

**Mode of Action:**

- *Photosynthesis II inhibitor*
- *Targets unique pathway within the PSII group of herbicides (Groups 5, 6 & 7)*
- *WSSA Classification: Group 6*
- *No known cross-resistance to other PSII's*

ACTIVE INGREDIENT:

Pyridate (Carbonothioic acid, O-(6-chloro-3-phenyl-4-pyridiziny) S-octyl ester):..... 56.1%

OTHER INGREDIENTS: 43.9%

TOTAL: 100.00%

* Contains 5 lbs of pyridate per gallon of product

QUICK FACTS:

- *Post-emergent, contact application only*
- *Rainfast within 1 hour*
- *No residual or rotation restrictions*
- *Controls key broadleaf weeds such as but not limited to: Common Waterhemp, Palmer amaranth, Kochia, Common Lambsquarters*
- *Tank-mixed: 8 oz/ac with other products active on the key weeds*

Observing an increase in herbicide resistance across the USA, Belchim Crop Protection revitalized a valuable chemistry, **TOUGH® 5EC**, (pyridate) in effort to preserve the long-term use of the valuable class of HPPD herbicides in corn.

Beginning in 2017, Belchim Crop Protection USA coordinated with key universities across the corn belt, implementing trials to evaluate the effectiveness of **TOUGH® 5EC** in numerous research trials (>150 trials).

Results show significant increase in weed control when **TOUGH® 5EC** is included in the tank mix. Increases of 5% to as much as 29% has been observed; especially when herbicide resistance to other classes of chemistry are present in the weed population.

Preliminary research showed an evident synergy* with Callisto®, and the HPPD class of herbicides. In 2020 and 2021, trials expanded to include other HPPD herbicides such as ShieldEx® and Impact® in addition to dicamba based products such as Status.®

Enhancement of atrazine is also evident and the ability to increase the use of PSII class of chemistry while maintaining crop safety.

Common Ragweed (4" tall)		
University of Missouri 2020	% Percent Control	
Treatment	7 DAA	14 DAA
Roundup PowerMax 32 oz + ShieldEx 1.35 oz	73	64
Roundup PowerMax 32 oz + ShieldEx 1.35 oz + TOUGH 5EC 8 oz	95	95

Pitted Morningglory		
University Tennessee 2020	% Percent Control	
Treatment	7 DAA	14 DAA
Roundup PowerMax 32 oz + ShieldEx 1.35 oz	79	78
Roundup PowerMax 32 oz + ShieldEx 1.35 oz + TOUGH 5EC 8 oz	90	88

Glyphosate Resistant Palmer amaranth (3-12" tall)		
Purdue University 2020	% Percent Control	
Treatment	7 DAA	14 DAA
Roundup PowerMax 32 oz + ShieldEx 1.35 oz	85	87
Roundup PowerMax 32 oz + ShieldEx 1.35 oz + TOUGH 5EC 8 oz	97	97

Glyphosate Resistant Palmer amaranth (3-12" tall)				
Purdue University 2020	% Percent Control			
Treatment	7 DAA	14 DAA	28 DAA	42 DAA
Roundup PowerMax 32 oz + Callisto 3 oz	71	68	49	45
Roundup PowerMax 32 oz + + Callisto 3 oz + TOUGH 5EC 8 oz	98	98	88	81

Glyphosate Resistant Waterhemp (0-3" tall)				
Purdue University 2020	% Percent Control			
Treatment	9 DAA	14 DAA	27 DAA	41 DAA
Roundup PowerMax 32 oz + Callisto 3 oz	50	87	95	95
Roundup PowerMax 32 oz + + Callisto 3 oz + TOUGH 5EC 8 oz	90	100	100	100
Roundup PowerMax 32 oz + + Callisto 3 oz + TOUGH 5EC 8 oz + Aatrex 2.4 pt	100	100	100	100

* Patent Pending





RESEARCH UPDATE CORN TRIALS 2021

Glyphosate Resistant Palmer Amaranth (4-8" tall)		
University of Arkansas 2021	% Percent Control	
Treatment	14 DAA	28 DAA
Roundup PowerMax 32 oz	65	58
Roundup PowerMax 32 oz + Callisto 3 oz	76	91
Roundup PowerMax 32 oz + Calisto 3 oz + TOUGH 5EC 8 oz	96	93
Roundup PowerMax 32 oz + Calisto 3 oz + TOUGH 5EC 8 oz + Aatrex 1.0 pt	95	93

Glyphosate Resistant Waterhemp (4-6" tall)				
Iowa State University 2021	% Percent Control			
Treatment	7 DAA	14 DAA	28 DAA	42 DAA
Roundup PowerMax 32 oz	40	40	33	33
Roundup PowerMax 32 oz + Callisto 3 oz	77	68	62	62
Roundup PowerMax 32 oz + Callisto 3 oz + TOUGH 5EC 8 oz	90	88	85	78
Roundup PowerMax 32 oz + Callisto 3 oz + TOUGH 5EC 8 oz + Aatrex 2.4 pt	92	95	93	92

