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Low Elevation Spray Application (LESA) for Growing Potatoes

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In some years, growers lack sufficient water to fully irrigate all of their crops. In addition, many growers are being required to cut back on the amount of water they use. There are more efficient methods of irrigation that greatly reduce the amount of water lost to wind drift and evaporation. Most center pivot irrigation systems in the Pacific Northwest are equipped with mid-elevation spray application (MESA) that has an irrigation efficiency of about 85%. MESA has sprinkler heads 3-6 ft above the ground and sprinklers are often spaced about 10 ft apart. Low elevation spray application (LESA) is an alteration to the sprinkler configuration where the spray heads are placed much closer to the ground (12 to 18 inches from the soil surface), and the outlet spacing is less than 5 ft apart (Figure 1). At this height the LESA sprinklers can operate in the canopy when the crops get tall (Figure 2). However, because of the close spacing between the sprinklers this is usually not a problem for crop uniformity.

LESA dramatically reduces water losses to wind drift and evaporation. It also uses less energy since it runs at lower pressures. Research done in 2017 at the WSU Irrigated Agriculture Research and Extension Center in Prosser by Abid Sarwar under the supervision of Dr. Troy Peters found that LESA was able to get 20% more water to the ground per gallon of water pumped than MESA systems. This can result in large improvements to overall yields and/or ground that can be in production, especially if the growers have insufficient water.

Although LESA saves water and energy, it has an increased propensity for runoff in steep or heavy soils because the smaller wetted radius means the same amount of water is applied to the ground in less time. Therefore, fields where ponding and runoff are already a concern may have additional difficulty if converting to LESA.

Figure 1. MESA and LESA operation on the potato field in trial in 2016.

Figure 2. The operation of spray head on the potato crop in LESA.

Concerns and solution for using LESA for potatoes.

LESA sprinkler drops with a 5 ft spacing and very low sprinkler heights (12 inches from the ground) were observed in one trial on potatoes in WA to have irrigation uniformity issues. This was noticeable when the row orientation was parallel or nearly parallel to the direction of the sprinkler movement through the field and when the sprinkler spacing was not evenly divisible by the row spacing. For example, potatoes on 2.5 foot row spacing had uniformity issues with sprinklers on a 4-foot spacing when the sprinklers were in the canopy. Under this scenario at one point of the pivot's rotation, some rows got more water than others did (Figure 3). These issues were less of a problem when the rows were perpendicular to the sprinkler travel direction (sprinklers moved across the rows instead of with them).

One solution for this issue is either to raise the sprinklers slightly so that they are not deep in the canopy when operating, or to decrease the spacing between the LESA drops (use more sprinklers). The spacing between the sprinkler drops can be implemented fairly simply by using a triple sprinkler drop goosenecks when converting MESA to LESA and have one spray in every 2.5 ft space with lower number of nuzzles (Figure 4). These can be purchased from your irrigation parts dealer. Another solution is to raise the spray head slightly higher to allow them to operate above the crop all the time, but not to raise them as high as MESA sprinkler heads. This latter solution won't be as efficient as increasing the number of drops when the crop is shorter.

Figure 3. Irrigation uniformity issues (some rows get more water than others) related to row crops with a row spacing that is different from the sprinkler spacing when the sprinklers are below the top of the canopy *and* when the row direction is nearly parallel to the sprinkler movement direction. This is less of an issue when the sprinkler movement direction is perpendicular to the rows. In this case the sprinklers should be raised slightly; spacing between the sprinklers should be tighter, or they should be set up so that they are even multiples of the row spacing.

Figure 4 : LEPA on alfalfa in Oregon where triple sprinkler drop goosenecks are used to increase the number of sprinkler drops (decrease the drop spacing) without requiring additional outlets in the pivot pipe or truss-rod hose clamps to position the hose correctly.

Put the Right Partner in the Tank

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You've seen articles in past Potato Grower editions about targeting the weed species in each field with the right combination of herbicides and not using the same combination on all fields even if different weed species are present in those fields ("The Right Mix" Potato Grower, May 2018). Crop competition with weeds not controlled season-long will result in the reduction of tuber quality and yield loss which means profit loss from the field. The Tank-mix Partner (TMP) Choice Charts in this article can help concoct the best brew for return on your investment.

