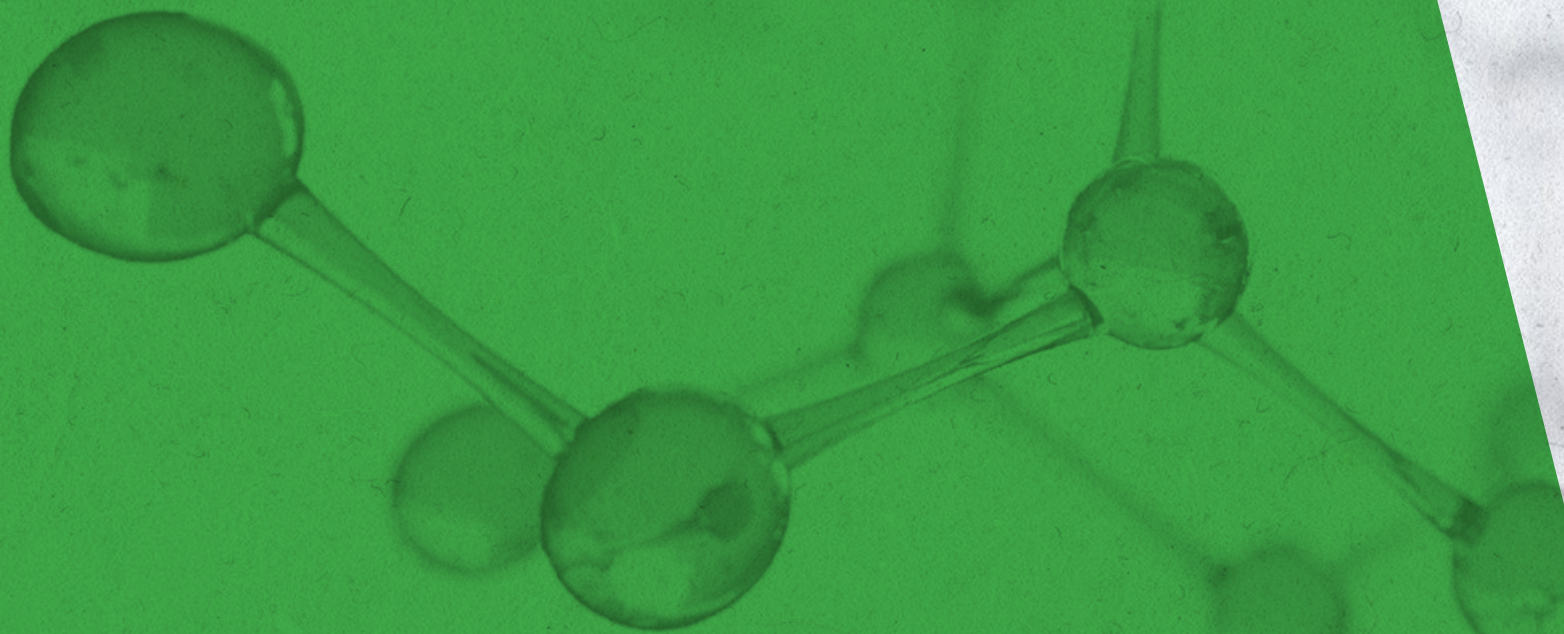


BREAKING THE WEED SEEDBANK



FMC

An Agricultural
Sciences Company

HELP STOP WEEDS FROM COMING UP

LAYER RESIDUAL HERBICIDES AND MULTIPLE SITES OF ACTION.

High deposits to the weed seedbank will plague fields for years to come if growers don't adopt integrated strategies to reduce the soil seedbank. A high weed seedbank delivers multiple weed flushes per season, overpowers treatments, reduces yields and increases chances for rapid failure of the latest herbicide technologies. Waterhemp, Palmer amaranth and barnyardgrass are prolific seed producers with resistance to multiple herbicides and sites of action, making them particularly problematic.

Breaking the weed seedbank requires going beyond herbicide-tolerant postemergence options to ones that halt weeds from emerging in the first place. This includes burndown, residual preemergence and residual post emergence herbicides as well as cultural practices. Layering residual herbicides and multiple sites of action should be the foundation of an integrated program that includes diverse tactics.



ACTIONS TO TAKE:

Start clean and stay clean.

