

# ONION RESPONSE TO TOUGH<sup>®</sup> HERBICIDE RATE AND APPLICATION TIMING

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## Introduction

Herbicides are the primary tool to manage weeds in onion. Timely control of weeds is essential in order not to compromise onion yield and bulb quality. There is a limited number of herbicides registered for weed control in onion, largely due to seedling sensitivity at the early growth stage. Repeated use of the same few registered products could result in selection of herbicide-resistant weeds. Therefore, in order to broaden the tool kit, it is vital to evaluate new products on the market for suitability to manage weeds in onion. Additionally, growers lack an efficacious herbicide that is safe to use in onions at the early growth stage.

Tough<sup>®</sup> 5EC (pyridate) is a group 6 herbicide marketed by Belchim Crop Protection (US Corporation) to manage weeds in mint and Roundup<sup>®</sup> resistant weeds in certain crops. Other herbicides in group 6 includes Basagran<sup>®</sup> (bentazon) and Buctril<sup>®</sup> (bromoxynil), which act by inhibiting photosystem II process in plants. Like other members of group 6 herbicides it is a contact product, which is absorbed rapidly by leaves and lacks soil residual weed control. In order to provide a thorough vegetative coverage, it is recommended to apply Tough in 20 to 30 gal water/acre. Tough herbicide use rate is restricted to 24 fl oz/acre/year (pyridate 0.94 lb ai/acre). The objective of this study was to evaluate onion response to Tough herbicide applied at various rates to onions starting at the 1- or 2-leaf stages and the level of weed control achieved.

## Materials and Methods

A field study was initiated during spring 2021 at the Malheur Experiment Station to evaluate the response of direct-seeded onion variety ‘Vaquero’ to Tough herbicide and the level of weed control at various application rates and timings. All the land preparation and seeding operations are similar to other weed control study at the Malheur Experiment Station.

The study had a randomized complete-block design with three replicates. Individual plots were 7.33 ft wide (4 beds) by 27 ft long. Herbicide treatments were applied using a CO<sub>2</sub>-pressurized backpack sprayer fitted with a boom calibrated to deliver 35 gal/acre for all post-emergence treatments. Treatments with Tough applied at the 1- or 2-leaf onion growth stage were preceded by a delayed pre-emergence (7 days before onion emergence) application of glyphosate at 22 fl oz/acre (glyphosate 0.77 lb ae/acre) plus Prowl<sup>®</sup> H<sub>2</sub>O at 2 pints/acre (pendimethalin 0.95 lb ai/acre) applied on April 12, 2021. The untreated check was included.

Tough herbicide alone at 0.8, 1.6 fl oz/a (pyridate 0.0313, 0.0625 lb ai/acre), or Tough 0.8 fl oz/acre + GoalTender<sup>®</sup> 1 fl oz/acre (oxyfluorfen 0.125 lb ai/acre) were applied when onions were at the 1-leaf growth stage (see dates in Tables 1 and 2). A grower standard that received a delayed pre-emergence application of Prowl<sup>®</sup> H<sub>2</sub>O at 32 fl oz/acre (pendimethalin 0.95 lb ai

/acre) + Roundup 22 fl oz/a (glyphosate 0.75 lb ae/acre) and an untreated control were included. On May 11, all treatments (except the hand-weeded and untreated control) were sprayed with Poast® herbicide at 1.5 pints/acre (sethoxydim 0.287 lb ai/acre) plus COC at 1 pint/acre (0.41% v/v) to control grassy weeds.

The study followed similar operations for in-season fertilizer, insecticide sprays for thrips control, drip irrigation, harvesting and grading, as indicated in the other weed control studies at the Malheur Experiment Station elsewhere in this report book.

Data were subjected to analysis of variance and the treatment means were compared using protected LSD at the 0.05% level of confidence.

## Results and Conclusions

Onion emergence was observed on April 20, 2021. Plant count on May 14 indicated uniform plant population density that ranged from 123,200 to 128,920/acre across herbicide treatments (data not shown). The irrigation 10 days after seeding helped to establish a uniform plant stand in this study. Weed control ratings on June 8 indicated poor weed control for treatments applied when the onions were at the 2-leaf stage (data not shown). The reduced weed control across all species could be related to the low Tough herbicide rates evaluated in this study. Consequently, all treatments applied when onions were at the 2-leaf were abandoned. Therefore, the results herein are only for the applications starting when onions were at the 1-leaf stage (Tables 1 and 2). Onions exhibited tolerance for Tough herbicide applied at 0.8 to 1.6 fl oz/acre starting when onions were at the 1-leaf stage.

