



Optimizing Biological Product Management to Improve Soybean Productivity

Ava Isaacs, Connor Sible, & Fred Below

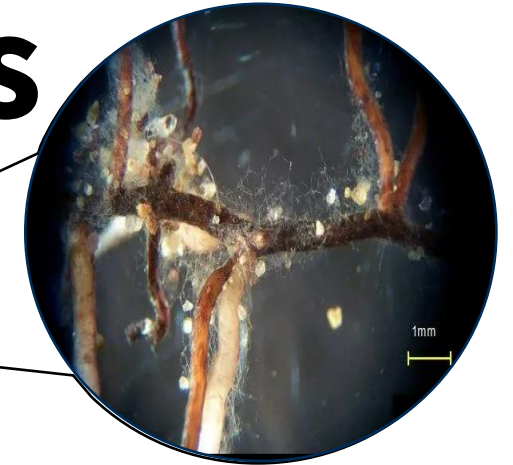
Crop Physiology Laboratory
Department of Crop Sciences
University of Illinois Urbana-Champaign



What are Biologicals?

- **Beneficial Microbes**

- **“Living”**

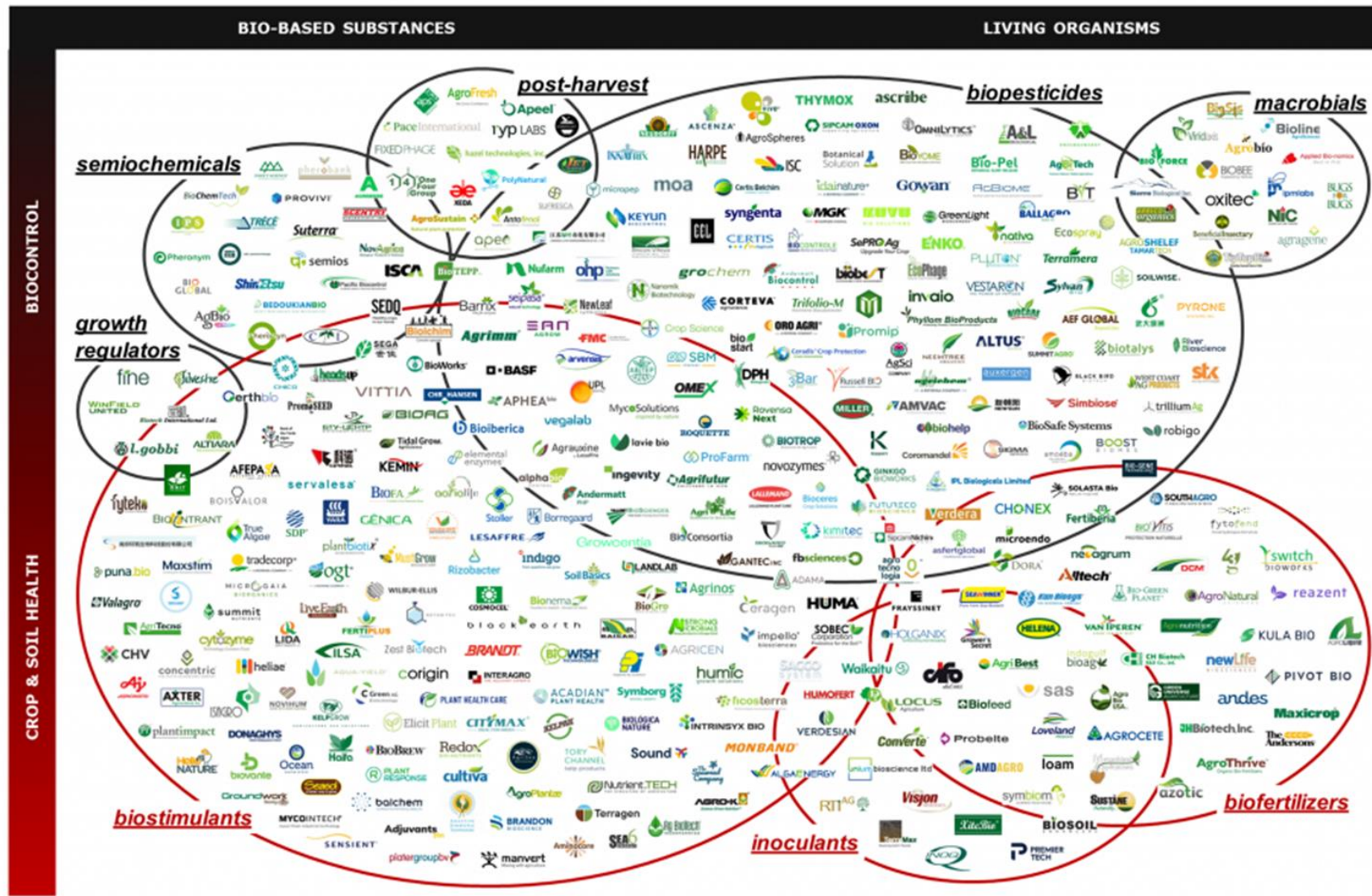


- **Biostimulants**

- **“Dead”**



