Herbicide Traits: Flexibility or Complexity

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Pillars to successful weed management

- Weed management in the field extends across the crop sequence
- Weed management starts with knowing your weed control challenges in field
  - Your most important weed control challenge
  - Your second most important weed control challenge
- Weed management requires an integrated approach; chemical, mechanical, and cultural practices
- One size does not fit all
  - Farms are not factories
  - Fields are boutiques

Crop sequence across region and Cooperative

Sugarbeet production in Minnesota and North Dakota

South – Southern Minnesota Beet Sugar Cooperative

- Corn, soybean, corn, sugarbeet – most common
- Soybean, corn, corn, sugarbeet – second most common

Mid – Minn-Dak Farmers Cooperative

- Corn, soybean, corn, sugarbeet

North –American Crystal Sugar Company

- Corn, soybean, wheat, sugarbeet

How do you select between 12 different soybean herbicide trait packages with resistance to various herbicides?

Soybean Herbicide Trait	Glyphosate	Glufosinate	2,4-D Choline	Dicamba	HPPD Inhibitors
Conventional					
Glyphosate Tolerant (GT)	✓				
Roundup Ready	✓				
Roundup Ready 2 Yield	✓				
Roundup Ready 2 Yield Xtend	✓			✓	
Roundup Ready 2 Yield Xtendflex	✓	✓		✓	
LibertyLink (LL)		✓			
LLGT27	✓	✓			✓
Enlist	✓		✓		
Enlist E3	✓	✓	✓		
GT27	✓				✓
MGI		✓			✓

PRE followed by timely POST treatments for weed management

Objectives of a sustainable weed management program:

- Control weeds
- Crop rotation flexibility
- Herbicide diversity
- Profitability

Hypothesis:

- Weed management plan delivers multiple effective herbicides against your must important weeds
- Effective weed control can be achieved with multiple herbicide traits thus influencing profit

HT2 Sugarbeet

- A biotech trait featuring glyphosate, glufosinate and dicamba in the same vector.
- Commercialize in sugarbeet in the middle of the next decade
- We need to ensure the herbicide traits are useful when they are introduced.
- **Reinforce strategies to preserve future herbicide tolerant trait products in sugarbeet by creating educational / outreach modules emphasizing weed management across the crop sequence.**

Materials and Methods

- Experimental design: RCBD and four replications
- Treatment arrangement: Two factor factorial, herbicide trait and herbicide treatment
- Soybean injury and waterhemp and common lambsquarters control
- Count effective herbicides based on control
- Profit = revenue - cost of soybean seed / herbicide trait and herbicide treatments

Two Factor Factorial

Herbicide Trait

- Conventional
- RR2 soybean (glyphosate)
- LibertyLink (glufosinate)
- Xtend soybean (dicamba)

Herbicide treatment

- Valor / Trait
- Valor[a] + Zidua / Trait
- Valor + Zidua / chloroacetamide[b] / Trait
- Valor + Zidua + metribuzin / chloroacetamide / Trait

[a]Valor or Engenia, depending on herbicide trait
[b] Dual Magnum, Outlook, or Warrant depending on herbicide trait