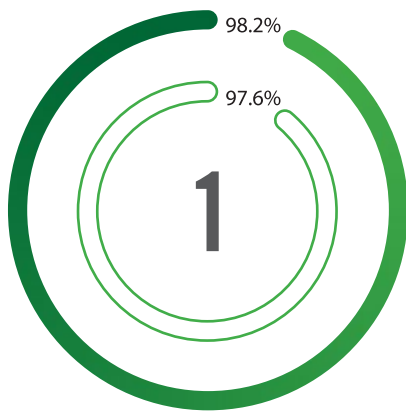
- Deploy herbicides with multiple sites of action in a layered residual program.
- Start with a strong preemergence residual herbicide and follow 14-21 days later with an overlapping residual.
- Utility of layering residual herbicides.
 - + Increased herbicide diversity
 - + Reduction in selection pressure
 - + Improved control of weed spectrum
 - + Fewer weed escapes
 - + Reduction in weed competition

WEED CONTROL IS BEST WHEN LAYERING RESIDUAL HERBICIDES WITH MULTIPLE EFFECTIVE SITES OF ACTION.

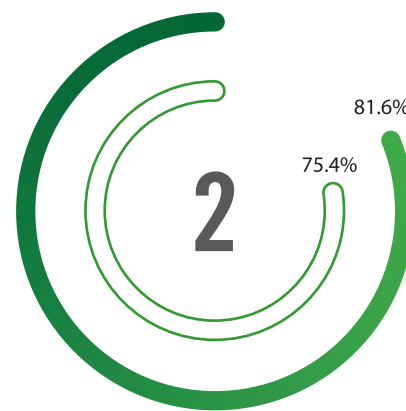
A Purdue University research study on soil seedbank dynamics compared the effectiveness of four different herbicide programs. Weed control dropped off dramatically when treatments did not include layered residual herbicides leaving many more weed escapes to return seed to the soil seedbank.

EFFICACY OF FOUR HERBICIDE PROGRAMS ON WATERHEMP AND BARNYARDGRASS PURDUE UNIVERSITY - FARMLAND, IN - POOLED YEARS 2018-2019*

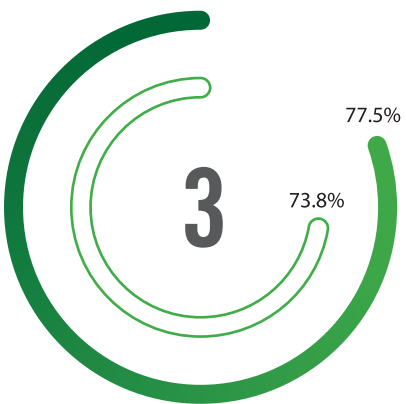
% WEED CONTROL -- 30 DAYS AFTER POST



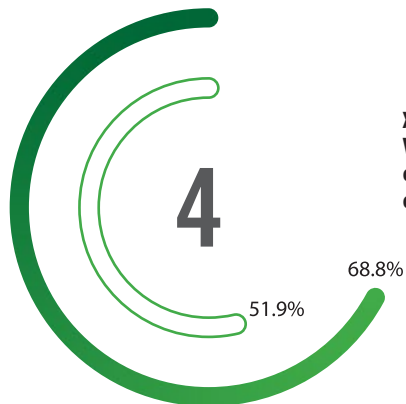
1
Authority® First DF herbicide 5 oz./A PRE fb Anthem® MAXX herbicide 3 fl. oz./A + XtendiMax® herbicide with VaporGrip® Technology 22 fl. oz./A + Roundup® PowerMAX herbicide 32 fl. oz./A EPOST



2
Metribuzin 75 DF 5 oz./A PRE fb XtendiMax herbicide with VaporGrip Technology 22 fl. oz./A + Roundup PowerMAX herbicide 32 fl. oz./A EPOST



3
Warrant® herbicide 3 pt./A + XtendiMax herbicide with VaporGrip Technology 22 fl. oz./A + Roundup PowerMAX herbicide 32 fl. oz./A EPOST