Palmer amaranth (4-5" tall)				
Kansas State 2021	% Percent Control			
Treatment	7 DAA	14 DAA	28 DAA	42 DAA
Roundup PowerMax 32 oz	78	78	71	71
Roundup PowerMax 32 oz + Impact 0.75 oz	85	86	87	89
Roundup PowerMax 32 oz + Impact 0.75 oz + TOUGH 5EC 8 oz	91	94	94	94

Palmer amaranth (4-5" tall)				
Kansas State 2021	% Percent Control			
Treatment	7 DAA	14 DAA	28 DAA	42 DAA
Roundup PowerMax 32 oz	73	75	63	54
Roundup PowerMax 32 oz + Impact 1.0 oz	75	67	55	58
Roundup PowerMax 32 oz + Impact 1.0 oz + TOUGH 5EC 8 oz	87	85	76	72

Glyphosate Resistant Waterhemp (3-7" tall)				
Iowa State University 2021	% Percent Control			
Treatment	7 DAA	14 DAA	28 DAA	42 DAA
Roundup PowerMax 32 oz + Impact 1.0 oz	78	75	83	83
Roundup PowerMax 32 oz + Impact 1.0 oz + TOUGH 5EC 8 oz	85	90	90	90

Glyphosate and PPO Resistant Waterhemp (1.5-9" tall)				
University of Illinois 2021	% Percent Control			
Treatment	7 DAA	14 DAA	28 DAA	42 DAA
Roundup PowerMax 32 oz + Impact 0.75 oz	62	68	73	73
Roundup PowerMax 32 oz + Impact 0.75 oz + TOUGH 5EC 8 oz	80	80	82	82
Roundup PowerMax 32 oz + Impact 1.0 oz	68	70	70	75
Roundup PowerMax 32 oz + Impact 1.0 oz + TOUGH 5EC 8 oz	85	86	90	92

Kochia (3-4" tall)				
Kansas State 2021	% Percent Control			
Treatment	7 DAA	14 DAA	28 DAA	42 DAA
Roundup PowerMax 32 oz + Impact 0.75 oz	72	67	45	20
Roundup PowerMax 32 oz + Impact 0.75 oz + TOUGH 5EC 8 oz	87	87	84	85
Roundup PowerMax 32 oz + Impact 1.0 oz	73	68	45	30
Roundup PowerMax 32 oz + Impact 1.0 oz + TOUGH 5EC 8 oz	85	82	75	71

Glyphosate & Dicamba Resistant Kochia (3-4" tall)		
Kansas State 2021	% Percent Control	
Treatment	7 DAA	21 DAA
Status 5 oz	48	56
Status 5 oz + TOUGH 5EC 8 oz	75	92
Roundup PowerMax 32 oz	16	50
Roundup PowerMax 32 oz + TOUGH 5EC 8 oz	48	72

Note this was a greenhouse study

TOUGH 5EC is a registered trademark of Belchim Crop Protection. Roundup is a registered trademark of Bayer Crop Science, Callisto, and Aatrex are registered trademarks of Syngenta US. Impact is a registered trademark of Amvac. ShieldEx is a registered trademark of Summit Agro.

This is a synopsis from research conducted in 2020 and 2021. For complete trial information, please contact your local Belchim USA Representative.

Pre-Plant Burndown Trial Summary



Mode of Action:

- Photosynthesis II inhibitor
- Targets unique pathway within the PSII group of herbicides (Groups 5, 6 & 7)
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ACTIVE INGREDIENT:

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Observing an increase in herbicide resistance across the USA, Belchim Crop Protection revitalized a valuable chemistry, **TOUGH® 5EC**, (pyridate) in effort to preserve the long-term use of the valuable class of HPPD herbicides in corn.

Beginning in 2017, Belchim Crop Protection USA coordinated with key universities across the corn belt, implementing trials evaluating the effectiveness of **TOUGH 5EC** as part of a post emergent program in corn. As research showed an evident synergy* with the HPPD class of herbicides, and significant increased control in post emergent applications, a discussion to include **TOUGH 5EC** in a pre-plant burndown program began. As a result, trials evaluating the effectiveness of **TOUGH 5EC** as part of a pre-plant burndown program were conducted at various universities focusing on Marestalk. A few of the trials also included Giant Ragweed. The results of these trials confirmed that including **TOUGH 5EC** in a pre-plant burndown program increases control of these tough to kill weeds. A synopsis of the results of trials conducted in 2019-2022 is below.

