



**TOUGH® 5EC INCREASES  
CONTROL**



# HOW DO YOU HANDLE HERBICIDE RESISTANCE?

Successfully addressing weed pressure is key to achieving optimal yields.

But weed management and control has become increasingly difficult in recent years with the rise of herbicide resistance in broadleaf weeds such as Waterhemp, Palmer Amaranth and Kochia. At the same time, tighter regulations have left growers with fewer available chemistries to control of resistant weeds.

***Enter TOUGH 5EC, a pyridate-based solution from Belchim Crop Protection USA.***



## A Great Tool for “TOUGH” to Control Weeds

- A SELECTIVE HERBICIDE For Postemergence Control Of Annual Broadleaf Weeds
- GROUP 6 – PROVEN, EFFECTIVE Mode of Action
- WIDE WINDOW Of Application (Preplant Burndown, Postemergence Up To V8)
- Contact herbicide -> NO ROTATIONAL Issues
- PROPRIETARY Active Ingredient: Pyridate
- Formulated as a 5 lb ai/gal EMULSIFIABLE CONCENTRATE
- RAINFAST Within 1 Hour
- NO RESIDUAL Restrictions

***TOUGH 5EC will enhance control of tank-mix partners and help prevent selection for herbicide resistance!***

## TOUGH 5EC PHOTOSYNTHESIS II INHIBITOR

Pyridate works by blocking a weed's photosystem II process, triggering the release of toxic forms of oxygen and causing rapid cell wall degradation. Pyridate is a highly effective mode of action in corn and shows increased levels of weed control in tank-mix combinations.

- Pyridate is applied after emergence of the weed.
- Pyridate is quickly absorbed by the leaves (rain-fast within 60 minutes).
- Pyridate blocks photosystem II of the weed by irreversibly binding to the D1 protein and inhibiting the transport of electrons. High energy electrons then interact with oxygen, producing toxic forms of oxygen.
- The toxic forms of oxygen interact and degrade the cell membranes resulting in necrosis (browning) and ultimate death to the weed.

## TOUGH 5EC SYNERGIZES\* HPPD INHIBITORS

For over a decade, weed resistance (Palmer Amaranth and Common Waterhemp) to HPPD inhibitors (Group 27) has been on the rise. TOUGH 5EC is an ideal tank mix partner, as a resistance management tool, with HPPD inhibitors. TOUGH 5EC herbicide puts a charge in your postemergence weed control program with rapid and complete control of your broadleaf weeds including resistant Common Waterhemp, Palmer amaranth, and Kochia. Field research has shown adding TOUGH 5EC to the mix, improves performance; promoting faster weed death and overcoming HPPD resistance.

### Pyridate Increases Free Radicals:

- Free radicals are single oxygen molecules that disrupt cell membranes causing cell collapse
- HPPDs:**
- Reduce the plants ability to detoxify these free radicals so its a one, two punch.

Image below depicts weed degradation symptoms 7 days after an application of TOUGH 5EC and a HPPD herbicide.



A trial was conducted at Purdue University in 2020.

Glyphosate resistant Palmer amaranth was treated with 3 oz of Callisto® (left) and Callisto + 8 oz of TOUGH 5EC (right).

Photos were taken 7 days after treatment.

**TOUGH 5EC increases the speed of kill!**



Dual II Magnum® PRE; Roundup PowerMAX 32 oz to all treatments.  
Bare ground trial with no corn planted so new emergence  
3-12" weed size, 3/ft<sup>2</sup>