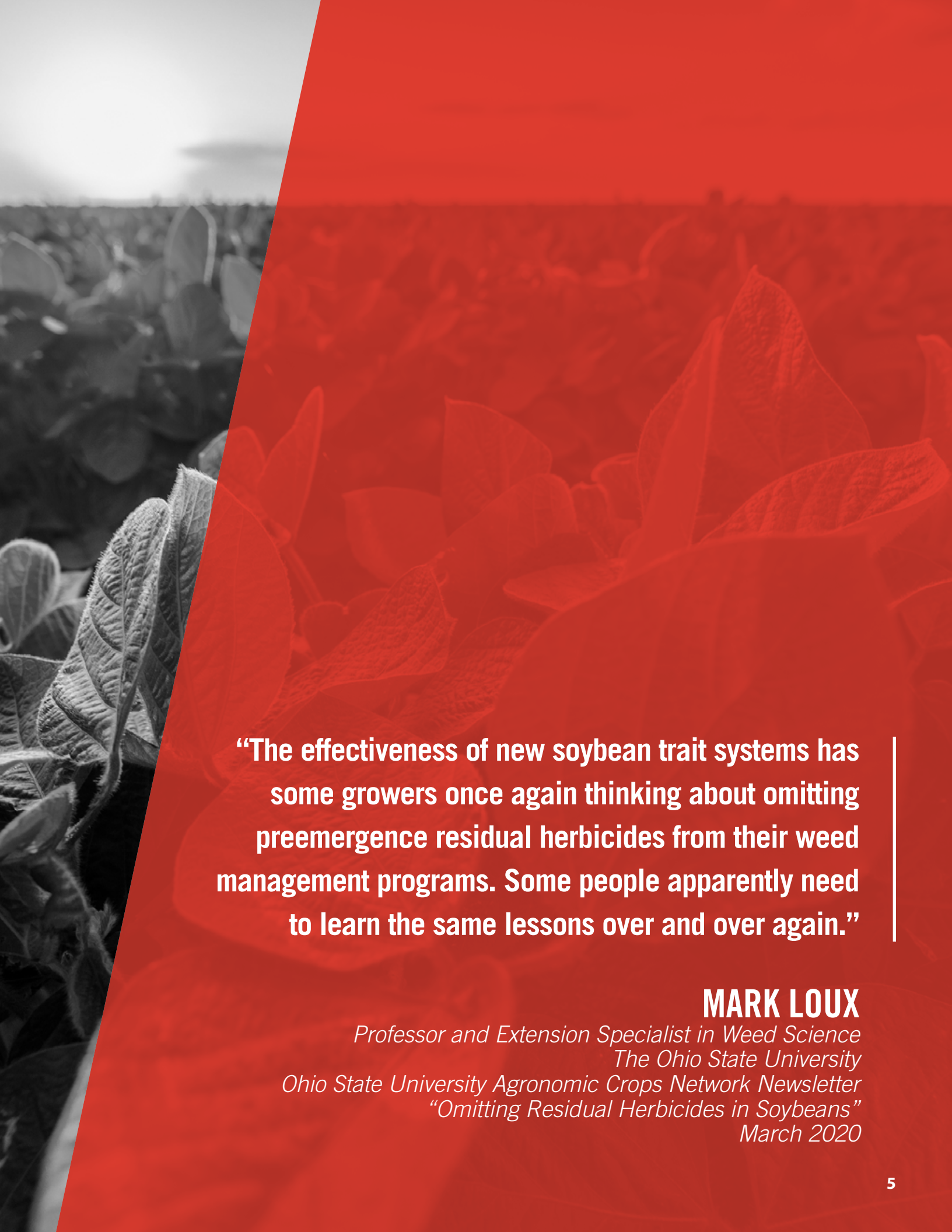
4
XtendiMax herbicide with VaporGrip Technology 22 fl. oz./A + Roundup MAX 32 fl. oz./A EPOST



- Treatment 1** Long residual preemergence with overlapping residual post program.
- Treatment 2** Short residual preemergence followed by non-residual post program.
- Treatment 3** Total post program with residual.
- Treatment 4** Total post program without residual.

Waterhemp and barnyardgrass control was significantly better when employing multiple sites of action and layered residual herbicides PRE and POST. Dramatically better control was achieved with the treatment that layered residuals, Authority First DF herbicide PRE with Anthem MAXX herbicide EPOST plus dicamba and glyphosate, resulting in 98.2% control of waterhemp and 97.6% control of barnyardgrass.

*Site contains glyphosate-resistant waterhemp.



“The effectiveness of new soybean trait systems has some growers once again thinking about omitting preemergence residual herbicides from their weed management programs. Some people apparently need to learn the same lessons over and over again.”

MARK LOUX

*Professor and Extension Specialist in Weed Science
The Ohio State University
Ohio State University Agronomic Crops Network Newsletter
“Omitting Residual Herbicides in Soybeans”
March 2020*