The number of weeds counted in the two center rows of each on June 3 (29 days after Tough herbicide application at 1-leaf) are presented in table 1. The number of common lambsquarters in the two center rows were  $\leq 1$  plant/99 ft<sup>2</sup> (Table 1). Corresponding numbers for pigweed species were 1 to 9 across Tough herbicide treatments. No differences in hairy nightshade control across herbicide treatments (38 to 88 plants/99 ft<sup>2</sup>) was observed. Similarly, the total number of weeds on June 3 ranged from 38 to 94 plants/99 ft<sup>2</sup> (two center rows), compared to 45 plants/99 ft<sup>2</sup> for the grower standard and 8,580 plants/99 ft<sup>2</sup> for the untreated control. These results indicated onion variety Vaquero tolerance to Tough herbicide applied at low rates to seedlings at the 1-leaf stage.

Onion yield reflected the level of weed control (Table 2). The marketable yield for US No. 1 was generally comparable to the grower standard herbicide practice. Marketable yield ranged from 1,012 to 1,128 cwt/acre across Tough treatments compared to 1,197 cwt/acre for the grower standard. The total onion yield (all grades combined) followed a similar trend.

These results suggested that onion variety Vaquero could tolerate Tough herbicide applied as early as the 1-leaf stage. Future studies in 2022 will evaluate Tough herbicide applied at rates higher than those used in this study. The addition of adjuvants will also be evaluated.

## **Acknowledgements**

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Table 1. Number of weeds in the two center rows of each onion plot (99 ft<sup>2</sup>) on July 3, 2021 in response to application of Tough<sup>®</sup> herbicide at various rates and timings, Malheur Experiment Station, Oregon State University, Ontario, OR, 2021.

Treatment <sup>a</sup>	Rate fl oz/acre	Growth stage	Application date	Number of weeds <sup>b</sup>					Total weed fresh weight ---lb/99 ft <sup>2</sup> ---	
				Common lambsquarters	Pigweeds	Hairy nightshade	Grasses	Other weeds		
Untreated				462 -	264 -	7,623 -	0 -	231 -	8,580 -	1,191.6 -
Prowl H <sub>2</sub> O	32	Delayed-PRE	4/3	1 a	9 a	42 a	2 a	1 a	56 a	27.1 a
Tough 5EC	0.8	1-Leaf	5/5							
Moxy 2E	12	2&4 Leaf	5/13 & 6/1							
GoalTender	4	2&4 Leaf	5/13 & 6/1							
Prowl H <sub>2</sub> O	32	Delayed-PRE	4/3	1 a	5 bc	88 a	0 a	0 a	94 a	38.2 a
Tough 5EC	1.6	1-Leaf	5/5							
Moxy 2E	12	2&4 Leaf	5/13 & 6/1							
GoalTender	4	2&4 Leaf	5/13 & 6/1							
Prowl H <sub>2</sub> O	32	Delayed-PRE	4/3	1 a	3 bc	65 a	0 a	0 a	69 a	23.0 a
Tough 5EC	0.8	1-Leaf	5/5							
GoalTender	1	1-Leaf	5/5							
Moxy 2E	12	2&4 Leaf	5/13 & 6/1							
GoalTender	4	2&4 Leaf	5/13 & 6/1							
Prowl H <sub>2</sub> O	32	Delayed-PRE	4/3	0 a	1 c	36 a	1 a	1 a	38 a	16.5 a
Tough 5EC	1.6	1-Leaf	5/5							
GoalTender	1	1-Leaf	5/5							
Moxy 2E	12	2&4-Leaf	5/13 & 6/1							
GoalTender	4	2&4-Leaf	5/13 & 6/1							
Prowl H <sub>2</sub> O	32	Delayed-PRE	4/3	0 a	6 ab	38 a	1 a	0 a	45 a	16.8 a
Brox 2EC	12	2&4 Leaf	5/13 & 6/1							
GoalTender	4	2&4 Leaf	5/13 & 6/1							
LSD (P = 0.05)				NS	4	NS	NS	NS	NS	NS

