u> present in a given field.

✓ Just as important as using more than one herbicide to control multiple weed species in a field is the <u>use of different SOA herbicide combinations</u> that can <u>control the same weed species</u> in order to prevent or delay the development of a herbicide-resistant population of that species.

Poast Plus (sethoxydim)/Select (clethodim)

WEED SPECIES PRESENT IN THE AREA						
Weed 1	Weed 2	Weed 3	Weed 4	Weed 5	Weed 6	Wee





	Creat v	Veed contro	ol ratings i	n the	ese	charts a
SOA Group #	Herbicides		on-long co			
14	Chateau (flumiox	and	informatio	n on	herk	oicide la
14	Sulfentrazone (var	ious names)				
14	Reflex 2017		Merbi	cide Effectiveness T	on Weeds in 1	Potetoes
15	Outlo	NORTHWEST	Terretoria de la companya		Annual Contract of the second	
15	Dual I		Benardana C. Belandida A. Belana ala . Redata alata . Calana .	$\begin{array}{cccccccccccccccccccccccccccccccccccc$		0 0 0 0 0 2 2 8 8 3 2 8 8 4 4 8 8 4 8 8 4 8 8
15	Metol		turn 24 Semperaturn 24	10 1 1 1 1 n 1 10 n	1 1 10 10 1 1 10 10	0 0 0 0 0 4 0 - 8 8 67 6 6 8 8 67 6 6 8 8 67 6 6 8 8 67 6 6 8 8 67 6 6 8 8 67 6 6 8 8 67 6 6 8 8 67 6 67 8 8
15	Zidua		Function Homeshinah (19) Aprilation (20) Aprilation (20) Aprilation (20)	A I G - PG I I I I I S S S I II I S S S II III III S S S III III III S S S III IIII IIII	1 16 44 - 1 18 14 7 1 1 14 1	4 5 6 8 8 4 5 6 8 8 4 5 6 8 8 4 5 6 8 8 4 5 6 8 8 4 5 6 8 8 4 5 6 8 8 4 5 6 8 8
2	Matri Mee	Anterest	Nomine price 1 On antyme OF On antyme OF Statut OF Statut OF Specification N	0 - 3 3 5 01 8 3 01 1 02 8 4 10 1 04 3 8 6 4 1 04 3 6 6 4 1	4 64 4 - 6 6 6 - 6 - 6 - 6 - 6 - 6	A - A B B d dH d d d d d dH d d d d d d dH d d d d d d d d d d d d d d d d d d d d d d
8	Eptan MANAGE	MENT HANDBOOK	Configurer Sandaucrised /14 Discriminations forstand Discriminations and Sandardis actual	A B B D4 D A B - A - A B - A - A B - A - A B - A - A B - A -		$\begin{array}{cccccccccccccccccccccccccccccccccccc$
3		TY, CALL HILLR PORSON CONTER: 1-000-3221-0232	Tests Asses Tests Asses They advised in F Asses Assess Asses Assess Assess Assess	A B B I I A	· · · · ·	
3	Trefla	apsed or is not isosathing, call (1-1-1) Innih for paisani sidety information.		an being the second material and		nt photo formatur fil your ofgreen
3		erosion Publication y - Nanteegten State Belowesity - Ontersity of Idaho reliens Autos are licited at the start of code section.	e	The line being		
5	Metribuzin (variou	is names)		ingoastings		
7	Linex/Lorox (linuro	on)				CAREFU
15 + 5	Boundary (and oth	ners)				FOLLOV
14 + 5	Sulfentrazone MT	Ζ				
1	Poast Plus (sethox	ydim)/Select	(clethodim)			

are based on

results

bels

College of Agricultural and Life Sciences

CIS 1037

Weed 6

Matrix in Weed Management Systems for Potatoes

by Pamela J.S. Hutchinson, Charlotte V. Iberlein, C. William Kral, and Mary J. Guttieri

Matrix is a sulfonylurea 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 con-

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, a cetolactate synthase, is commonly abbreviated ALS. When ALS is inhibited, cell division ceases, plants stop growing, and they slowly die. Matrix is obsorbed 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 Idaha resistant to ALS-inhibitor herbicides. These resistant bi types will not be controlled by Matrix.