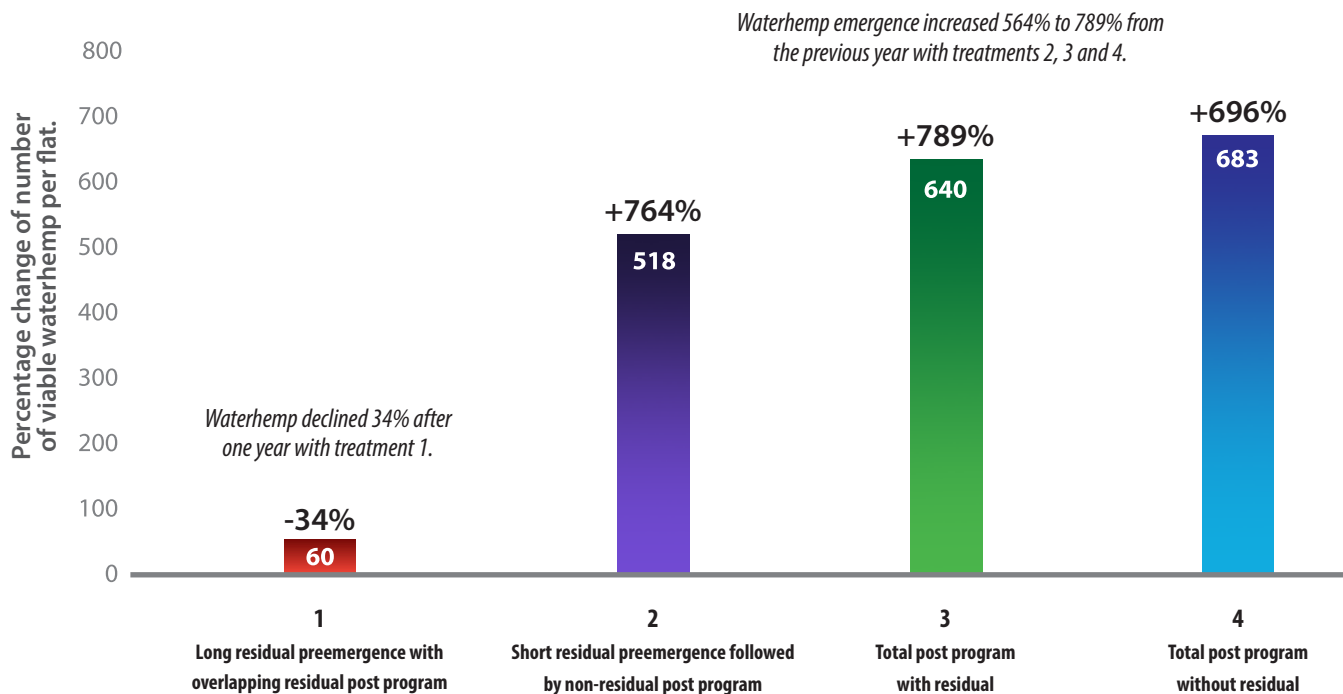
SEEDBANK DEPOSITS SKYROCKET WITHOUT SEQUENTIAL RESIDUAL HERBICIDES APPLIED PRE AND POST.

In this Purdue University study on soil seedbank dynamics, viable waterhemp density in the seedbank skyrocketed with treatments that did not deploy overlapping residual herbicides with multiple sites of action.

WATERHEMP SEEDBANK AFTER ONE YEAR OF MANAGEMENT

INFLUENCE OF USING MULTIPLE SITES OF ACTION AND LAYERED RESIDUALS ON SOIL SEEDBANK DYNAMICS

PURDUE UNIVERSITY - FARMLAND, IN 2018 -2019*



Treatment 1

Authority® First DF herbicide 5 oz./A PRE fb Anthem® MAXX herbicide 3 fl. oz./A + XtendiMax® herbicide with VaporGrip® Technology 22 fl. oz./A + Roundup PowerMAX® herbicide 32 fl. oz./A EPOST

Treatment 2

Metribuzin 75 DF 5 oz./A PRE fb XtendiMax herbicide with VaporGrip Technology 22 fl. oz./A + Roundup PowerMAX herbicide 32 fl. oz./A EPOST

Treatment 3

Warrant® herbicide 3 pt./A + XtendiMax herbicide with VaporGrip Technology 22 fl. oz./A + Roundup PowerMAX herbicide 32 fl. oz./A EPOST

Treatment 4

XtendiMax herbicide with VaporGrip Technology 22 fl. oz./A + Roundup PowerMAX 32 fl. oz./A EPOST

Treatment 1, which layered strong residual herbicides PRE and POST (Authority First DF herbicide fb Anthem MAXX herbicide plus dicamba and glyphosate), reduced viable waterhemp emergence by 34% after one year. In contrast, metribuzin applied preemergence followed by a non-residual post treatment resulted in a five-fold increase in viable waterhemp seeds while POST-alone herbicide treatments increased viable waterhemp seeds by 696% to 789%.

