

## Site-specific weed management with precision application technology

Field Research projects were conducted in Kansas, Nebraska, and Wisconsin during the 2023 growing season. Highlighted results include:

### Kansas -

#### Small Plot Sprayer

- Results showed that treatments with residuals provided the greatest weed control; with simultaneous BCST of residuals and SS of foliar herbicides, it was possible to obtain weed control not statistically different than the broadcast applications, at a fraction of the cost.

### Nebraska

#### Large Sprayer Study 1 – Combination of Broadcast and Spot Spray Application

- Weed density in soybean: 6 weeks after treatment, High rate broadcast + Low Spot Spray had the lowest weed pressure throughout all thresholds.
- Weed-free area rating in soybean: 6 weeks after treatment, all detection thresholds in the High Rate Broadcast + Low Spot Spray were not statistically different.

#### Large Sprayer Study 2 – Application Timing in Soybean

- The V3 spike treatment resulted in the most effective weed control.
- The difference between spot spray and spike was greatest at V3 timing.
- Difference in treatments is most likely due to small undetected weeds in the spot spray only treatment that were treated with a broadcast application and a spot application for the spike treatment.

### Wisconsin

- Four soybean small plot field experiments were conducted in Seymour, IL in 2023 comparing spot spray versus broadcast applications at different crop growth stages
- Small plot field experiments were conducted in Arlington and Janesville, WI in 2023 comparing weed control and spray coverage with different nozzles, boom height, and number of nozzles triggered upon weed detection.

### Extension Activities for 2023 Include:

- Preliminary results were presenting during the 2023 Arlington Agronomy and Soils field day (August 30 2023; 200 participants)
- A webinar was recorded for the Crop Protection Network TV (episode will be released in the winter)
- Two podcast episodes were recoded (UNL FarmBits podcast)

- Results will be presented during the 2023 North Central Weed Science Society meeting (December 2023, Minneapolis, MN) and 2024 Weed Science Society of America (January 2024, San Antonio, TX)

NCSRP Grant Funds Supported Webinar:

- September 06, 2023 – Spot Spray Technologies Zoom Webinar (2-hour event, 2 CEUs in Pest Management were Offered)
- 530 participants registered from 16 different countries
- 278 participants attended the live webinar
- Webinar recording is available via YouTube  
<https://www.youtube.com/watch?v=x6D3Q5hUjWA&t=5381s>
- >1,300 views of the webinar recording as of 10/30/2023

## Detailed Description of Results

### Small Plot Sprayer

Manhattan, KS – Continuation of studies established in 2022.

Five treatments:

- Green-on-brown (GOB) Broadcast residual (BCST) + spot-spray foliar (SS) herbicides followed by (fb) green-on-green (GOG) SS
- GOB SS fb GOG SS
- GOB BCST + SS
- GOB BCST foliar + SS “Spike” fb GOG BCST foliar + SS “Spike”
- GOB BCST + SS fb GOG BCST + SS

Split-plot design with four artificial intelligence (AI) thresholds:

- Broadcast (for traditional comparison)
- Efficacy
- Savings
- Balanced (halfway between the Efficacy and Savings setting)

Results showed that treatments with residuals provided the greatest weed control; with simultaneous BCST of residuals and SS of foliar herbicides, it was possible to obtain weed control not statistically different than the broadcast applications, at a fraction of the cost.

Table 1. Interaction between treatment and threshold seasonal herbicide cost for selected corn and soybean sites. Sites were found to have a significant interaction between herbicide treatment and threshold.