2023 AG BIOLOGICALS LANDSCAPE



Chris Taylor
chris@mixingbowlhub.com

www.MixingBowlhub.com
© Chris Taylor & THE MIXING BOWL

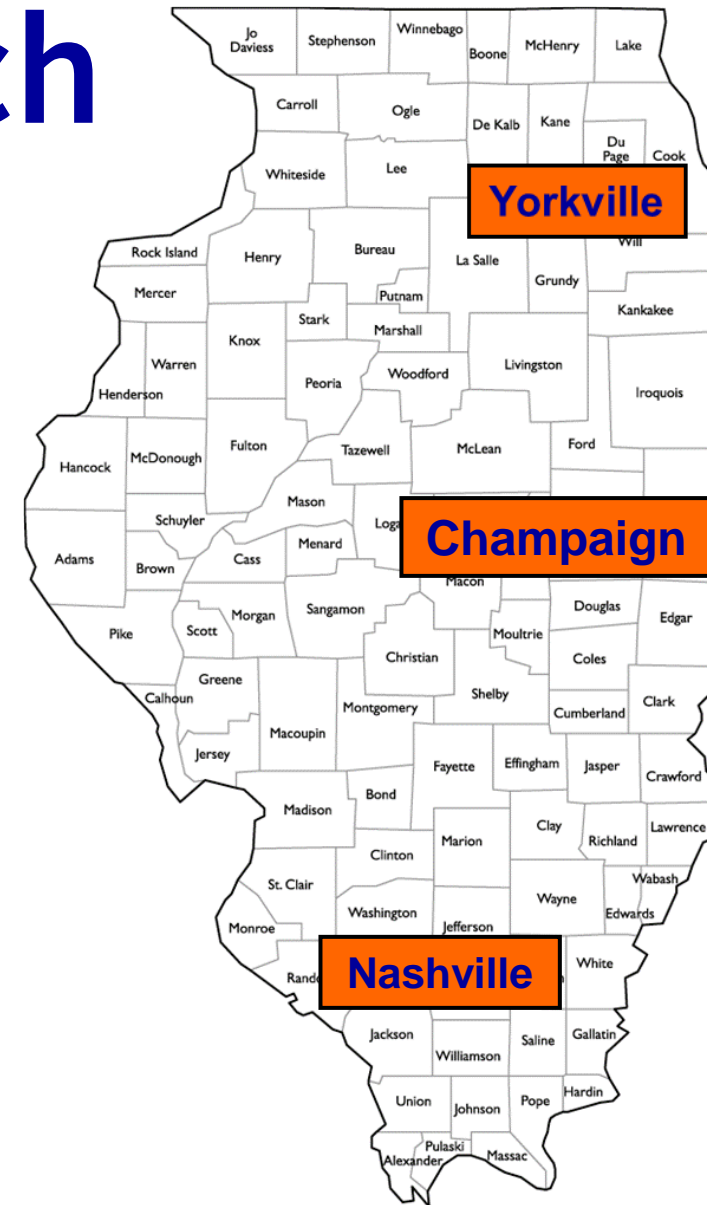


Companies appear on the landscape only once, although some may offer products in multiple segments. Overlapping areas are meant to imply this, however, logo positions are not necessarily indicative of any specific or limited product offerings.