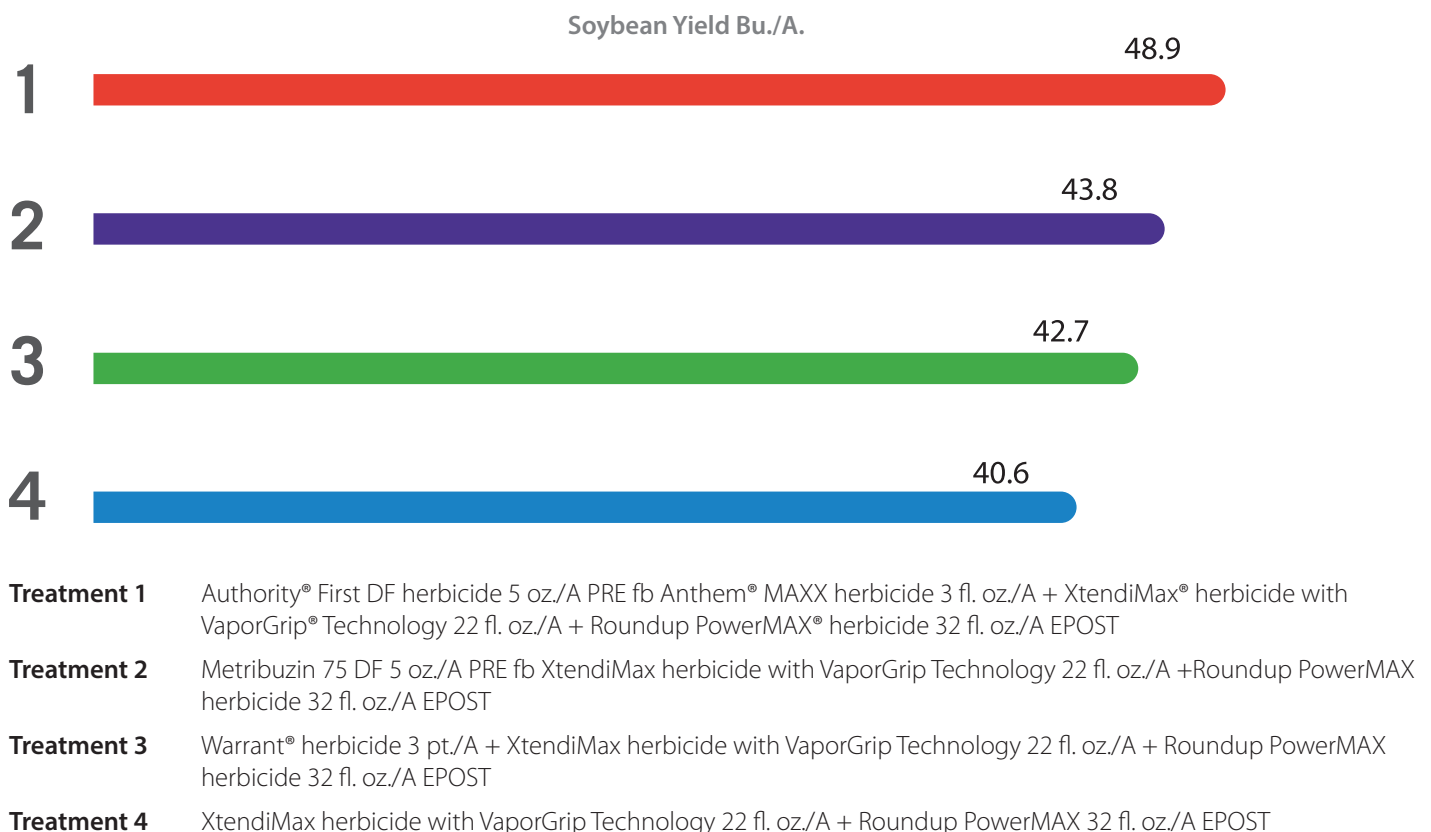
*Site contains glyphosate-resistant waterhemp.

“Besides glyphosate, waterhemp now resists six other herbicide sites of action. Palmer amaranth resists five herbicide sites of action. Cracks are also appearing in the dicamba-tolerant system.”

- *The New Math of Weed Control, Successful Farming/Agriculture.com, January 2020*