	Thresholds							
	BCST		EFF		BAL		SAV	
----- Price (\$) ha <sup>-1</sup> -----								
Manhattan KS 2023 - Soybeans								
GOB BCST + SS fb GOG SS (A)	217.18 (0)	a	71.56 (6.75)	d	67.89 (6.63)	d	62.59 (6.45)	d
GOB SS fb GOG SS (B)	168.40 (0)	b	44.00 (5.67)	de	49.89 (5.93)	de	31.95 (4.91)	e
GOB BCST + SS Spike fb GOG BCST + SS Spike (D)	209.70 (0)	a	134.02 (7.44)	bc	133.75 (7.45)	bc	126.59 (7.47)	c
GOB BCST + SS fb GOG BCST + SS (E)	217.18 (0)	a	73.63 (7.62)	d	75.83 (7.68)	d	72.61 (6.77)	d
Seymour IL 2023 - Soybeans								
GOB BCST + SS fb GOG SS (A)	216.80 (0)	a	64.43 (7.10)	cde	79.60 (8.48)	c	70.98 (7.33)	c
GOB SS fb GOG SS (B)	168.21 (0)	b	34.89 (5.54)	de	56.10 (7.58)	cde	34.04 (5.48)	e
GOB BCST + SS Spike fb GOG BCST + SS Spike (D)	209.35 (0)	a	135.21 (9.06)	b	145.06 (8.96)	b	133.07 (9.07)	b
GOB BCST + SS fb GOG BCST + SS (E)	216.80 (0)	a	71.53 (7.35)	c	66.46 (7.18)	cd	75.16 (7.46)	c
Manhattan KS 2023 - Corn								
GOB BCST + SS fb GOG SS (A)	212.17 (0)	a	171.61 (3.67)	bc	156.59 (3.90)	cd	157.15 (3.90)	c
GOB SS fb GOG SS (B)	137.33 (0)	e	106.78 (4.05)	f	104.69 (4.04)	f	92.61 (3.93)	f
GOB BCST + SS Spike fb GOG BCST + SS Spike (D)	209.62 (0)	a	176.19 (3.58)	bc	180.78 (3.49)	b	177.94 (3.55)	b
GOB BCST + SS fb GOG BCST + SS (E)	213.86 (0)	a	170.30 (3.69)	bcd	157.17 (3.89)	c	157.17 (3.89)	c

Abbreviations: GOB, green-on-brown; GOG, green-on-green; BCST, broadcast; SS, spot spray