\*Patent pending

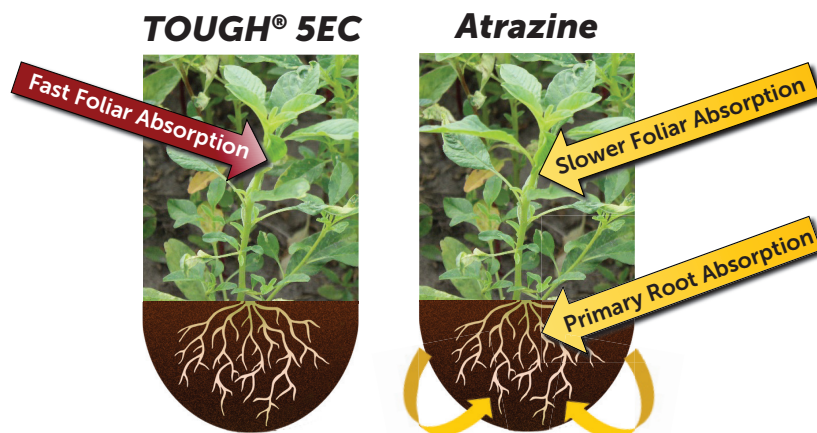
## TOUGH 5EC ENHANCES ATRAZINE

Because TOUGH 5EC binds differently and can kill atrazine resistant weeds, it is a great partner in the tank to enhance control with atrazine. Pyridate has fast foliar absorption to get to the target site but also degrades rapidly in the soil to prevent carry over concerns. Atrazine has slow leaf absorption and primarily works through root absorption which requires moisture. Atrazine has residual effects for weed control but can result in carry over; **maximize the PSII class of chemistry with this combination.**

Glyphosate Resistant Common Waterhemp  
Photos taken 10 Days After Application



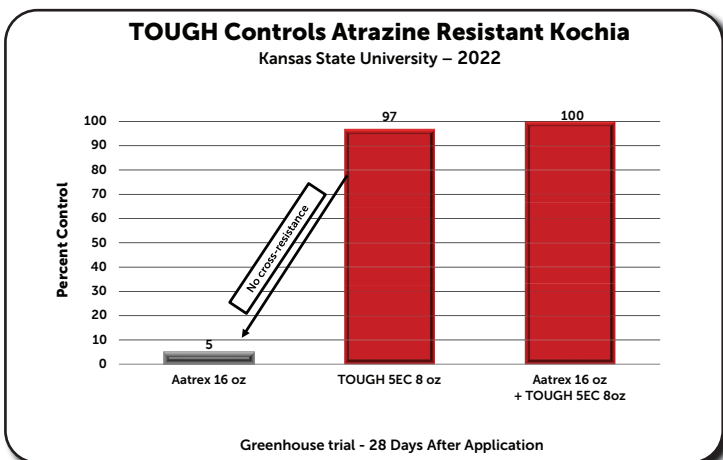
**15-30% Extra Control Can Be Significant!**



## TOUGH 5EC - A NEW SYNERGIST FOR HPPDs

In 2022 a trial was conducted at Kansas State, on an atrazine resistant population of Kochia, to confirm that TOUGH 5EC and atrazine are NOT cross resistant. In this greenhouse trial, atrazine did not control this Kochia, yet TOUGH 5EC provided good control, showing no cross resistance between TOUGH 5EC and atrazine.

***If you have atrazine resistance, TOUGH 5EC is the answer to put into the tank mix with HPPDs!***



## WHY IS "SHARPENING" CONTROL 5-10% IMPORTANT??

Resistant weeds such as Palmer Amaranth and Common Waterhemp can produce 100,000 to 400,000 seeds even when competing with a crop. These seeds are small (1-2mm) and are easily dispersed by wind, animals, livestock feed and equipment.

For example, if a postemergence product provides 95% control; that would still allow 5% (50 seeds per acre) to escape. Based on this, the potential for escape is  $50 \times 400,000 = 20$  million seeds per acre! That's 460 per square foot!

While tillage can bury a lot of seeds deeper than they can germinate the following year, research revealed viability, even when buried 6" deep: 1 year ~ 20% viable, 2 years ~ 10% viable, and 3 years ~ 5% viable.

Just 8 waterhemp per 11 square feet can reduce corn yield by 74% (Steckel 2007)

***Add TOUGH® 5EC to the postemergence tank mix and reduce the seed bank!***



## TOUGH 5EC A NEW Synergist for HPPD Inhibitors

TOUGH 5EC is an ideal tank mix partner for combating herbicide-resistant weeds: Commercial use and university trial data consistently show that adding TOUGH 5EC to the postemergence tank mix increases weed control up to 30%—particularly when resistance to other herbicide classes are present in the weed population.

The top and center charts show the synergistic effect when adding TOUGH 5EC to the tank mix with HPPDs.

