

Grant Code: AP5457

Title: Pre-plant burndown herbicide efficacy and wheat crop safety

Personnel:

Albert Adjesiwor, University of Idaho, Kimberly Research & Extension Center

Joan Campbell, University of Idaho, Department of Plant Sciences, Moscow

Jared Spackman, University of Idaho, Aberdeen Research & Extension Center

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Justification/Rationale: No-till dryland wheat growers in Idaho are becoming increasingly reliant on glyphosate for pre-plant and post-harvest weed control. The repeated use of glyphosate as the main weed management tool could result in widespread glyphosate-resistant weed populations. To protect the value of glyphosate in wheat production systems, it is important to identify effective alternative herbicides and mixtures for weed control.

The value of glyphosate to growers practicing minimum or no-till has been primarily a function of three factors: improved weed control (especially grass weeds) with glyphosate compared to other herbicides; lack of residual effect or injury from glyphosate; and relatively cheap cost of glyphosate. Thus, any possible alternatives to glyphosate must satisfy at least some of these conditions if they were to be adopted by growers.

We are proposing to evaluate tank mixtures of herbicides with different sites of action including *Aim EC*[®] (Group 14), *Maestro*[®] 2EC (group 6), *Gramoxone*[®] (Group 22), *Impact*[®] (group 27), *Liberty*[®] (Group 10), *Reviton*[®] (Group 14), *Roundup PowerMax*[®] (Group 9), *Sharpen*[®] (Group 14), and *Vida*[®] (Group 14). These herbicides are fast-acting and short-lived in the soil, making them ideal as pre-plant burndown herbicides. Most of these herbicides are not taken up or translocated in the plant, making it unlikely to have residues in grains. If proven to be safe on wheat and provide effective control of common and troublesome grass weeds in no-till systems, this will provide growers with alternative herbicides to glyphosate for weed control. This could reduce glyphosate use and preserve the value of glyphosate in wheat production systems.

Objectives: In order to provide the science-based guidelines growers need to make an informed management decision on effective alternative pre-plant burndown herbicides and mixtures, we will measure weed control and wheat crop injury. Specifically, we are proposing to:

1. Evaluate the efficacy of pre-plant burndown herbicides and mixtures,
2. Assess the safety of pre-plant burndown herbicides and mixtures on wheat, and
3. Economics of using alternative pre-plant burndown herbicides and mixtures on wheat

Procedures/Plan of work:

This field study would be established at four locations including the University of Idaho Kimberly Research and Extension Center, Aberdeen Research and Extension Center, Idaho Parker Plant Science Farm near Moscow, ID, and one on-farm site in Power County. Herbicide applications will be made within 14 days before winter wheat is planted (Table 1). Winter wheat will be planted in September/October 2022. Wheat will be managed (e.g. fertilizer application, disease control, etc.) following standard production practices. There will be 20 treatments arranged in a

randomized complete block with four replications (Table 1). Each plot will be approximately 10 ft wide by 30 feet long.

Data collection and analysis: Crop injury and weed control (by each weed species) will be visually assessed at 7, 14, 21 days after treatment and in early spring on a scale of 0 to 100%, with 0% being no injury/control, and 100% being plant death. If there's high weed density in early spring, all plots will be sprayed with a post-emergence herbicide. At the end of the season, plots will be harvested to determine grain yield. Data will be analyzed following standard statistical procedures.

Table 1. Proposed herbicide treatments

No.	Treatment	Rate (oz/acre)
1	Untreated	-
2	Impact	1
3	Impact	1
	Reviton	2
4	Gramoxone	32
5	Reviton	2
6	Liberty	29
7	Aim	2
	Gramoxone	32
8	Sharpen	2
	Gramoxone	32
9	Vida	2
	Gramoxone	32
10	Reviton	2
	Gramoxone	32
11	Maestro 2 EC	24
	Gramoxone	32
12	Maestro 2 EC	24
	Reviton	2
13	Liberty	29
	Sharpen	2
14	Liberty	29
	Reviton	2
15	Liberty	29
	Impact	1
16	Maestro 2 EC	24
	Impact	1
17	Roundup Powermax	22
18	Roundup Powermax	32
19	Roundup Powermax 3	20.7
20	Roundup Powermax 3	30

Duration: This is the second year of a 2-year study.

Cooperation/Collaboration: Jared Spackman's team will assist with establishing the research plots and collecting data at the Aberdeen location. Joan Campbell will establish the research plots

and collect data at the Northern Idaho location. Cordell Kress (Power County) will provide land space and assist with the on-farm trial.