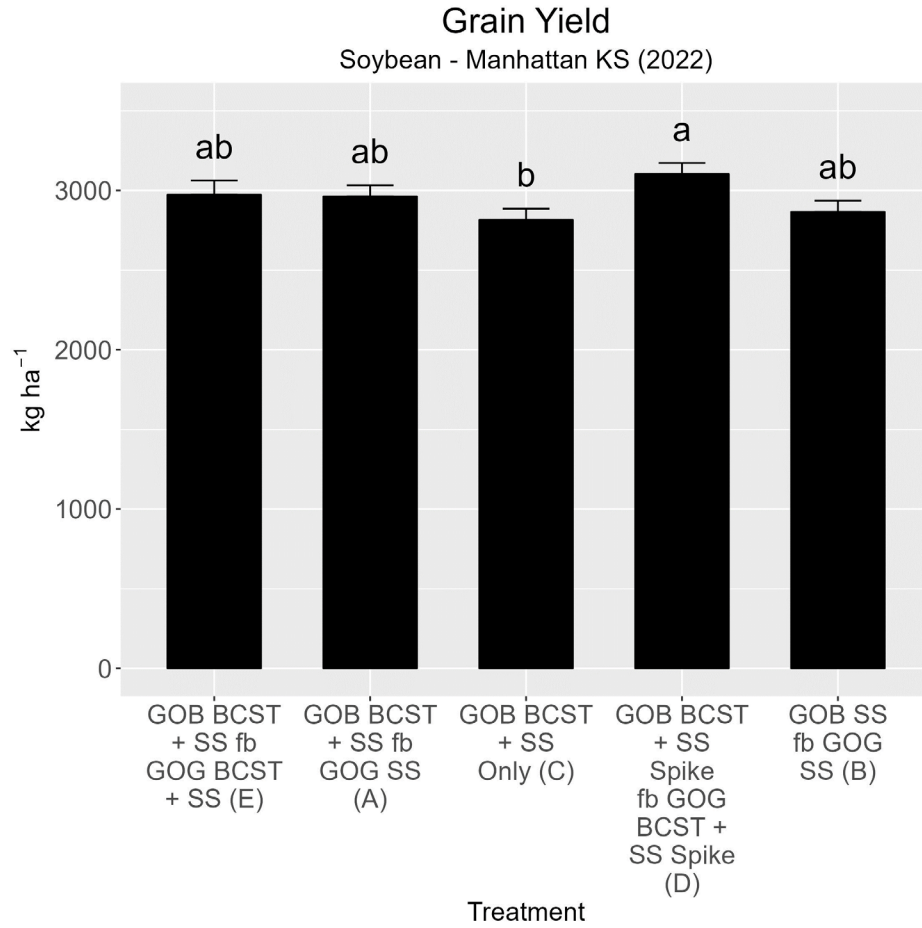


Figure 1. Grain yield for the soybean study in Manhattan, Kansas (2022). This was the only site that was found to have any statistical differences in grain yield.