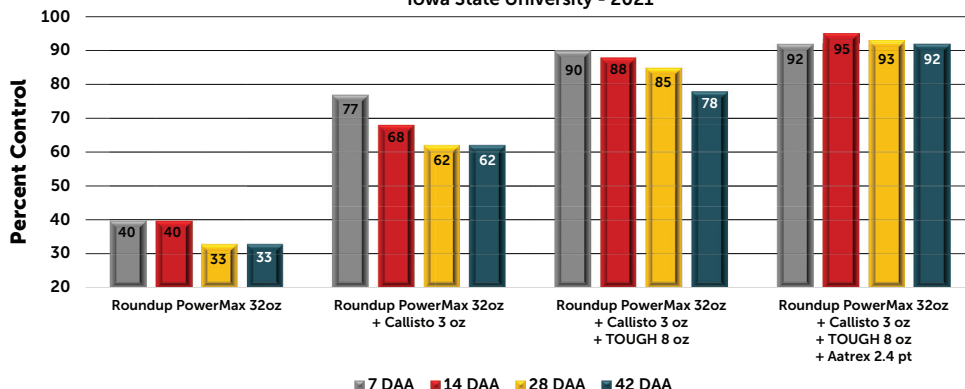
The bottom chart shows how TOUGH 5EC also improves weed control when mixed with Status.

Contact your local retailer, Belchim representative, or scan below for additional trial results or more information about how you can *Get TOUGH on Weeds!*



### TOUGH Synergizes HPPD Herbicides

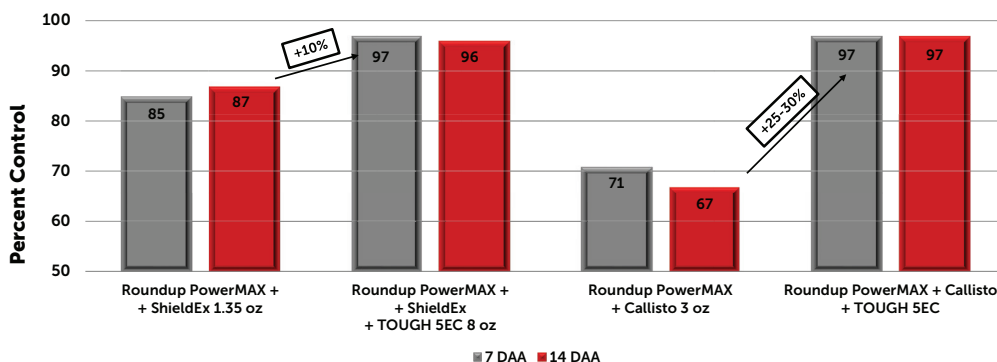
Glyphosate Resistant Waterhemp  
Iowa State University - 2021



Waterhemp 4-6" tall

### TOUGH Synergizes HPPD Herbicides

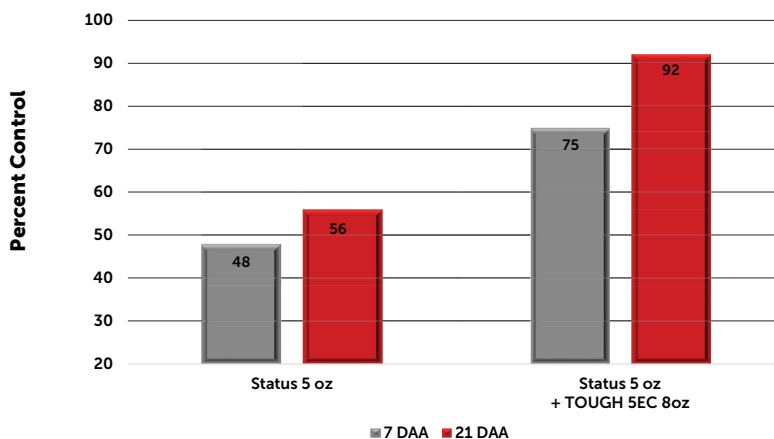
Glyphosate Resistant Palmer Amaranth  
Purdue University - 2020



Dual II Magnum PRE  
Bare ground trial with no corn planted  
3-12" weed size, 3/ft<sup>2</sup>

### TOUGH on Dicamba Resistant Kochia

Kansas State University - Hays - 2021



Kochia 3-4" tall  
Note this was a greenhouse study

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