**Where, when, and how
can we use a biological
product for the best
chance of success?**

Research Approach

- **10 Products**
- **3 Application Methods**
- **3 Unique Soil Environments**
- **2 Agronomic Management Types**
- **2 Varieties – AG38XF3 & GH3765XF**
- **Population –350,000 plants per ha**
- **Row Spacing – 76 cm**



Research Approach

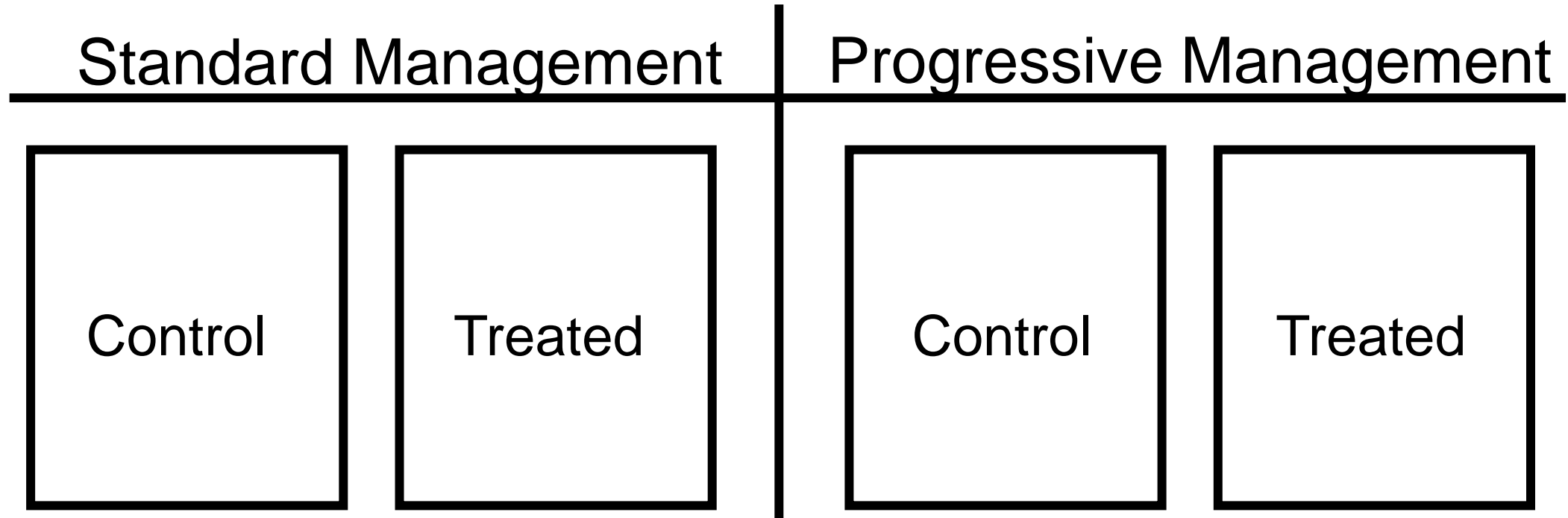


Champaign	35	15.9	6.8	27	164
Yorkville	41	18.7	6.0	58	180

Trial Design

Management System	Preplant Fertility ¹	Foliar Protection
Standard	None	None
Progressive	19.6 kg N ha ⁻¹ 22.4 kg S ha ⁻¹	Fungicide and Insecticide at R3

¹Preplant fertility supplied as ammonium sulfate (21-0-0-24S) broadcast with a Gandy drop spreader.