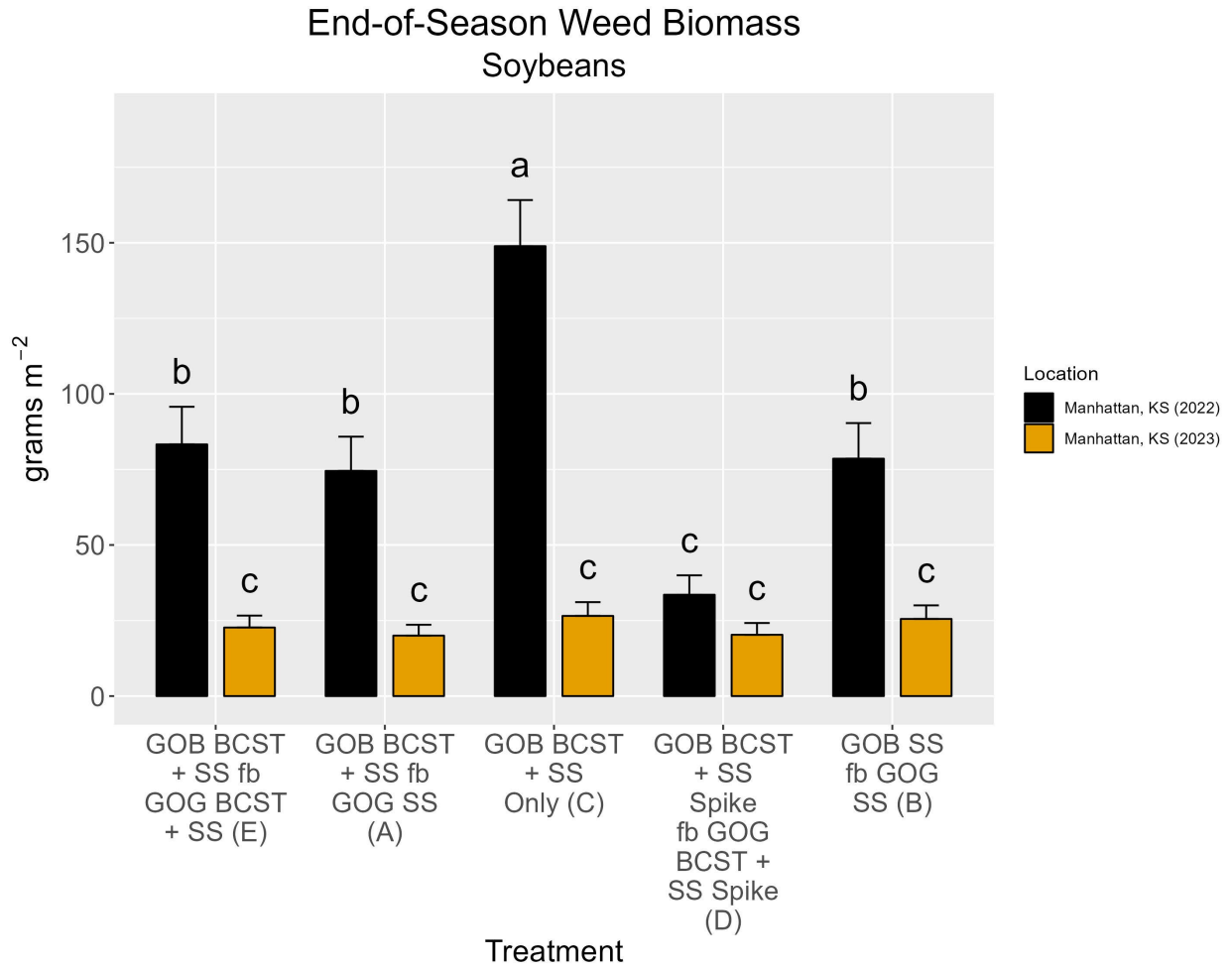


Figure 2. End-of-season weed biomass for the Manhattan KS soybean locations. Treatment C (the one-pass approach) had the greatest biomass for each year (despite not being statistically different than the other treatments in 2023).

Table 2. Main effects for soybean weed density (14 DAGT) for all experiment sites.

Herbicide Treatment	Location		
	Manhattan KS 2022	Manhattan KS 2023	Seymour IL 2023
	----- Weeds m <sup>-2</sup> -----		
BCST + SS PRE fb SS POST (A)	1.56 (0.32) <sup>a</sup> ab <sup>b</sup>	0.53 (0.1) bc	0.57 (0.14) c
SS PRE fb SS POST (B)	1.83 (0.35) a	1.61 (0.17) a	0.97 (0.21) a
BCST + SS Spike PRE fb BCST + Spike POST (D)	0.87 (0.2) b	0.39 (0.08) c	0.71 (0.17) b
SS + BCST PRE fb SS + BCST POST (E)	1.37 (0.31) ab	0.82 (0.14) ab	0.57 (0.14) c
<u>Threshold</u>			
Broadcast	ns <sup>c</sup>	0.4 (0.08) b	0.52 (0.13) b
Efficacy	ns	0.68 (0.12) ab	0.57 (0.14) b
Balanced	ns	0.78 (0.13) a	0.76 (0.18) ab
Savings	ns	0.96 (0.15) a	1 (0.22) a

Abbreviations: GOB, green-on-brown; GOG, green-on-green; BCST, broadcast; SS, spot spray

# Large Sprayer

## Lincoln– Nebraska

- Corn and soybean trials – Split plot
- Three replications of the following treatments:
  - SS only
  - Low BCST + high SS
  - High BCST + low SS
- 5 thresholds, based on weed size
  - Broadcast (for statistical comparison)
  - Balanced
  - Efficacy
  - Savings
  - UNL (large weed size detection, for modeling purposes)