Start with a chart such as **TMP Choice Chart 1**. Herbicides labeled for use in potatoes in the U.S. and Canada are in the first column of the TMP Choice Charts. Not all trade names for herbicides are provided in this chart due to space limitations. Trade names specific to Canada are noted. Pre-plant and preemergence burndown herbicides and vine-kill products are not included.

This example chart lists five weed species critical for control in many potato production areas, hairy nightshade, redroot pigweed, common lambsquarters, kochia, and green foxtail, and level of control by each herbicide. *Hopefully all five weeds are not in each field at the same time*! Listing the weeds that are known to be in the area you farm allows you to have a choice of weeds for a specific field. Charts with different weeds that are known to be in an area can be created.

Control levels in the charts are G, Good = 90 to 100%; F, Fair = 80 to 89%; S, Suppress = approximately 50%, PN, Poor to None = 0 to 30%, N, None = 0%. *The goal is to choose herbicide tank mix partners that can provide 90 to 100% (G) season-long control of the weed species in the field of interest*.

<u>Weed control goal</u>

- Best case would be to have a tank mix with 90 to 100% control of all weeds present but it might not be possible. Of course the next best would be to have at least one herbicide with 90 to 100% matched up with a herbicide that can provide 80 to 89% (F) control.

<u>Herbicide resistance management during the potato crop year should also be a goal</u>.

Herbicides in these TMP Choice Charts with similar box color are in the same herbicide mechanism of action (MOA) classification group. Tank mix herbicides with different mechanisms of action in order to attain control of the weeds in a specific field and also to prevent or delay the development of herbicide-resistant weed populations.

- Using the same MOA repeatedly selects the "one-in-a-million" plant that is naturally resistant to that MOA. All normally susceptible are killed while the naturally resistant lives and produces seed. Eventually the field is dominated by a weed that cannot be controlled by a MOA that used to control that weed.
- Choose herbicide tank mix partners with different MOAs that have overlapping control of a weed species present i.e. a species is controlled 90 to 100% (G) with at least two different herbicide MOAs.
- Depending upon the situation, one of the herbicides that has 80 to 89% (F) control might be the only choice to include a different MOA**.

If it is not possible to have more than one MOA controlling the same weed during the potato year, choosing herbicides with different MOAs in the rotation crops is especially important.

The second TMP Choice Chart is an example of a field with three weeds: hairy nightshade, common lambsquarters, and green foxtail (depicted in Figure 1a and b). The possible tank mix partners for 90 to 100% season-long control of each weed are circled.

The third TMP Choice Chart shows an example of one of the two-way mixtures that could be used to control a combination of three weeds - hairy nightshade, common lambsquarters, and green foxtail, in a field of interest.

The weed control goal can be reached with Outlook + Linex/Lorox applied preemergence (after hilling and incorporated with sprinkler irrigation or rainfall) (Figure 2).

- ✓ Hairy nightshade is controlled season long 90 to 100% (G) and 80 to 89% (F)* by Outlook and Linex/Lorox, respectively.
- ✓ Common lambsquarters is controlled by Linex/Lorox 90 to 100% (G) (Outlook only provides PN control 0 to 30%).
- ✓ Green foxtail is controlled 90 to 100% (G) by both herbicides.

More than one tank mixture can target the three weeds in the example scenario e.g. PRE-applied, Eptam + Prowl H2O. Hairy nightshade is controlled 90 to 100% (G) by Eptam and suppressed by Prowl H2O; common lambsquarters is controlled 90 to 100% (G) by Prowl H2O and suppressed by Eptam; and green foxtail is controlled by Eptam and Prowl H2O 90 to 100% (G).

**NOTE: It may not be possible to customize a tank mixture with herbicides that can provide 90 to 100% control of every weed species in the field with more than one MOA. What is important is that if one herbicide does provide 90-100% control, then at least some control activity from the other herbicide is better than no control by that herbicide. However, a field that has high densities of some or all of the weeds present would warrant making sure that more than one herbicide providing 90 to 100% control of the same high-density weed(s) is included in the tank mixture. As stated before, a tank mixture should not be comprised of herbicides with the same MOA.