Research in the U.S. and Canada has shown that a number of commonly grown potato varieties have good toleronce to Matrix. However, growers should note that

Potato varietal tolerance to Matrix

HE AREA

5

VVEEU

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

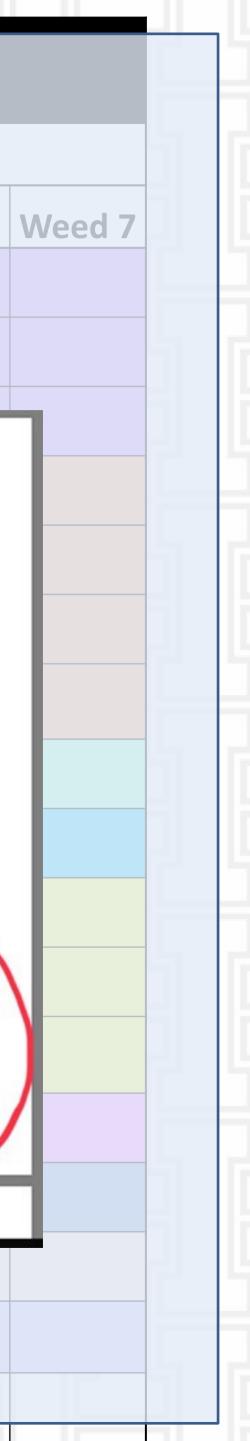
preemergence.		
Variety	Matrix	Sencar
Abutas	Tolerant	Tolerant
Bannock Russet	Tolerant	Tolerard.
Russet Burbank	Tolerant	Toker and
Ranger Russet	Tolerant	Toker and
Russet No-kotah	Tolerant	Toker and
Umatila Russet	Tolerant	Toker and
Chipeta	Tolerant	Tolerant
kdaiRose	Tolerant.	Tolerant
Norland	Tolerant.	Moderatelytoletant
Red LaSoda	Tolerant	Moderately susceptible
Shipody	Tolerant	Susceptible
Adapted	Tolerard	Moderately Susceptible

rectiveness on various weed species

trix 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 lambsquarters 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 cutleaf nightshade, Russian thistle, and wild buckwheat, and require the use of tank-mixtures for control (see tank-mixtures section).

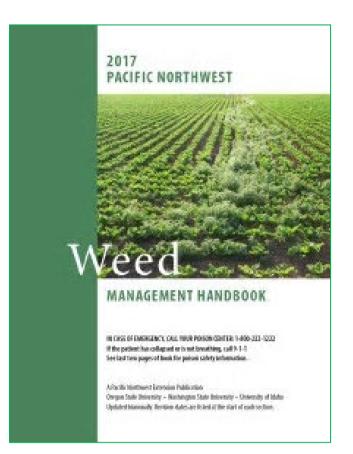
University of Idaho Entension . ho Agricultural Experiment Station

FULLY READ AND W THE LABELS!



POTATO HERBICIDE WEED CONTROL

Table 2A from the PNW Weed Mgt Handbook Potato chapter (2022)



https://pnwhandbooks.org/ weed/agronomic/potato

Herbicides
Chateau (flum
Dual Magnum metolachlor)
Eptam (EPTC)
Linex 4L (linuro Matrix or othe
(rimsulfuron) F
Prism ¹ (rimsulf
POST only, Car
Metribuzin (various trade
PRE/POST
Outlook
(dimethenamio
Prowl 3.3 or H2
(pendimethalin
Reflex (fomesaf Sonalan HFP
(ethalfluralin)
Metolachlor (v
trade names)
Sulfentrazone (various trade
Treflan HFP or c
(trifluralin)
Zidua (pyroxas
Boundarv ²
(S-metolachlor metribuzin)
Sencor STZ (Ca
Sulfentrazone I
and other trade
(metribuzin + sulfentrazone)
SEASON-LO
control; - = n
Herbicide effe
Response of v type, pH, orga
generally deci
¹ Product used
POST.