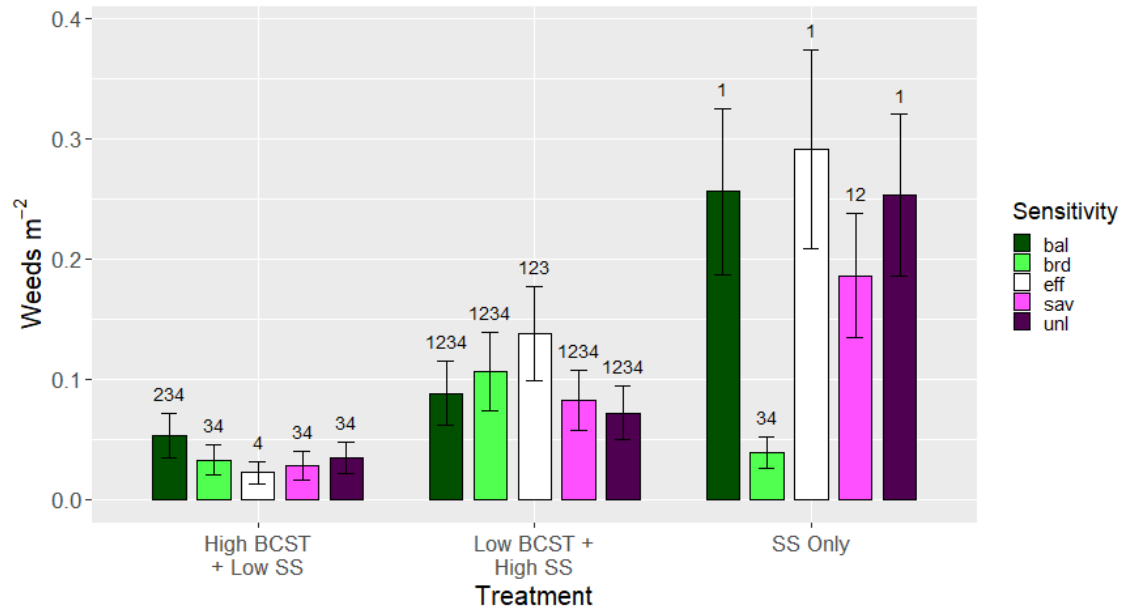
## Results

- Weed density, soybean: 6 weeks after treatment, High BCST + Low SS had the lowest weed pressure throughout all thresholds.
- Weed density, corn: 6 weeks after treatment, High BCST + Low SS had the lowest consistent weed pressure throughout all thresholds. However, the Efficacy and Savings thresholds in the Low BCST + High SS treatment had weed densities significantly insignificant from the Broadcast threshold in the High BCST + Low SS treatment.
- Weed-free area rating, soybean: 6 weeks after treatment, all sensitivities in the High BCST + Low SS were not statistically different.
- Weed-free area rating, corn: No statistical differences in thresholds, but SS only was statistically weedier than the others.



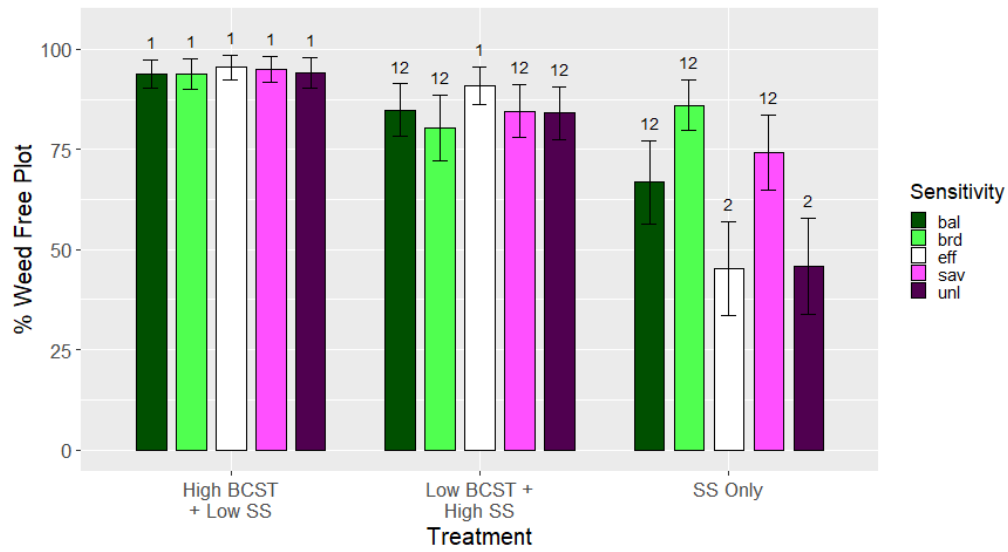
# Nebraska Soybean Study (2023)