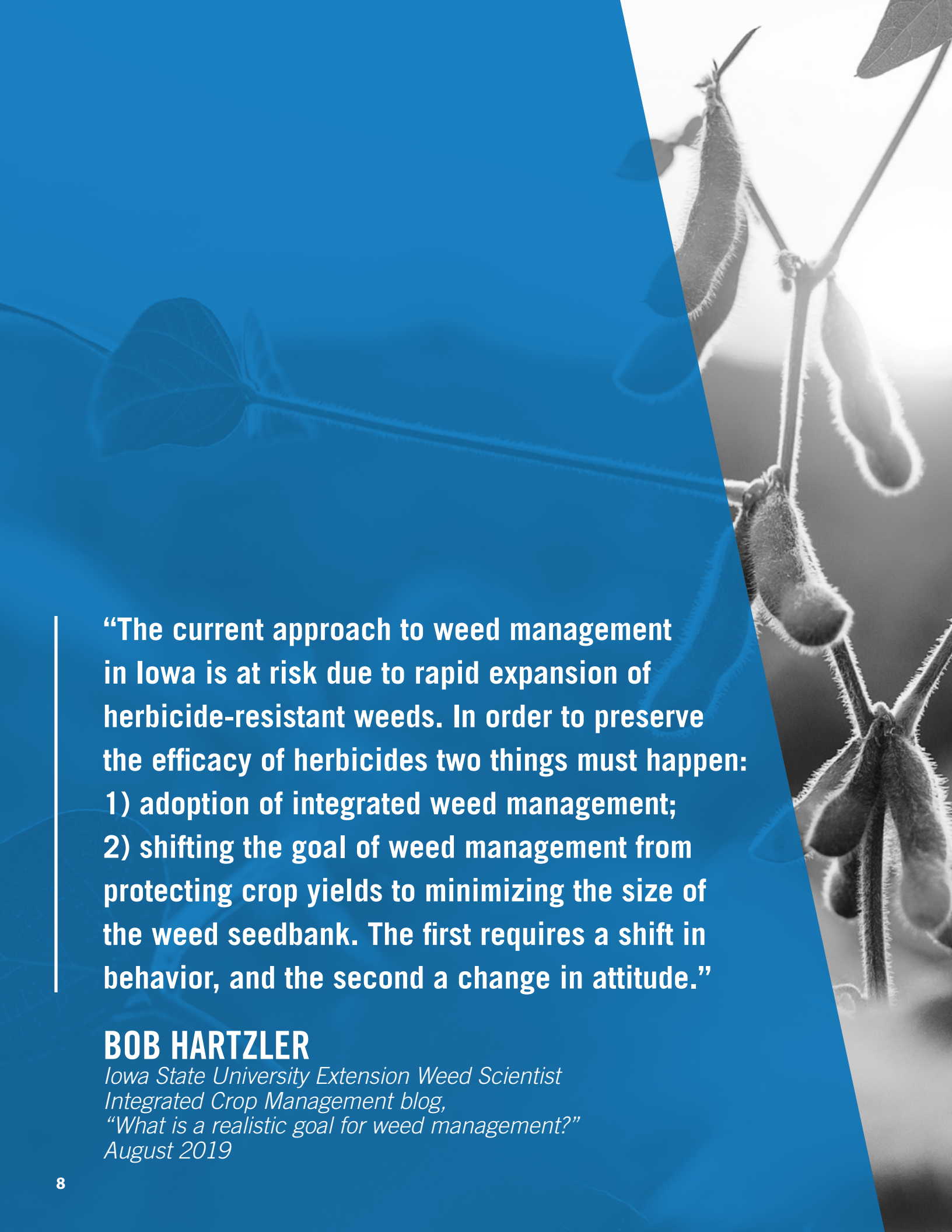
SOYBEAN YIELDS ARE HIGHEST WITH SEQUENTIAL APPLICATIONS OF RESIDUAL HERBICIDES WITH MULTIPLE SITES OF ACTION.

INFLUENCE OF USING MULTIPLE SOA AND LAYERED RESIDUALS ON SOIL SEEDBANK DYNAMICS PURDUE UNIVERSITY - FARMLAND, IN 2018*



Sequential applications of multiple sites of action residual herbicides resulted in higher soybean yields due to the higher level of weed control in those treatments. The top yielding treatment was the one that layered Authority First DF herbicide PRE with Anthem MAXX herbicide early POST. It out-yielded the other treatments by 5.1 to 8.3 bu/A.

*Site contains glyphosate-resistant waterhemp.



“The current approach to weed management in Iowa is at risk due to rapid expansion of herbicide-resistant weeds. In order to preserve the efficacy of herbicides two things must happen: 1) adoption of integrated weed management; 2) shifting the goal of weed management from protecting crop yields to minimizing the size of the weed seedbank. The first requires a shift in behavior, and the second a change in attitude.”

BOB HARTZLER

*Iowa State University Extension Weed Scientist
Integrated Crop Management blog,
“What is a realistic goal for weed management?”
August 2019*