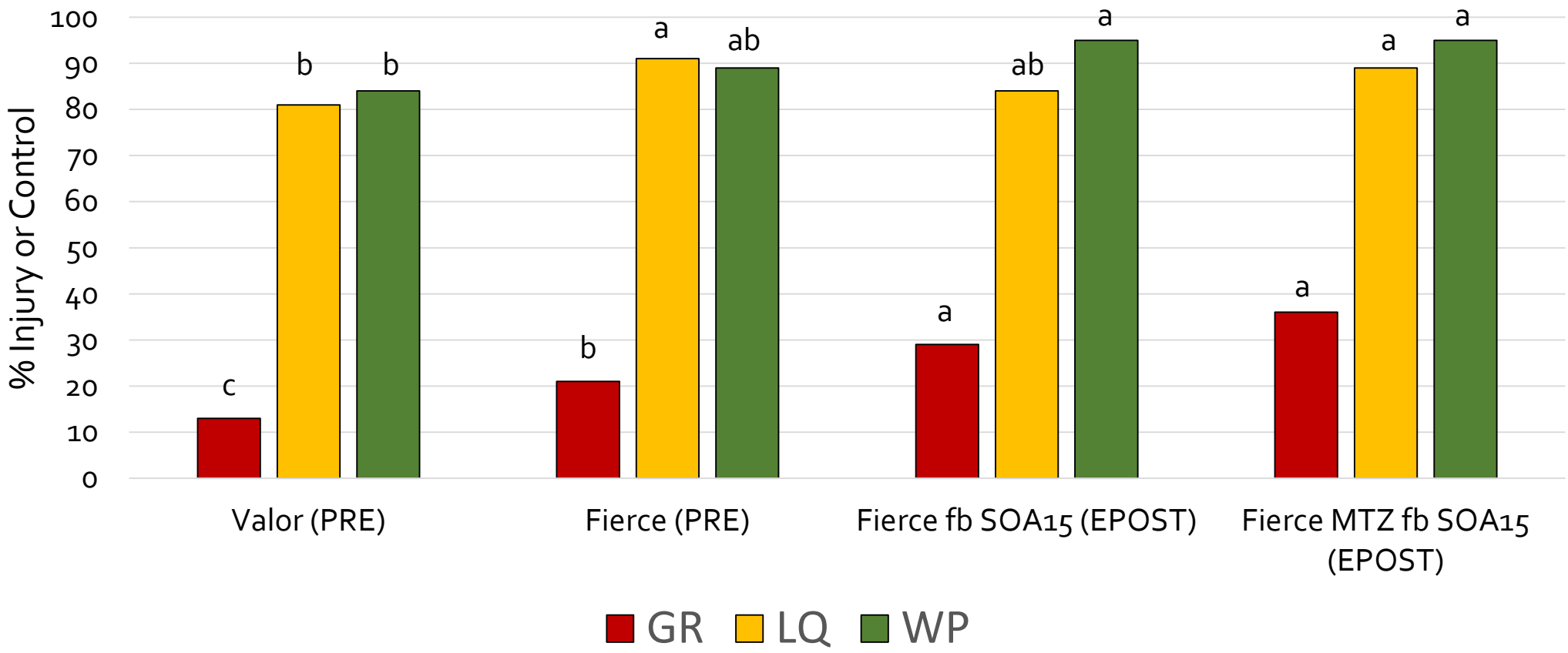
Soybean injury and common lambsquarters and waterhemp control in response to herbicide treatment in Xtend soybean, Moorhead MN, 2019.

Treatment	Rate	Growth Reduction		Lambsquarters	Waterhemp
		26 DAP	30 DAT	38 DAT	38 DAT
	oz/A	%	%	%	%
Engenia / PowerMax	12.8 / 32	0	9 b	97	68
Engenia + Zidua / PowerMax	12.8 + 2.1 / 32	3	15 b	99	73
Engenia + Zidua / Warrant / PowerMax	12.8 + 2.1 / 40 / 32	0	31 a	99	83
Engenia + Zidua + Metribuzin / Warant / PowerMax	12.8 + 2.1+ 5 / 40 / 32	3	33 a	99	85
P-Value		0.4363	0.0355	0.4363	0.0623

Soybean injury and common lambsquarters and waterhemp control in response to herbicide treatment in LibertyLink soybean, Moorhead MN, 2019.

Treatment	Rate	Growth Reduction		Lambsquarters	Waterhemp
		26 DAP	30 DAT	38 DAT	38 DAT
	oz/A	%	%	%	%
Valor / Liberty	2.5 / 32	0	21 b	95	92 b
Fierce / Liberty	3 /32	3	26 b	96	98 a
Fierce + Outlook / Liberty	3 / 10 / 22	0	37 a	95	99 a
Fierce MTZ + Outlook / Liberty	16 / 10 / 32	0	40 a	95	99 a
P-Value		0.4363	0.0354	0.9838	0.0495

Soybean injury and common lambsquarters and waterhemp control in response to herbicide treatment averaged across herbicide trait, Moorhead MN, 2019.