Marestalk 3-6" Tall; 7/ft ²		
Iowa State University	% Percent Control	
Treatment	7 DAA	14 DAA
Gramoxone 3.0 pt + ShieldEx 0.68 oz	62	57
Gramoxone 3.0 pt + ShieldEx 0.68 oz + TOUGH 5EC 8 oz	73	75
Gramoxone 3.0 pt + ShieldEx 1.0 oz	67	68
Gramoxone 3.0 pt + ShieldEx 1.0 oz + TOUGH 5EC 8 oz	73	82
COC added		

Marestalk 1-8" Tall; 8/ft ²			
Purdue University	% Percent Control		
Treatment	7 DAA	14 DAA	28 DAA
Gramoxone 1.0 pt + ShieldEx 0.68 oz	80	77	73
Gramoxone 1.0 pt + ShieldEx 0.68 oz + TOUGH 5EC 8 oz	96	96	94
Gramoxone 1.0 pt + ShieldEx 1.0 oz	83	84	81
Gramoxone 1.0 pt + ShieldEx 1.0 oz + TOUGH 5EC 8 oz	94	95	94
COC added			

Marestalk 1-8" Tall; 8/ft ²		
Purdue University	% Percent Control	
Treatment	7 DAA	14 DAA
Gramoxone 1.0 pt	71	66
Gramoxone 1.0 pt + Tricor 75DF 0.33 lb	89	85
Gramoxone 1.0 pt + Tricor 75DF 0.33 lb + TOUGH 5EC 8oz	94	90
COC added		

Marestalk			
University of Missouri	% Percent Control		
Treatment	7 DAA	14 DAA	28 DAA
Gramoxone 2.7 pt	56	54	60
Gramoxone 2.7pt + Callisto 3oz + TOUGH 5EC 8oz	58	90	94
NIS added			

* Patent Pending



CORN RESEARCH UPDATE

Pre Plant Burndown Trial Summary

Marestail 1-5" Tall			
University of Illinois	% Percent Control		
Treatment	7 DAA	14 DAA	28 DAA
Roundup PowerMAX 22oz	57	58	58
Roundup PowerMAX 22 oz + Callisto 3 oz + TOUGH 5EC 8 oz	75	91	87
Soil Moisture: Normal, AMS added			

Marestail 3-7" Tall; 10/ft ²			
Purdue University	% Percent Control		
Treatment	7 DAA	14 DAA	28 DAA
Roundup PowerMAX 22oz	18	13	15
Roundup PowerMAX 22 oz + Callisto 3 oz + TOUGH 5EC 8 oz	100	100	100
Soil Moisture: Very Dry, AMS added			

Marestail			
University of Missouri	% Percent Control		
Treatment	7 DAA	14 DAA	28 DAA
Roundup PowerMAX 22oz	0	14	10
Roundup PowerMAX 22 oz + Callisto 3 oz + TOUGH 5EC 8 oz	3	66	72
Soil Moisture: Wet, AMS not added			

Marestail 3-9" Tall; 2/ft ²			
Iowa State University	% Percent Control		
Treatment	7 DAA	14 DAA	28 DAA
Roundup PowerMAX 22oz	33	43	43
Roundup PowerMAX 22 oz + Callisto 3 oz + TOUGH 5EC 8 oz	90	97	97
Soil Moisture: Wet, AMS not added			

Marestail 3" Tall,		
Ohio State	% Percent Control	
Treatment	7 DAA	14 DAA
Roundup PowerMAX 22oz	30	70
Roundup PowerMAX 22 oz + Callisto 3 oz + TOUGH 5EC 8 oz	42	91
AMS not added		

Giant Ragweed 1-2" Tall		
Ohio State	% Percent Control	
Treatment	14 DAA	28 DAA
Roundup PowerMAX 22oz	27	28
Roundup PowerMAX 22 oz + Callisto 3 oz + TOUGH 5EC 8 oz	93	95
AMS not added		

Giant Ragweed 4-10" Tall; 5/ft ²		
Iowa State University	% Percent Control	
Treatment	14 DAA	42 DAA
Roundup PowerMAX 22oz	40	37
Roundup PowerMAX 22 oz + Callisto 3 oz + TOUGH 5EC 8 oz	82	75
Soil Moisture: Wet, AMS not added		

Note: TOUGH 5EC is currently labeled for pre-plant burndown on field corn, seed corn, and popcorn.

A label extension to add crops for pre-plant burndown has been submitted to EPA - expected approval May 2023.

For complete trial information, please contact your local Belchim USA Representative.

TOUGH 5EC is a registered trademark of Belchim Crop Protection. Gramoxone and Callisto are registered trademarks of Syngenta. Tricor is a registered trademark of United Phosphorus, Inc. Roundup is a registered trademark of Bayer Crop Science US. ShieldEx is a registered trademark of Summit Agro.