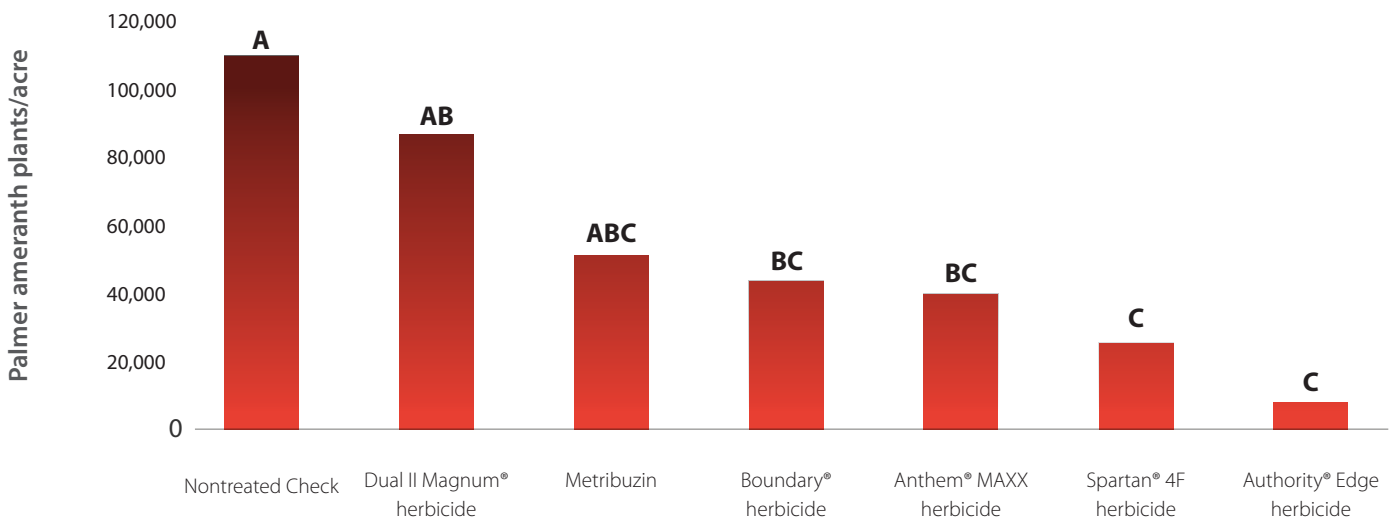
SELECT THE MOST EFFECTIVE HERBICIDES TO SLOW THE DEVELOPMENT OF HERBICIDE-RESISTANT WEEDS.

Choosing the most effective and longest residual preemergence herbicide means fewer weeds are being exposed to post treatments. Use the most effective herbicides for your weed spectrum at full rates. Scouting is important to identify weeds, weed escapes and to tailor herbicide programs accordingly.

PALMER AMARANTH DENSITY FOLLOWING HERBICIDE TREATMENT

35 DAYS AFTER APPLICATION AT PLANTING

UNIVERSITY OF TENNESSEE - JACKSON, TN - 2019

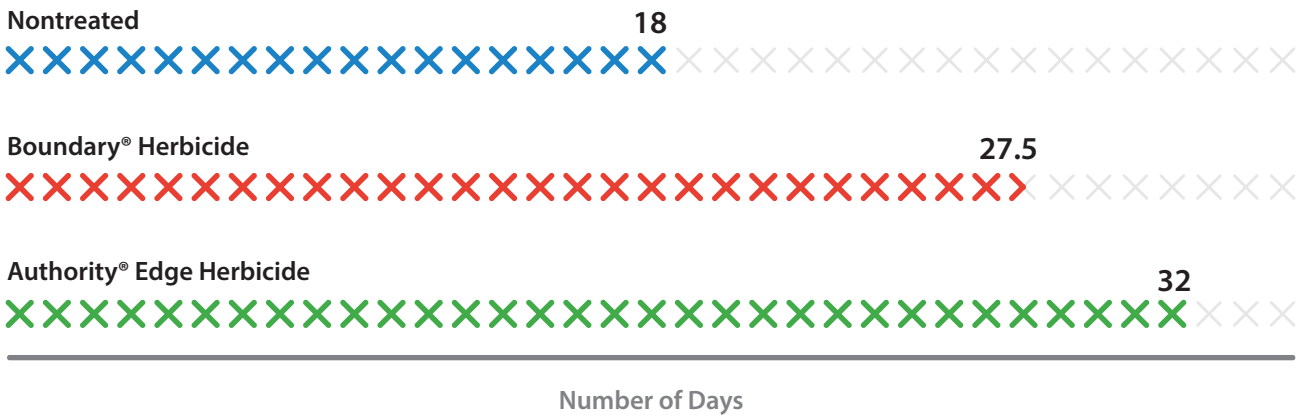


Five weeks after planting, the Authority Edge herbicide treatment maintained a 93% reduction in the population of Palmer amaranth compared to the non-treated check, which had more than 107,000 Palmer amaranth plants per acre. Deploying the most effective herbicide exposes fewer weeds to post treatments thus reducing selection pressure on those herbicides.

RESIDUAL HERBICIDES CAN EXPAND YOUR WINDOW FOR EFFECTIVE POST HERBICIDE TREATMENT.