Anticipated Benefits, Expected Outcomes and Impacts, and Transfer of Information: This will provide science-based guidelines to growers to make an informed management decision on effective alternative pre-plant burndown herbicides and mixtures. This project will be shown at field days in Kimberly, Aberdeen, and northern Idaho and results will also be discussed at the Cereal Schools. Results will also be presented at the Weed Science Society of America and Western Society of Weed Science annual meetings. Results will be published on the UI Weed Science website (www.uidaho.edu/weed-science) and results will be incorporated in the annually updated Pacific Northwest Weed Management Handbook. We intend to publish the results in the Weed Technology journal.

Literature Review:

It is widely known that repeated use of the same herbicide is the primary factor leading to herbicide resistance in weeds. To reduce the chances of resistance development to glyphosate, it is often recommended to alternate glyphosate with other effective herbicides or apply glyphosate in tank mixtures with effective herbicides. Herbicides such as *Aim EC*®, *Gramoxone*®, *Liberty*®, *Maestro*® 2EC, *Sharpen*®, *Reviton*®, and *Vida*® are fast-acting and short-lived in the soil, making them ideal as pre-plant burndown herbicides.

Liberty® is a non-selective herbicide that is effective on a broad spectrum of weeds. However, because *Liberty*® does not move well within plants, its efficacy is greatly affected by environmental factors such as temperature and humidity. A recent experiment found that in high humidity (70%), *Liberty*® provided complete control (100%) of pigweed. When humidity was reduced to 30%, pigweed control was only 60% (Takano et al. 2020). The effect of humidity on the effectiveness of *Liberty*® has limited the use of this herbicide in western United States. However, Takano et al. (2020) recently found that when *Liberty*® was mixed with *Sharpen*®, it provided complete pigweed control. Thus, this positive interaction can be exploited for enhanced weed control with *Liberty*® in Idaho. Although *Liberty*® is currently not labeled for pre-plant burndown in wheat (Loux 2014), if pre-plant application of *Liberty*® doesn't injure emerging winter wheat, the data could be used to support a 24(c) Special Local Need (SLN) label application. The United States Environmental Protection Agency has recently approved a new herbicide called *Reviton*® for use in four crops including wheat. *Reviton*® is a Group 14 herbicide, which is fast-acting and has 0-day rotation restriction to wheat (Helm Agro US Inc. 2020). *Reviton*® is being promoted as an effective herbicide for grass weed control, especially wild oat. If proven to be effective, it will be a useful additional herbicide for Idaho wheat growers.

References

- Helm Agro US Inc. (2020) *Reviton* Herbicide. URL: <https://www.discoverhelm.com/reviton-home/>
- Loux M (2014) Burndown herbicides for no-tillage wheat. C.O.R.N. Newsletter 2014-32. URL: <https://agcrops.osu.edu/newsletter/corn-newsletter/2014-32/burndown-herbicides-no-tillage-wheat>
- Takano HK, Beffa R, Preston C, Westra P, Dayan FE (2020) Glufosinate enhances the activity of protoporphyrinogen oxidase inhibitors. *Weed Sci.* 68: 324–332.

**FY2023
COMMODITY COMMISSION BUDGET**

Principal Investigator: Adjesiwor

Allocated by _____	during FY2021	\$	-
(Commission/Organization)			
Allocated by IDAHO WHEAT COMMISSION	during FY2022	\$	7,290
(Commission/Organization)			

REQUESTED SUPPORT:	<u>Awarded for FY2022</u>	<u>Requested for FY2023</u>
Budget Categories		
(10) Salary <i>(staff, post-docs, et NOTE: Faculty salary/fringe not allowed)</i>	\$ -	\$ 2,954.00
(12) Temporary Help	\$ 2,400.00	\$ 1,500
(11) Fringe Benefits	\$ 190.00	\$ 219.00
(20) Travel	\$ 3,300.00	\$ 1,308.00
(30) Other Expenses	\$ 1,400.00	\$ 1,500.00
(40) Capital Outlay >\$5k	\$ -	\$ -
(45) Capital Outlay <\$5k	\$ -	\$ -
(70) Graduate Student Tuition/Fees	\$ -	\$ -
TOTALS	\$ 7,290.00	\$ 7,481.00