Broadleaves

	Broadleaf Annuals							Peren	nials		
es	Kochia	Common lambsquarters	Mustard spp.	Cutleaf nightshade	Black nightshade	Eastern black nightshade	Hairy nightshade	Redroot pigweed	Russian thistle	Canada thistle	Field bind wee
mioxazin)	S	S	S	S	G	G	G	S	-	N	-
n (S-	F	F	Р	F-G	F	F	F	G	Р	N	-
	P-F	G	Р	F-G	G	G	G	F-G	Р	Р	Р
ron)	F	G	G	_	_	S	F	G	-	Р	_
ers PRE/POST	G	P/F	G	Ν	G	G	G	G	Ρ	—/F	Р
llfuron) anada only	F-G	S	-	Ν	_	_	F-G	-	_	_	Р
e names)	G	G	G	Ρ	F	P-F	P/F	G	G	F	Р
iid-p)	P-F	Р	Р	F-G	G	G	G	G	_	_	Р
120 in)	G-F	F-G	-	P-F	P-F	P-F	F-P	F-G	G	-	Р
afen)	-	Р	G	F	G	G	F	G	-	Ν	-
)	F-G	F-G	Р	Ι	F	F	F	G	F-G	-	_
(various	F	F	Р	F	F	F	F	G	Р	Ν	_
e e names)	G	G	G	G	G	G	G	F-G	G	-	Р
rothers	F-G	F-G	Р	Р	Р	Р	Р	G	F-G	Р	Р
asulfone)	P-F	_	_	_	F-G	F-G	F-G	F-G	_	_	_
or +	F	F-G	F	F-G	F	F	F	G	F-G	P-F	Р
anada), e MTZ, de names e)	G	G	G	G	G	G	G	G	G	F	Р

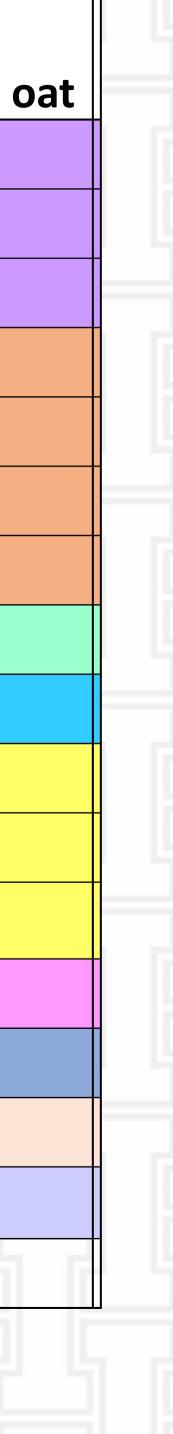
ONG CONTROL: G, good = 90%-100%; F, fair = 80%-89%; P, poor = 0%-30%; N, none = 0%; S, suppression only = approx. 50\% no information available.

ffectiveness chart and control ratings are derived from herbicide labels and potato field research trial results.

weeds to any of the listed herbicides may be altered by growing conditions, weed populations, type of irrigation, genetic variations, soil ganic matter (OM), time of application, and application rate. Ratings may vary from season to season and from site to site. Weed control creases as the season progresses.

ed only in Canada. The Prism rate in Canada is 60 g/ha (0.86 oz/A) POST only. Matrix rate range in the United States is 1–1.5 oz/A PRE or

			Hairy	Redroot	C. lambs-		
He	erbicides	5 weeds and level of	nightshade	pigweed	quarters	Kochia	Wild o
Cha	ateau (flumio	control by each herbicide	G	G	PN	S	N
Sul	lfentrazone (v	various names)	G	G	PN	G	N
Ret	flex (formesat	fen)	F	G	PN	F	S
Ou	tlook (dimeth	nenamid-p)	G	G	PN	F	G
Du	al Magnum (s	s-metolachlor)	F	G	PN	F	G
Me	etolachlor (va	rious names)	F	G	PN	F	G
Zid	lua (pyroxasul	lfone)	F	G	PN	S	F
Ma	atrix (and othe	ers) (PRE or POST)	G	G	PN	F	F
Ept	tam (EPTC)		G	G	S	F	G
So	nalan HFP (et	halfluralin)	PN	G	F	F	G
Tre	e flan HFP (trif	luralin)	PN	G	F	F	G
Pro	owl H2O (and	others) (pendimethalin)	S	G	G	F	F
Me	etribuzin (vari	ous names)	N	G	G	G	G
Lin	ex/Lorox (linu	uron)	F	G	G	F	G
Bo	undary (s-me	tolachlor + metribuzin)	F	G	G	F	G
Sul	lfentrazone N	ITZ (sulfentrazone + metribuzin)	G	G	G	G	G
		tra (sethoxydim)/Select (clethodim)		Ν	N	Ν	G
G	i , good = 90 t	to 100%; F , fair = 80 to 89%; PN , p	oor to none	= 0 to 30%	control;		
N	I , None = 0%	control; S = suppression only, app	rox. 50% co	ntrol			