Most postemergence herbicide programs recommend treating waterhemp before it is 4-inches tall, which can be a challenge for growers when weather or other field operations interfere. Here, the University of Illinois conducted a study that measured herbicide residual by the number of days it takes before a waterhemp plant reaches 4 inches in height. Each extra day helps growers be more timely and successful in their weed control.

LENGTH OF RESIDUAL COMPARISON - DAYS UNTIL WATERHEMP REACHES 4-INCH HEIGHT UNIVERSITY OF ILLINOIS - CHAMPAIGN, IL - 2019



It took just 18 days for a waterhemp plant in the non-treated check to reach the 4-inch height that is known to reduce the effectiveness of post herbicide treatments. The strong residual of Authority Edge herbicide widened that window by a full two weeks, significantly more than the other residual herbicides. Authority Edge herbicide can provide growers a larger window to treat weeds when they are small and when post herbicides are most effective.

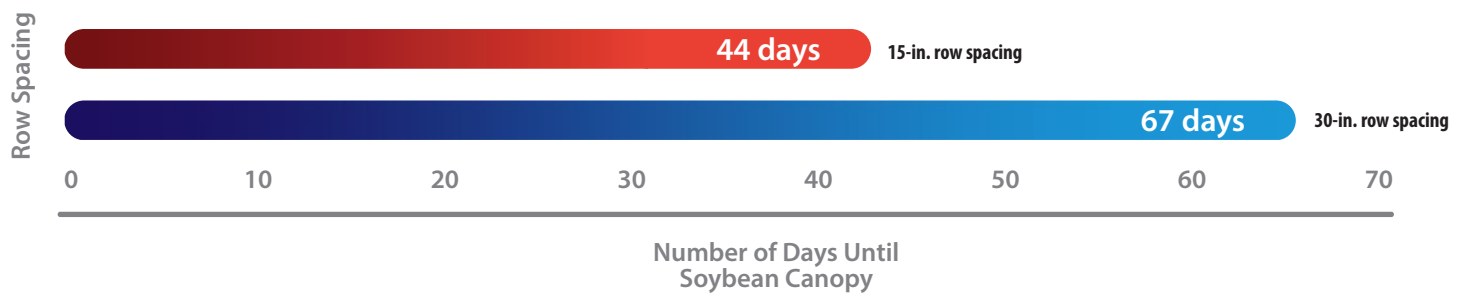


FOLLOW A DIVERSIFIED WEED MANAGEMENT PROGRAM FOR BEST RESULTS.

- Integrate chemical, cultural, mechanical and biological methods for sustainable control of resistant biotypes.
 - + **Chemical:** Layered residual herbicides pre and post with multiple sites of action.
 - + **Cultural:** Increased seeding rates, narrow row spacings and crop rotations.
 - + **Mechanical:** Deep tillage, windrow burning, seed destructors.
 - + **Biological:** Cover crops.
- Female waterhemp and Palmer amaranth plants are capable of producing in excess of 500,000 seeds per plant. Practice zero tolerance for weed escapes even if it means hand removal. Minimize field-by-field seed movement by cleaning equipment and harvesting the worst fields last.
- It is possible to regain control of the weed seedbank. Restricting waterhemp seed return reduces seedbank persistence over time. Viability of pigweed seeds can drop dramatically after three years of intense management.

EFFECT OF ROW SPACING ON DAYS UNTIL SOYBEAN CANOPY

UNIVERSITY OF ILLINOIS - CHAMPAIGN, IL - 2019



MAIN EFFECT OF ROW SPACING ON SOYBEAN YIELDS

UNIVERSITY OF TENNESSEE - 2019



Soybean canopy closure occurred 23 days quicker in 15-inch rows compared to 30-inch rows in a University of Illinois study. Canopy closure reduces weed competition, late-season germination and weed seed production. Soybean yields were also highest in 15-inch rows, 62.6 bu/A, compared to 56.8 bu/A in 30-inch rows in a University of Tennessee study.



XtendiMax herbicide with VaporGrip Technology is a Restricted Use Pesticide. Always read and follow all label directions, precautions and restrictions for use. Some products may not be registered for sale or use in all states. Authority Edge herbicide may not be registered for sale or use in all states. Contact your local FMC retailer or representative for details and availability in your state. FMC, the FMC logo, Anthem, Authority and Spartan are trademarks of FMC Corporation or an affiliate. Roundup PowerMAX, VaporGrip, Warrant and XtendiMax are trademarks of Bayer CropScience or an affiliate. Boundary and Dual II Magnum are trademarks of a Syngenta Group Company. ©2020 FMC Corporation. All rights reserved. 20-FMC-0553 05/20