TOTAL BUDGET REQUESTED FOR FY2023:	\$ 7,481
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BREAKDOWN FOR MULTIPLE INDEXES:					
Budget Categories	<i>Adjesiwor</i>	<i>Spackman</i>	<i>Cumpbell</i>	<i>(Insert Co-PI Name)</i>	
(10) Salary <i>(staff, post-docs, et</i>	\$ 2,954.00	\$ -	\$ -	\$ -	\$ -
(12) Temporary Help	\$ -	\$ 750.00	\$ 750.00	\$ -	\$ -
(11) Fringe Benefits	\$ 89.00	\$ 65.00	\$ 65.00	\$ -	\$ -
(20) Travel	\$ 1,308.00	\$ -	\$ -	\$ -	\$ -
(30) Other Expenses	\$ 650.00	\$ 400.00	\$ 450.00	\$ -	\$ -
(40) Capital Outlay >\$5k	\$ -	\$ -	\$ -	\$ -	\$ -
(45) Capital Outlay <\$5k	\$ -	\$ -	\$ -	\$ -	\$ -
(70) Graduate Student Tuition/Fees	\$ -	\$ -	\$ -	\$ -	\$ -
TOTALS	\$ 5,001.00	\$ 1,215.00	\$ 1,265	\$ -	\$ -
			Total Sub-budgets	\$	7,481

ANNUAL REPORT

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Background: No-till dryland wheat growers in Idaho are becoming increasingly reliant on glyphosate for pre-plant and post-harvest weed control. The repeated use of glyphosate as the main weed management tool could result in widespread glyphosate-resistant weed populations. To protect the value of glyphosate in wheat production systems, it is important to identify effective alternative herbicides and mixtures for weed control.

Objectives: The objectives of this study were to

1. Assess the efficacy and safety of pre-plant burndown herbicides and mixtures on wheat
2. Economics of using alternative pre-plant burndown herbicides and mixtures on wheat

Accomplishments

2021 field trial:

Field studies were established in 2021 at three locations: the University of Idaho Kimberly Research and Extension Center, Aberdeen Research and Extension Center, and one on-farm site in Power County. There will be 20 treatments arranged in a randomized complete block with four replications (Figure 1). Each plot was 10 ft wide by 30 feet long. Herbicide applications were made within 14 to 28 days before winter wheat was planted. Winter wheat was planted September/October 2021 at all sites.

Weed control (by each weed species) was visually assessed within, 7 to 21 days after treatment on a scale of 0 to 100%, with 0% being no control, and 100% being plant death. Data will be analyzed following standard statistical procedures.

Objective #1: efficacy and safety of pre-plant burndown herbicides and mixtures

Nearly all herbicide treatments (except Impact applied alone) provided good control of common lambsquarters, kochia, redroot pigweed, and hairy nightshade (Figure 1). Grassy weed (barnyardgrass and green foxtail) varied among treatments, but the majority of the treatments provided good grassy weed control (Figure 1). Impact and Reviton applied alone provided less than 80% control of barnyardgrass and green foxtail. These herbicides may need to be tankmixed with other herbicides to provide good grassy weed control. At the on-farm site, most treatments (except Impact, Reviton, Everest, and Roundup PowerMax) provided more than 80% control of yellow sweetclover. No crop injury was observed after crop emergence at any of the study sites. Crop injury will be visually assessed in the spring of 2022.

Objective #2: Economics of using alternative pre-plant burndown herbicides and mixtures

Preliminary economic analyses showed that although glyphosate (Roundup PowerMax) remains one of the cheapest options for broad-spectrum weed control, glufosinate (Liberty) and

combinations of paraquat (Gramoxone) and bromoxynil (Maestro), tiafenacil (Reviton), and pyraflufen (Vida) are promising alternatives for pre-plant weed control in wheat.

Projections: This study will be repeated in 2022 and results will be made available to the Idaho Wheat Commission and Idaho wheat growers. Results from this study will be presented at the 2022 Western Society of Weed Science Conference to be held from March 7-10th, 2022.

Publication/ Outreach: This study was showcased at the 2021 Kimberly Field Day and results were presented at the 2021 Idaho Association of Plant Protection meeting in Burley, Idaho.