<sup>a</sup> All delayed-pre-emergence treatments included Roundup PowerMax 22 fl oz/acre = glyphosate 0.77 lb ae/acre; Tough 0.8 fl oz/acre = pyridate 0.0313 lb ai/acre + Tough 1.6 fl oz/acre = pyridate 0.0625 lb ai/acre; Moxy 2EC 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Prowl H<sub>2</sub>O 32 fl oz/acre = pendimethalin 0.95 lb ai/acre.

<sup>b</sup> Means within a column followed by same letter do not significantly differ (P = 0.05, LSD)

Table 4. Onion yield in response to application of Tough® herbicide at various rates and timings, Malheur Experiment Station, Oregon State University, Ontario, OR, 2021.

Treatment <sup>a</sup>	Rate fl oz/acre	Application		Marketable onion yield <sup>b</sup>								
		Growth stage	date	Rot	US No. 2	Small	Medium	Jumbo	Colossal	Super colossal	Marketable	Total yield
				cwt/acre								
Untreated				0.0 -	0.0 -	0.0 -	0.0 -	0.0 -	0.0 -	0.0 -	0.0 -	0.0 -
Prowl H <sub>2</sub> O	32	Delayed-PRE	4/3	1.5 a	2.4 a	18.0 a	41.0 a	682.7 a	285.6 a	35.2 a	1,044.5 a	1,066.3 a
Tough 5EC	0.8	1-Leaf	15/5									
Moxy 2EC	12	2&4 Leaf	5/13 & 6/1									
GoalTender	4	2&4 Leaf	5/13 & 6/1									
Prowl H <sub>2</sub> O	32	Delayed-PRE	April 3	0.0 a	1.0 a	21.8 a	58.8 a	693.7 a	249.8 a	28.0 a	1,030.3 a	1,053.0 a
Tough 5EC	1.6	1-Leaf	5/5									
Moxy 2EC	12	2&4 Leaf	5/13 & 6/1									
GoalTender	4	2&4 Leaf	5/13 & 6/1									
Prowl H <sub>2</sub> O	32	Delayed-PRE	4/3	0.0 a	1.2 a	24.3 a	51.1 a	786.1 a	164.3 a	10.4 a	1,012.0 a	1,037.4 a
Tough 5EC	0.8	1-Leaf	5/5									
GoalTender	1	1-Leaf	5/5									
Moxy 2EC	12	2&4 Leaf	5/13 & 6/1									
GoalTender	4	2&4 Leaf	5/13 & 6/1									
Prowl H <sub>2</sub> O	32	Delayed-PRE	4/3	0.0 a	1.9 a	16.3 a	31.4 a	748.5 a	326.9 a	21.5 a	1,128.2 a	1,146.4 a
Tough 5EC	1.6	1-Leaf	5/5									
GoalTender	1	1-Leaf	5/5									
Moxy 2EC	12	2&4 Leaf	5/13 & 6/1									
GoalTender	4	2&4 Leaf	5/13 & 6/1									
Prowl H <sub>2</sub> O	32	Delayed-PRE	4/3	0.7 a	0.0 a	19.2 a	16.3 a	740.4 a	379.3 a	61.0 a	1,197.0 a	1,216.9 a
Moxy 2EC	12	2&4 Leaf	5/13 & 6/1									
GoalTender	4	2&4 Leaf	5/13 & 6/1									
LSD (P = 0.05)				NS	NS	NS	NS	NS	NS	NS	NS	NS

<sup>a</sup> All delayed-pre-emergence treatments included Roundup PowerMax 22 fl oz/acre = glyphosate 0.77 lb ae/acre; Tough 0.8 fl oz/acre = pyridate 0.0313 lb ai/acre + Tough 1.6 fl oz/acre = pyridate 0.0625 lb ai/acre; Moxy 2EC 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Prowl H<sub>2</sub>O 32 fl oz/acre = pendimethalin 0.95 lb ai/acre.

<sup>b</sup> Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).