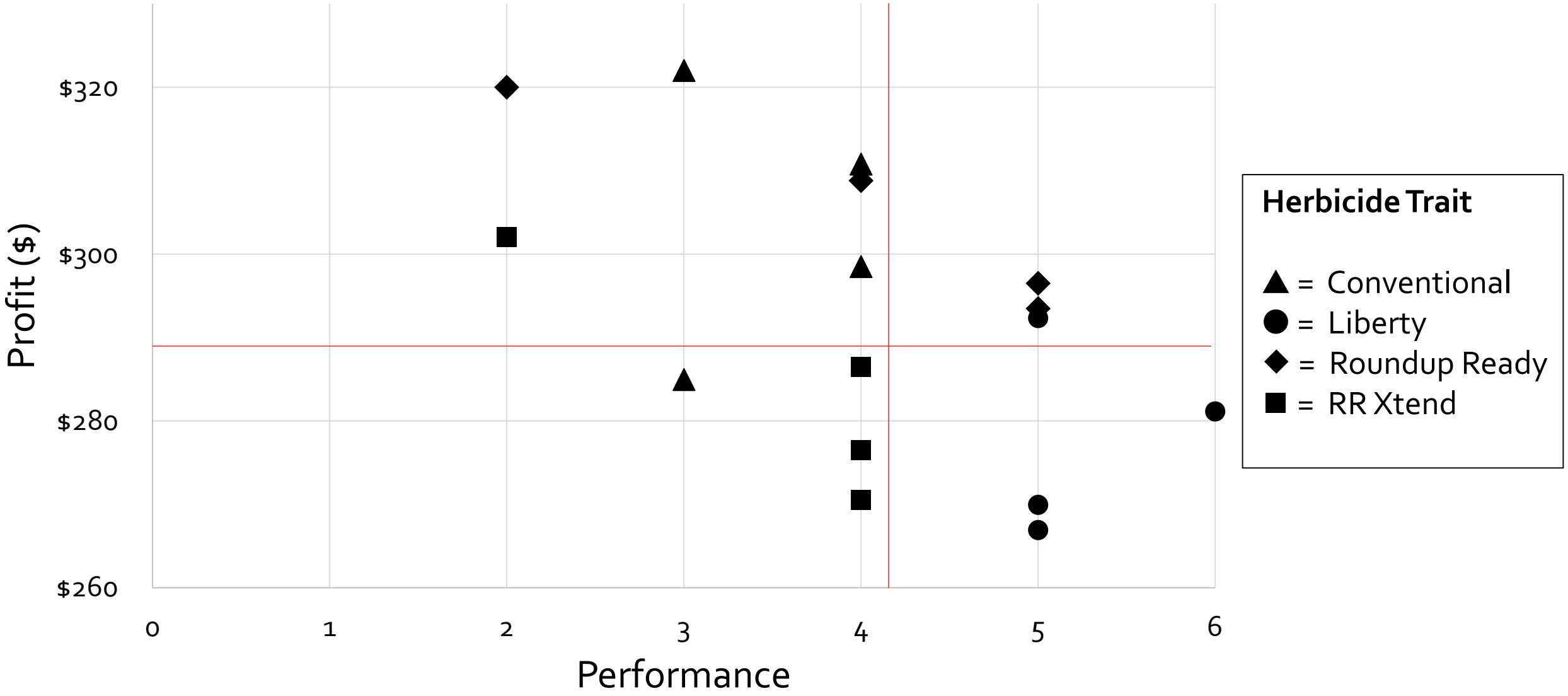


Effective Sites of Action[a] against lambsquarters or waterhemp

Treatment	Flexstar		Roundup		LibertyLink		Xtend[b]		Ave
	LQ	WH	LQ	WH	LQ	WH	LQ	WH	
Valor	1	2	2	1	2	2	2	1	1.6
Fierce (Valor + Zidua)	1	3	2	2	2	3	2	2	2.1
Fierce / chloroacetamide	1	4	2	3	2	4	2	3	2.6
Fierce MTZ / chloroacetamide	1	5	2	4	2	5	2	4	3.1