University of Idaho research has shown that two-way tank mixtures of Matrix, Chateau, Eptam, Outlook, Reflex, or sulfentrazone applied preemergence will improve season-long hairy nightshade control compared with any of these herbicides applied alone, especially in heavily infested fields. Figure 3 is an example of a high-density hairy nightshade population and control provided by a tank mixture of Outlook + sulfuentrazone.

SUMMARY

The same weed management approach will not work for all fields because the number of weed species can vary greatly from one field to another even if they are close together. Use Tank Mix Partner Choice Charts to create a customized herbicide tank mixture that will target the specific weed species in a field of interest.

- Tank mixtures with two or more herbicides can be designed.
- Weed control goal: All species in the field are controlled 90 to 100% season long with the custom tank mix.
    - A combination of Good (90 to 100%) and Fair (80 to 89%) controlling herbicides might be acceptable. However, *if density of a particular weed is high, then more than one herbicide controlling that species 90 to 100% season long is important*.
- Herbicide resistance management goal: each weed species in the field is controlled with two different herbicide MOAs in the tank mixture.
- Tank mixtures can be designed for PRE only, PRE + POST, POST only application timings.
- Even though a targeted tank mix could cost more in terms of time and money, returns on investment could outweigh the cost: weeds competing with crops reduce yields and profit, add seed to the seed bank which results in higher weed densities and higher costs for weed control in the future.

Happy Tank mixing!!

Tank Mix Partner Choice Chart 1. Example of the initial chart to create for control of a possibility of five weed species that might be present in an area. Shown is the level of control for each weed by each herbicide.

TANK MIX PARTNER CHOICE CHART WITH 5 WEED SPECIES							
	Weed species present						
Herbicides	Hairy nightshade	C. lambs quarters	Redroot pigweed	Kochia	Green foxtail		
Chateau	G	PN	G	S	N		
Sulfentrazone	G	PN	G	G	N		
Reflex	F	PN	G	F	S		
Outlook	G	PN	G	F	G		
Dual Magnum/Dual II Magnum[1]	F	PN	G	F	G		
metolachlor (various trade names)	F	PN	G	F	G		
Zidua	F	PN	G	S	F		
Matrix[2]	G	PN	G	F	F		
Eptam	G	S	G	F	G		
Prowl H2O	S	G	G	F	G		
Sonalan HFP	PN	F	G	F	G		
Treflan HFP	PN	F	G	F	G		
Metribuzin (various trade names)	N	G	G	G	G		
Linex/Lorox	F	G	G	F	G		
Boundary (s-metolachlor + metribuzin)	F	G	G	F	G		
Sencor STZ[1] Sulfentrazone MTZ (metribuzin + sulfentrazone)	G	G	G	G	G		
Poast(Plus or Ultra)/ Select/Venture[2]	N	N	N	N	G		

[1] Trade name for the product in Canada.

[2] Matrix is not labeled for use in Canada – the rimsulfuron herbicide labeled there is Prism and is only used postemergence. Venture (Fluazifop-p-butyl) is only labeled in Canada for control of weeds in potatoes.

NOTE: Control levels are from herbicide labels, potato weed control research results, and other resources such as herbicide effectiveness tables in the 2020 PNW Weed Control Handbook Potato Chapter.

NOTE: Except for the grass-only herbicides in the last line, this chart reflects season-long control by these herbicides applied preemergence. Crop rotation, and other factors such as soil texture and pH can impact choice of herbicide and timing required to target the weeds in the field. A different timing program might be more effective and of so, should be used if possible.

Tank Mix Partner Choice Chart 2. Using the chart to see the best possible tank mixtures for a combination of hairy nightshade, common lambsquarters, and green foxtail in a potato field.