Петнеч	Example Field with 3 weeds:	nightchada	C. lambs- quarters	Redroot pigweed	Kochia	Gre foxt
Chateau (flumioxa:	Herbicides providing "Good"	G	PN			N
Sulfentrazone (var	control circled	G	PN			N
Reflex (formesafer		F	PN			S
Outlook (dimether	namid-p)	G	PN			G
Dual Magnum (s-n	netolachlor)	F	PN			G
Metolachlor (vario	us names)	F	PN			G
Zidua (pyroxasulfo	ne)	G	PN			F
Matrix (and others	s) (PRE or POST)	G	PN			F
Eptam (EPTC)		G	S			G
Sonalan HFP (etha	lfluralin)	PN	F			G
Treflan HFP (triflur	alin)	PN	F			G
Prowl H2O (and ot	hers) (pendimethalin)	S	G			F
Metribuzin (variou	is names)	Ν	G			G
Linex/Lorox (linuro	on)	F	G	G		G
Boundary (s-meto	lachlor + metribuzin)	F	G	G	F	G
Sulfentrazone MTZ	Z (sulfentrazone + metribuzin)	G	G		G	G
Poast Plus or Ultra	(sethoxydim)/ Select (clethodim)	Ν	N			G
G , good = 90 to	100%; F , fair = 80 to 89%; PN , poo	r to none = 0	to 30% contr	ol;		
N , None = 0% co	ontrol; S = suppression only, approx	x. 50% contro				



[1 2 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		Hairy	C. lambs-
Herbicides:	Example of a 3-	nightshade	quarters
Chateau (flumioxazin)	way tank	G	PN
Sulfentrazone (various names)	mixture:	G	PN
Reflex (formesafen)	Chateau	F	PN
Outlook (dimethenamid-p)		G	PN
Dual Magnum (s-metolachlor)	+ metribuzin	F	PN
Metolachlor (various names)	+ Linex	F	PN
Zidua (pyroxasulfone)		G	PN
Matrix (and others) (PRE or PO	ST)	G	PN
Eptam (EPTC)		G	S
Sonalan HFP (ethalfluralin)		PN	F
Treflan HFP (trifluralin)		PN	F
Prowl H2O (and others) (pendir	methalin)	S	G
Metribuzin (various names)		N	G
Linex/Lorox (linuron)		F	G
Boundary (s-metolachlor + met	ribuzin)	F	G
Sulfentrazone MTZ (sulfentrazo	G	G	
Poast Plus or Ultra (sethoxydim	n)/ Select (clethodim)	N	N
G , good = 90 to 100%; F , fair =	80 to 89%; PN , poor to r	one = 0 to 30% co	ntrol;
N, None = 0% control; S = supp	ression only, approx. 50	% control	









Hairy nightshade and Common lambsquarters Control: Metribuzin alone or tank-mixed with Outlook



Metribuzin controls <u>c.</u> **lambsquarters Does not control hairy** nightshade







Outlook controls h. nightshade Does not control common lambsquarters

> **Trial was conducted at the Aberdeen R&E Center.** control. Herbicides were applied PRE and sprinkler-incorporated w/in 24 hr by 0.5 inches irrigation water Juckey Ak



Metribuzin + Outlook provided 100% **Season-long control of** all weeds in the plot.

CAUTION: This 2-way mix does not have overlapping





metribuzin: SOA Group 5

Metribuzin controls

c. lambsquarters

Does not control hairy

nightshade

Outlook: SOA Group 15

Outlook controls h. nightshade

Does not control common lambsquarters

Overlapping control/activity with different SOA's ???

Hairy nightshade and Common lambsquarters Control: **Outlook tank-mixed with metribuzin**



Metribuzin + Outlook provided 100% season-long control of c. Lambsquarters and h. nightshade



Nontreated: Hairy nightshade and common lambsquarters

Linex: SOA Group 7 common lambsquarters (90-100%) **AND** hairy nightshade (80-89%)

metribuzin: SOA Group 5 common lambsquarters (90-100%)

OUTLOOK + METRIBUZIN + LINEX

WE HAVE OVERLAP!!!

Outlook: SOA Group 15 hairy nightshade (90-100%)





WHAT YOU HEARD TODAY

TIMING **NIGHTSHADES**

- **INTEGRATED WEED MANAGEMENT**
- HERBICIDES LABELED FOR USE IN POTATOES
- **CULTIVATION AND HERBICIDE APPLICATION**

- THREE SCENARIOS
- **CUSTOMIZE YOUR TANK MIXTURE**

University of Idaho College of Agricultural and Life Sciences





WEED MANAGEMENT IN POTATOES RESOURCES

www.weedscience.org WSSA.net/resistance

Want .pdf files of potato extension bulletins? www.cals.uidaho.edu/edCom Online catalog Click on Crop on the side menu Click on Potato:

Potato Production Systems Handbook: Weed chapter

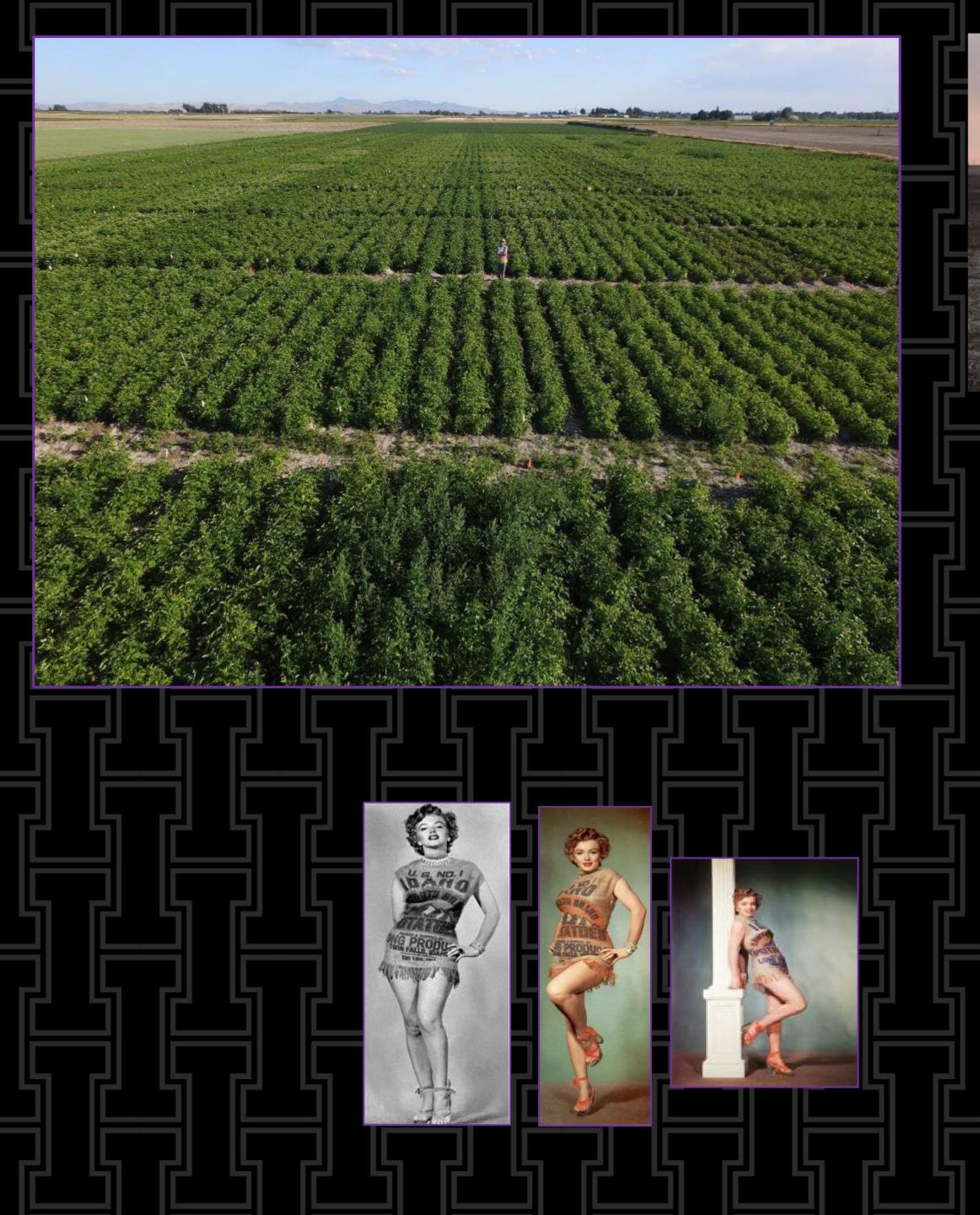
- **CIS 1037** Matrix in Weed Management Systems for Potatoes
- **CIS 1126** Outlook Herbicide for Weed Control in Potatoes
- **CIS 1136** Chateau Herbicide for Use in Potatoes
- **CIS 1185** Weed Control and Potato Crop Safety with Metribuzin

 - In the second second

University of Idaho

College of Agricultural and Life Sciences





Thank you for your time, attention, and interest in my Research and

Extension Program!

Pamela J.S. Hutchinson University of Idaho Potato Cropping Systems Weed Scientist Aberdeen R&E Center phutch@uidaho.edu