[a]based on control in the 2020 ND Weed Control Guide
[b]glyphosate or dicamba

Herbicide treatment and trait performance plotted against profit (revenue minus herbicide treatment and trait cost)



Summary

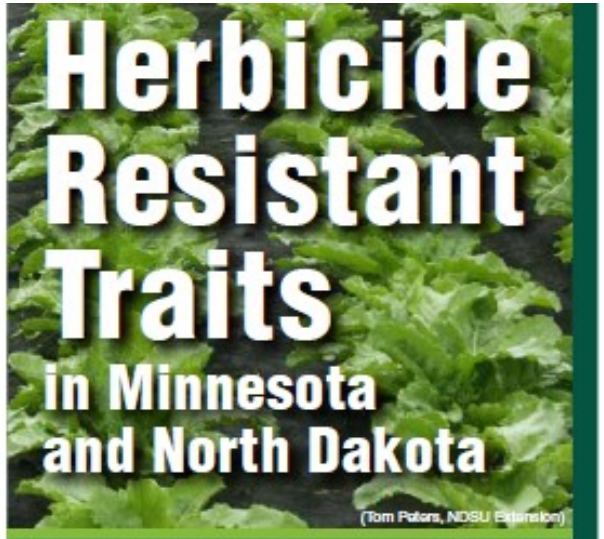
1. Herbicide treatments (mixtures or PRE fb POST combinations) provided greater than 95% lambsquarters and waterhemp control.
2. Herbicide mixtures usually provide multiple effective sites of action.
3. Herbicide traits use strategically solve field specific weed control challenges.
4. Profitability is more complex than cost of herbicide treatment and / or trait.

Conclusions

Use both effective PRE and timely POST applications to manage weeds, regardless of the herbicide or herbicide trait

- The herbicide system used with traits is more important than Trait and respective herbicide(s)
- Traits are opportunities for improved control of troublesome weeds

Technical Bulletin to be distributed at Grower Seminars and other extension meetings in MN and ND



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It is important to read and follow label guidelines when applying herbicides to any crop. The label of some glyphosate products indicates they can be applied to Roundup Ready® and glyphosate-tolerant crops. Most glyphosate labels state the products are for use in Roundup Ready® crops or in crops that have the Roundup Ready® gene. Other glyphosate labels have language stating the glyphosate product can be applied to glyphosate-tolerant crops.

This reference guide is designed to help clarify which herbicide products can be applied to various trait packages. You always should check seed tags and herbicide labels to ensure missapplications do not occur.

Table 1. Alfalfa herbicide-resistant traits and herbicides that can be used in combination with resistant traits. A checkmark indicates that alfalfa herbicide trait packages have resistance to various herbicide products.[a]

Alfalfa Herbicide Trait	Glyphosate	Glufosinate	Growth Regulators
Conventional			
Roundup Ready Alfalfa[b]	✔		

[a]Always consult herbicide labels for application requirements.
[b]Always consult herbicide label to determine if glyphosate formulation is approved for RR alfalfa.

Table 2. Canola herbicide-resistant traits and herbicides that can be used in combination with resistant traits. A checkmark indicates that canola herbicide trait packages have resistance to various herbicide products.[a]

Canola Herbicide Trait	Glyphosate	Glufosinate	ALS Inhibitors
Conventional			
Roundup Ready	✔		
Roundup Ready TruFlex	✔		
LibertyLink		✔	
Clearfield Canola[b]			✔
SU Canola[c]			✔

[a]Always consult herbicide labels for application requirements.
[b]Apply Beyond (imazamox) to Clearfield canola varieties.
[c]Apply Draft (thifensulfuron and triberuron) to SU Canola varieties.

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Thank you for your Support

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