Application Methods



2024 Treatments

Company	Product	Product Type	Application
Lallemand	LAL Fix ProYield	Bradyrhizobium	Seed Treatment
Brandt	Microsurge	Bradyrhizobium	Seed Treatment
Mosaic	Biopath	Bacillus	In-Furrow
Biolevel	Phos N	Bacillus	Seed Treatment
Helena Agri	Myco-Sol	AMF	In-Furrow
Valent	Symvado	AMF	Seed Treatment
Azotic North America	Envita	N-Fixing Endophyte	Foliar
Corteva	Utrisha N	N-Fixing Endophyte	Foliar
AMVAC	iNvigorate	Non-Traditional	In-Furrow
Novozymes	Jumpstart	Non-Traditional	Seed Treatment

2024 Treatments

Company	Product	Product Type	Application
Lallemand	LAL Fix ProYield	Bradyrhizobium	Seed Treatment
Brandt	Microsurge	Bradyrhizobium	Seed Treatment
Mosaic	Biopath	Bacillus	In-Furrow
Biolevel	Phos N	Bacillus	Seed Treatment
Helena Agri	Myco-Sol	AMF	In-Furrow
Valent	Symvado	AMF	Seed Treatment
Azotic North America	Envita	N-Fixing Endophyte	Foliar
Corteva	Utrisha N	N-Fixing Endophyte	Foliar
AMVAC	iNvigorate	Non-Traditional	In-Furrow
Novozymes	Jumpstart	Non-Traditional	Seed Treatment



POX-C

Biological Product	Biological Category	Δ POX-C			
		NV	CU	YV	
		----- mg kg ⁻¹ C -----			
LAL Fix ProYield	Bradyrhizobium				
Microsurge	Bradyrhizobium				
Biopath	Bacillus				
Phos N	Bacillus				
Myco-Sol	AMF				
Symvado	AMF				
Envita	N-Fixing Endophyte				
Utrisha N	N-Fixing Endophyte				
iNvigorate	Non-Traditional				
Jumpstart	Non-Traditional				
		LSD ($P \leq 0.05$) ²	NS	NS	NS
		P > F	0.3832	0.1019	0.6591

POX-C

Biological Product	Biological Category	Δ POX-C		
		NV	CU	YV
		----- mg kg ⁻¹ C -----		
LAL Fix ProYield	Bradyrhizobium	+ 12.9	- 18.9	+ 9.7
Microsurge	Bradyrhizobium	- 20.5	+ 13.5	- 13.5
Biopath	Bacillus	- 65.5	+ 49.2	+ 26.6
Phos N	Bacillus	- 3.5	- 23.9	- 2.2
Myco-Sol	AMF	- 10.9	+ 19.1	- 17.0
Symvado	AMF	- 35.5	- 1.3	- 19.2
Envita	N-Fixing Endophyte	+ 25.0	+ 2.8	- 3.4
Utrisha N	N-Fixing Endophyte	+ 19.9	- 31.5	- 14.4
iNvigate	Non-Traditional	+ 12.0	- 27.1	+ 5.0
Jumpstart	Non-Traditional	+ 10.0	+ 11.0	- 27.6
LSD ($P \leq 0.05$) ²		NS	NS	NS
P > F		0.3832	0.1019	0.6591

β -Glucosidase

Δ BG

Biol

YV

+0.2

+0.5

-2.0

+0.7

-1.1

-2.3

+2.6

-0.7

+1.1

+0.3

NS

Biologicals had no consistent effects on POX-C and β -Glucosidase across the three sites.

P > F

0.4919

0.3677

0.8293

Soil NH₄⁺-N and Nodule Biomass

Biological Product	Biological Category	Δ Soil NH ₄ ⁺ -N			Δ Nodule biomass		
		NV	CU	YV	NV	CU	YV
		----- mg kg NH ₄ -N -----			----- grams -----		
LAL Fix ProYield	Bradyrhizobium	+ 0.8	+ 0.2	- 0.3	+ 0.1	- 0.1	+ 0.1
Microsurge	Bradyrhizobium	+ 0.1	+ 0.1	+ 0.2	+ 0.2	+ 0.1	- 0.1
Biopath	Bacillus	- 0.3	+ 0.3	- 0.2	+ 0.1	- 0.1	± 0.0
Phos N	Bacillus	+ 0.3	± 0.0	+ 0.7	- 0.1	+ 0.2	- 0.6
Myco-Sol	AMF	- 0.9	+ 0.2	- 0.1	+ 1.1	± 0.0	+ 0.3
Symvado	AMF	+ 0.9	- 0.1	+ 0.4	- 0.1	+ 0.1	- 0.1
Envita	N-Fixing Endophyte	+ 0.4	+ 0.1	- 0.7	-	-	-
Utrisha N	N-Fixing Endophyte	+ 0.8	- 0.1	+ 0.6	-	-	-
iNvigorate	Non-Traditional	± 0.0	± 0.0	+ 0.8	± 0.0	+ 0.1	+ 0.5
Jumpstart	Non-Traditional	+ 0.4	- 0.1	+ 0.2	+ 0.4	+ 0.2	- 0.2
LSD (<i>P</i> ≤ 0.05) ³		NS	NS	NS	NS	NS	0.6
<i>P</i> > <i>F</i>		0.5641	0.8633	0.3039	0.0775	0.4218	0.0202