6 weeks after treatment



# Nebraska Soybean Study (2023)

Weed Control - 6 WAPT



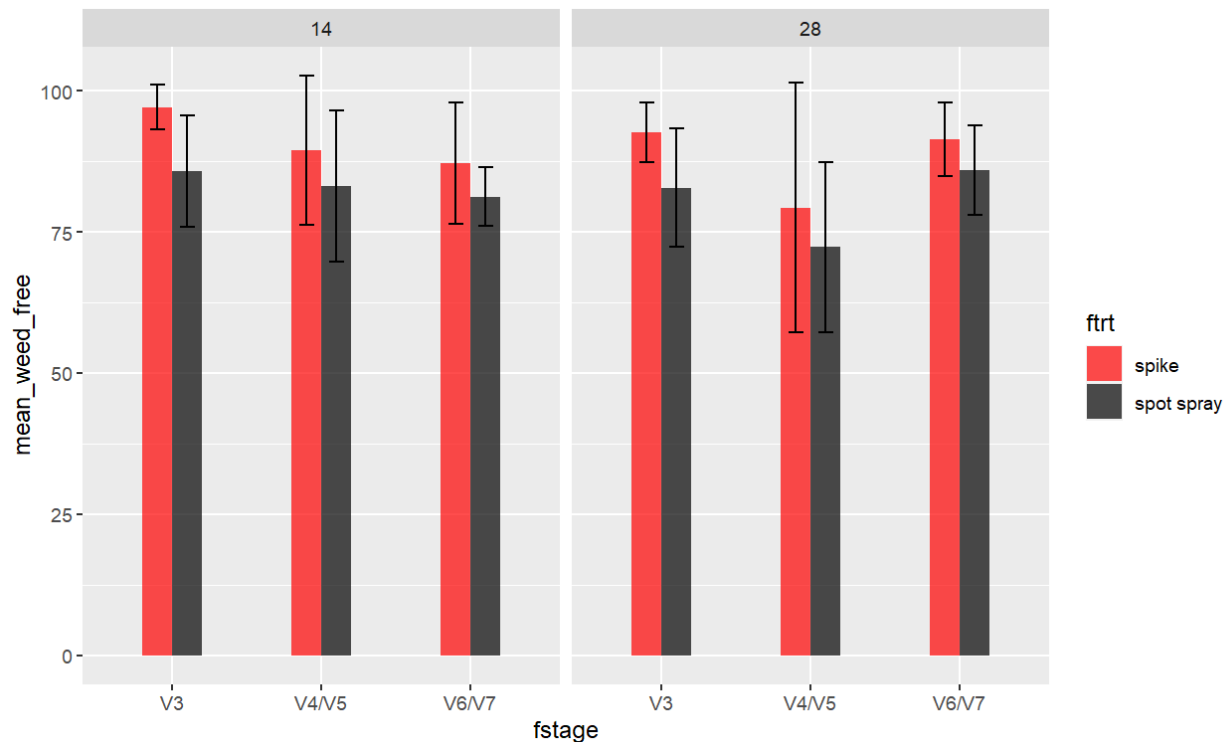
## Large Sprayer Application timing

- Application timing protocol: the main objective of this protocol was to evaluate the effect of crop growth stage/phenology stage on weed control. The protocol consisted of three different application timings on soybeans using POST emergence herbicides.

### Application timing - soybean

**Spike** = LIBERTY 32oz/ac + RPM3 24 oz/ac spot spray + LIBERTY 32oz/ac + RPM3 24 oz/ac broadcast spray

**Spot spray** = LIBERTY 32oz/ac + RPM3 24 oz/ac spot spray



### **Results**

- The V3 spike treatment resulted in the most effective weed control.
- The difference between spot spray and spike was greatest at V3 timing.
- Difference in treatments is most likely due to small undetected weeds in the spot spray only treatment that were treated with a broadcast application and a spot application for the spike treatment.

V3 spot spray plots



V3 spike plots

---



V4/V5 spot spray plots

---



V4/V5 SPIKE plots

---



V6/V7 spot spray plots

---





V6/V7 SPIKE plots

---