TANK MIX PARTNER CHOICE CHART – TARGETING A COMBINATION OF 3 WEEDS							
	Weed species present						
Herbicides	**Hairy nightshade**	**C. lambs quarters**	**Redroot pigweed**	**Kochia**	**Green foxtail**		
Chateau	**G**	PN	[redacted]	[redacted]	N		
Sulfentrazone	**G**	PN	[redacted]	[redacted]	N		
Reflex	**F**	PN	[redacted]	[redacted]	S		
Outlook	**G**	PN	[redacted]	[redacted]	**G**		
Dual Magnum/Dual II Magnum[1]	**F**	PN	[redacted]	[redacted]	**G**		
metolachlor	**F**	PN	[redacted]	[redacted]	**G**		
Zidua	**F**	PN	[redacted]	[redacted]	**F**		
Matrix[2]	**G**	PN	[redacted]	[redacted]	**F**		
Eptam	G	S	[redacted]	[redacted]	**G**		
Prowl H2O	S	**G**	[redacted]	[redacted]	**G**		
Sonalan HFP	PN	**F**	[redacted]	[redacted]	**G**		
Treflan HFP	PN	**F**	[redacted]	[redacted]	**G**		
Metribuzin	N	**G**	[redacted]	[redacted]	**G**		
Linex/Lorox	**F**	**G**	[redacted]	[redacted]	**G**		
Boundary (s-metolachlor + metribuzin)	**F**	**G**	[redacted]	[redacted]	**G**		
Sencor STZ[1] Sulfentrazone MTZ (metribuzin + sulfentrazone)	**G**	**G**	[redacted]	[redacted]	**G**		
Poast (Plus or Ultra)/ Select/Venture[2]	N	N	[redacted]	[redacted]	G		

[1] Trade name for the product in Canada.

[2] Matrix is not labeled for use in Canada – the rimsulfuron herbicide labeled there is Prism and is only used postemergence. Venture (Fluazifop-p-butyl) is only labeled in Canada for control of weeds in potatoes.

Tank Mix Partner Choice Chart 3. Choosing a tank mix of Outlook + Linex if hairy nightshade, common lambsquarters, and green foxtail are in the potato field.

TANK MIX PARTNER CHOICE CHART - TARGETING A COMBINATION OF 3 WEEDS							
	Weed species present						
Herbicides	Hairy nightshade	C. lambs quarters	Redroot pigweed	Kochia	Green foxtail		
Chateau	G	PN	[redacted]	[redacted]	N		
Sulfentrazone	G	PN	[redacted]	[redacted]	N		
Reflex	F	PN	[redacted]	[redacted]	S		
Outlook	**G**	PN	[redacted]	[redacted]	**G**		
Dual Magnum/ Dual II Magnum[1]	F	PN	[redacted]	[redacted]	G		
metolachlor	F	PN	[redacted]	[redacted]	G		
Zidua	F	PN	[redacted]	[redacted]	F		
Matrix[2]	G	PN	[redacted]	[redacted]	F		
Eptam	G	S	[redacted]	[redacted]	G		
Prowl H2O	S	G	[redacted]	[redacted]	G		
Sonalan HFP	PN	F	[redacted]	[redacted]	G		
Treflan HFP	PN	F	[redacted]	[redacted]	G		
Metribuzin	N	G	[redacted]	[redacted]	G		
Linex/Lorox	**F**	**G**	[redacted]	[redacted]	**G**		
Boundary (s-metolachlor + metribuzin)	F	G	[redacted]	[redacted]	G		
Sencor STZ[1] Sulfentrazone MTZ (metribuzin + sulfentrazone)	G	G	[redacted]	[redacted]	G		
Poast(Plus or Ultra)/ Select/Venture[2]	N	N	[redacted]	[redacted]	G		

[1] Trade name for the product in Canada.

[2] Matrix is not labeled for use in Canada – the rimsulfuron herbicide labeled there is Prism and is only used postemergence. Venture (Fluazifop-p-butyl) is only labeled in Canada for control of weeds in potatoes.

Figure 1a and b. A mixture of hairy nightshade, common lambsquarters, and green foxtail in a potato field.

Figure 2. Control of a mixture of hairy nightshade, common lambsquarters, and green foxtail provided by a two-way tank mixture of Outlook + Linex/Lorox applied preemergence to potato and weeds after a hilling operation and sprinkler incorporated with 0.5 in water within 24 h of application with overhead irrigation.

Figure 3. On the left, high density population of hairy nightshade in a nontreated research trial plot at the University of Idaho Aberdeen Research and Extension Center. On the right, control of a high density hairy nightshade population with Outlook + sulfentrazone applied preemergence to potatoes and weeds after a hilling operation and sprinkler incorporated with overhead irrigation within 24 h of application in a research trial at the University of Idaho Aberdeen Research and Extension Center.