Soil NH₄⁺-N and Nodule Biomass

Biological Product	Biological Category	Δ Soil NH ₄ ⁺ -N			Δ Nodule biomass		
		NV	CU	YV	NV	CU	YV
		----- mg kg ⁻¹ NH ₄ -N -----			----- grams -----		
LAL Fix ProYield	Bradyrhizobium	+ 0.8	+ 0.2	- 0.2	+ 0.1	- 0.1	+ 0.1
Microsurge	Bradyrhizobium	+ 0.1	+ 0.1	+ 0.2	+ 0.2	+ 0.1	- 0.1
Biopath	Bacillus	- 0.3	+ 0.3	- 0.2	+ 0.2	- 0.1	± 0.0
Phos N	Bacillus	+ 0.3	± 0.0	+ 0.7	- 0.1	+ 0.2	- 0.6
Myco-Sol	AMF	- 0.9	+ 0.2	- 0.1	+ 1.1	± 0.0	+ 0.3
Symvado	AMF	+ 0.9	- 0.1	+ 0.4	- 0.1	+ 0.1	- 0.1
Envita	N-Fixing Endophyte	+ 0.4	+ 0.1	- 0.7	-	-	-
Utrisha N	N-Fixing Endophyte	+ 0.8	- 0.1	+ 0.6	-	-	-
iNvigorate	Non-Traditional	± 0.0	± 0.0	+ 0.8	± 0.0	+ 0.1	+ 0.5
Jumpstart	Non-Traditional	+ 0.4	- 0.1	+ 0.1	+ 0.4	+ 0.2	- 0.2
LSD (<i>P</i> ≤ 0.05) ³		NS	NS	NS	0.5	NS	0.6
<i>P</i> > <i>F</i>		0.5641	0.8633	0.3783	0.0051	0.4218	0.0202

2024 Biological Response x Management

Biological Product	Biological Category	Standard			Progressive		
		NV	CU	YV	NV	CU	YV
		————— Δ Kg/ha —————					
LAL Fix ProYield	Bradyrhizobium	+87.1	+19.7	-116.0	-105.6	-46.1	+25.4
Microsurge	Bradyrhizobium	-190.4	+39.9	-9.2	161.9	-115.6	-45.9
Biopath	Bacillus	-346.6	+55.9	-44.1	-304.6	+11.4	+15.0
Phos N	Bacillus	-133.4	+59.5	-7.1	+80.5	-6.3	+89.8
Myco-Sol	AMF	-256.1	-51.1	+58.1	-117.9	-24.3	+104.6
Symvado	AMF	-47.6	+17.6	+54.8	-1.3	-46.6	-5.8
Envita	N-Fixing Endophyte	+66.5	-4.4	+50.7	-12.3	-21.0	+0.9
Utrisha N	N-Fixing Endophyte	+46.2	+75.6	+26.0	182.1	-24.4	+62.8
iNvigorate	Non-Traditional	+84.7	+34.5	-73.8	-73.2	-13.7	-43.9
Jumpstart	Non-Traditional	-165.5	+30.4	-59.0	-84.2	+4.9	+40.3

LSD ($\alpha=0.05$) = NS

Conclusion

- **Bradyrhizobium product types improved Soil $\text{NH}_4\text{-N}$ concentration as well as total nodule biomass. This supports our previous research on the effectiveness of Bradyrhizobium in soybean.**
- **There is still much to be determined about the use of biological products within our agronomic systems for greater success.**

Special Thank You to USB!

More info at:

Crop Physiology Laboratory

University of Illinois

<http://cropphysiology.cropsci.illinois.edu>