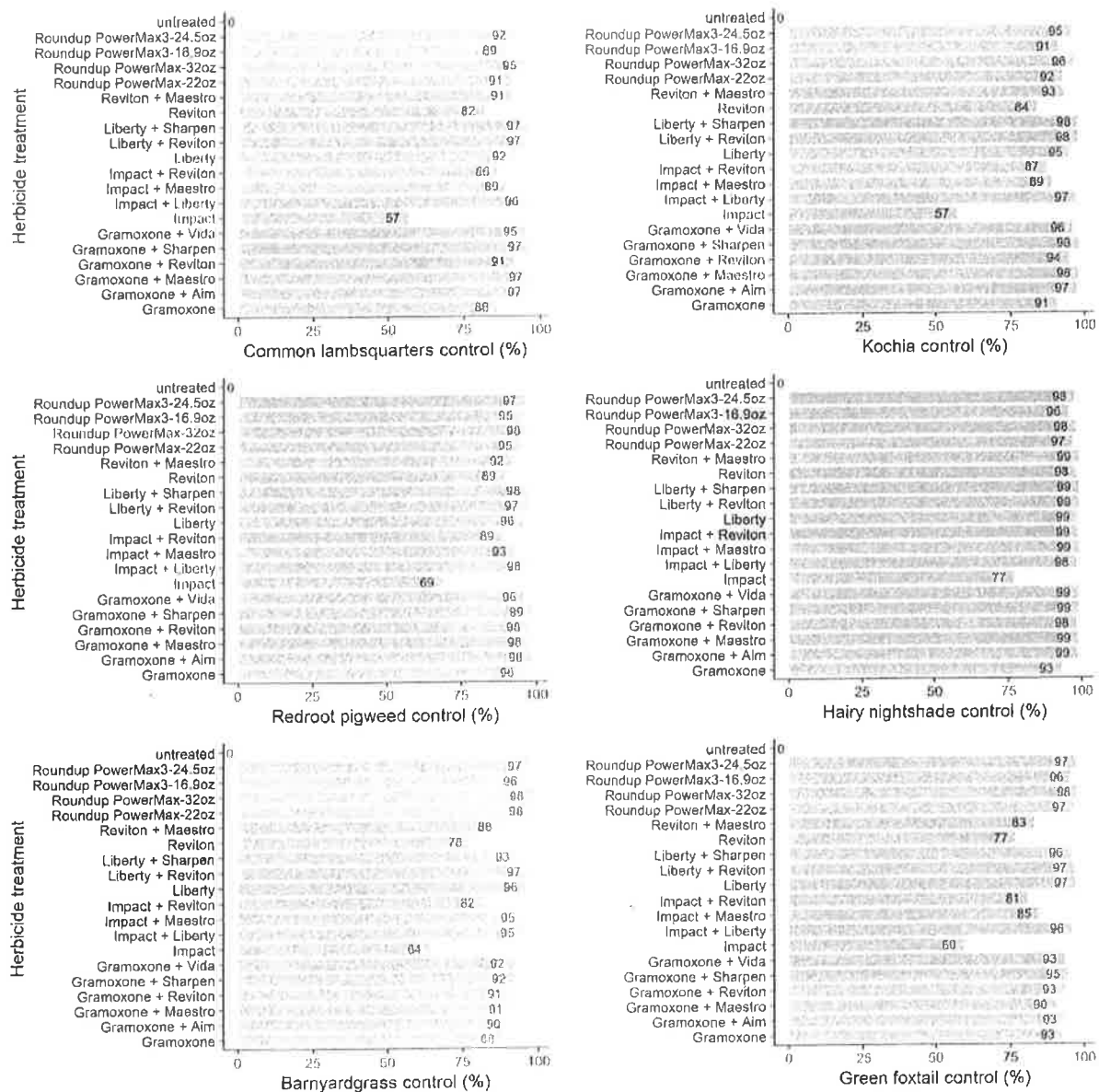


Figure 1. The efficacy of herbicide programs on broadleaf and grassy weeds at Kimberly and Aberdeen study sites.

Table 1. Preliminary analyses of the cost of herbicide programs

Treatment	Herbicide	Rate used (oz/acre)	Unit price	Cost (\$/acre)
1	Impact	1	\$15/oz	15
2	Impact	1	\$15/oz	26.1
	Reviton	2	5.55/oz	
3	Gramoxone	32	\$27/gal	6.8
4	Reviton	2	5.55/oz	11.1
5	Liberty 280	29	53/gal	12
6	Gramoxone	32	\$27/gal	19.5
	Aim	2	6.35/oz	
7	Gramoxone	32	\$27/gal	24.3
	Sharpen	2	6.15/oz	
8	Gramoxone	32	\$27/gal	15.8
	Vida	2	\$4.52/oz	
9	Gramoxone	32	\$27/gal	17.9
	Reviton	2	5.55/oz	
10	Gramoxone	32	\$27/gal	16.5
	Maestro 2EC	24	52/gal	
11	Reviton	2	5.55/oz	20.9
	Maestro 2EC	24	52/gal	
12	Liberty 280	29	53/gal	24.3
	Sharpen	2	6.15/oz	
13	Liberty 280	29	53/gal	23.1
	Reviton	2	5.55/oz	
14	Impact	1	\$15/oz	27
	Liberty 280	29	53/gal	
15	Impact	1	\$15/oz	24.8
	Maestro 2EC	24	52/gal	
16	Roundup PowerMax	22	48/gal	8.3
17	Roundup PowerMax	32	48/gal	12
18	Roundup PowerMax 3*	20.7	-	8.3
19	Roundup PowerMax 3	30	-	12

*Roundup PowerMax 3: No price data available yet. Equivalent price of regular PowerMax was used