UW – Madison Weed Science Renz Lab

Imazapic effectiveness on roadside grass and seedhead suppression when compared to other Plant Growth Regulators

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Objective:

Evaluate imazapic alone or mixed with other plant growth regulators for grass height and seedhead suppression.

Summary:

Research continues evaluating the benefit of using plant growth regulators to reduce grass height. If effective less mowing is needed, saving money. In 2023 results were heavily impacted by drought conditions, and grass growth was limited in the summer. Initial results (16 DAT) saw most treatments suppressing growth with only treatments with Pac-Low (16 and 48 fl oz/a) showed similar in height for both tall fescue and Kentucky bluegrass. After one month (31 DAT) treatments that with Pac-Low alone (16 and 48 fl oz/a), Pac-low + Panoramic @ 1 fl oz/a, and Pac-low 16 fl oz/a + T-NEX 16 fl oz/a did not show a significant difference in both tall fescue and Kentucky bluegrass heights when compared to the nontreated control. Treatments with Panoramic (0.5 and 1 fl oz/a) and T-NEX 16 fl oz/a also did not show a significant difference in height for Kentucky bluegrass. All other treatments reduced height of both grass species/

During the growing season mowing was done on plots beginning thirty days after treatment when grasses met one of the criteria 1) reached 20 inches in height or 2) had high seedhead production (> 70% of non treated control). Most plots were mowed as a result of our criteria and the drought. The only treatments that didn't have all replications mowed at least once throughout the course of the trial was T-NEX 44 fl oz/a + Panoramic 2 fl oz/a and T-Nex 44 fl oz/a + Panoramic 1 fl oz/A.

While the drought prevented us from determining benefits after 30 days, results confirm that Pac-Low was not effective at suppressing grasses at the rates applied. Treatments that contained T-Nex or mainline however displayed promise as results were similar to standard treatments (Panoramic at 2 or 3 fl oz/A). Further results should focus on these products applied alone or with reduced rates of panoramic.

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Notes

Data for plot 317 was omitted due to plot being sprayed twice.
Arlington Ag Research Station experienced lower than average precipitation amounts for the 2023 growing season. See graph on page 6.

Herbicide Treatments

Treatment Number	Treatment	Rate
1	Nontreated Control (NTC)	-
2	Panoramic 2SL	0.5 fl oz/a
3	Panoramic 2SL	1 fl oz/a
4	Panoramic 2SL	2 fl oz/a
5	Panoramic 2SL	4 fl oz/a
6	T-NEX	16 fl oz/a
7	T-NEX	44 fl oz/a
8	Pac-Low	16 fl oz/a
9	Pac-Low	48 fl oz/a
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a
18	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a
23	Mainline	24 fl oz/a

Herbicide Application	
Application Timing	A
Date	May 15, 2023, 2:30 pm – 4:50 pm
Equipment	CO_2 pressurized 10-foot boom sprayer / single nozzle sprayer (20 GPA)
Nozzles & spacing	8 nozzles, Teejet XR 11002 VS nozzle, with 15-inch spacing
Regulator PSI	46

Weather Data	
Weather Station	KWIARLIN7
Temperature	69°F
Wind Speed and Direction	0 mph – 3 mph SW
Relative Humidity	29% - 27%
Cloud Cover	65%
Previous Rain Event Within 48 Hours	None
When $\geq$ 0.25 inches of precipitation occurred after treatment	June, 01, 2023, 2:50 pm – 0.8 inches

Research Plot Information	
Plot Dimensions	10 feet by 20 feet
Design	Randomized Complete Block, 4 blocks
Soil Type	Plano silt loam
Soil Characteristics	21% clay, 0.91% organic matter, 7.1 pH, 1% slope

Plants Present at Application – Developmental Stage

Species	Average Height (in)	Phenological Stage
Tall Fescue (*Festuca arundinacea*)	12.2	Vegetative
Kentucky Bluegrass (*Poa pratensis*)	9.9	Vegetative

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49 DAT – July 3rd, 2023 15

66 DAT – July 20th, 2023 16

95 DAT – August 18th, 2023 17

137 DAT – September 29th, 2023 18

Total Number of Plots Mowed per Treatment........ 19

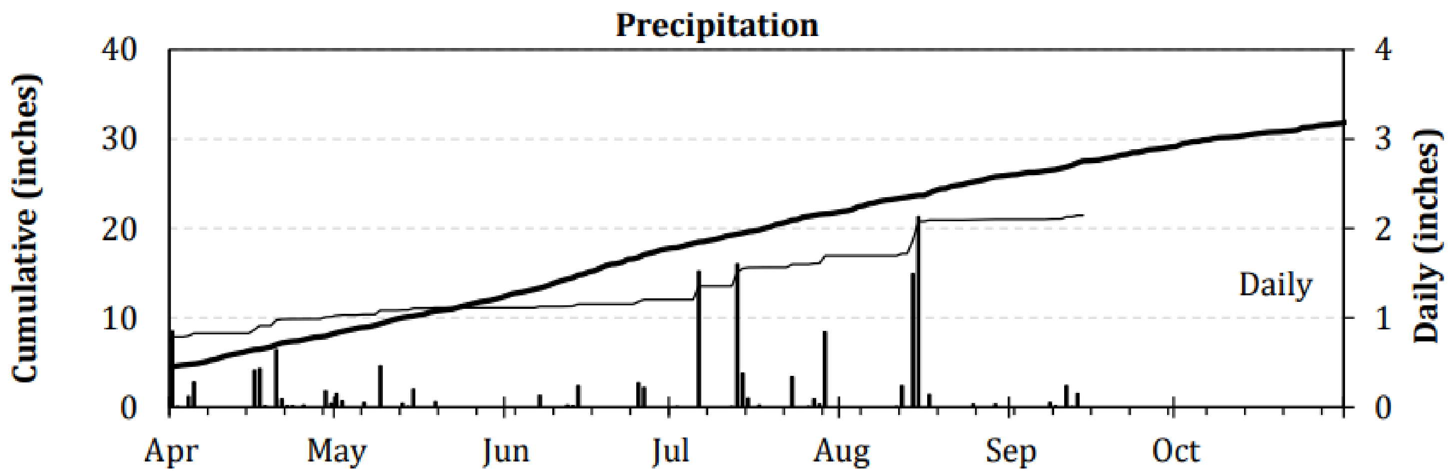
Picture above shows a view of the trial area on the day of treatment. Pasture included grass species such as tall fescue, Kentucky bluegrass, smooth brome and quackgrass, along with broadleaf weed species such as dandelion and red clover.

Picture on the left shows plot sprayed with Panoramic @ 1 fl oz/a, 31 days after treatment right before being mowed.

Picture on the right shows the same plot, 137 days after treatment. Notice the height of the plot compared to the unsprayed areas outside of the trial area, above the red line.

2023 Weather Summary for UW ARS - Arlington, WI

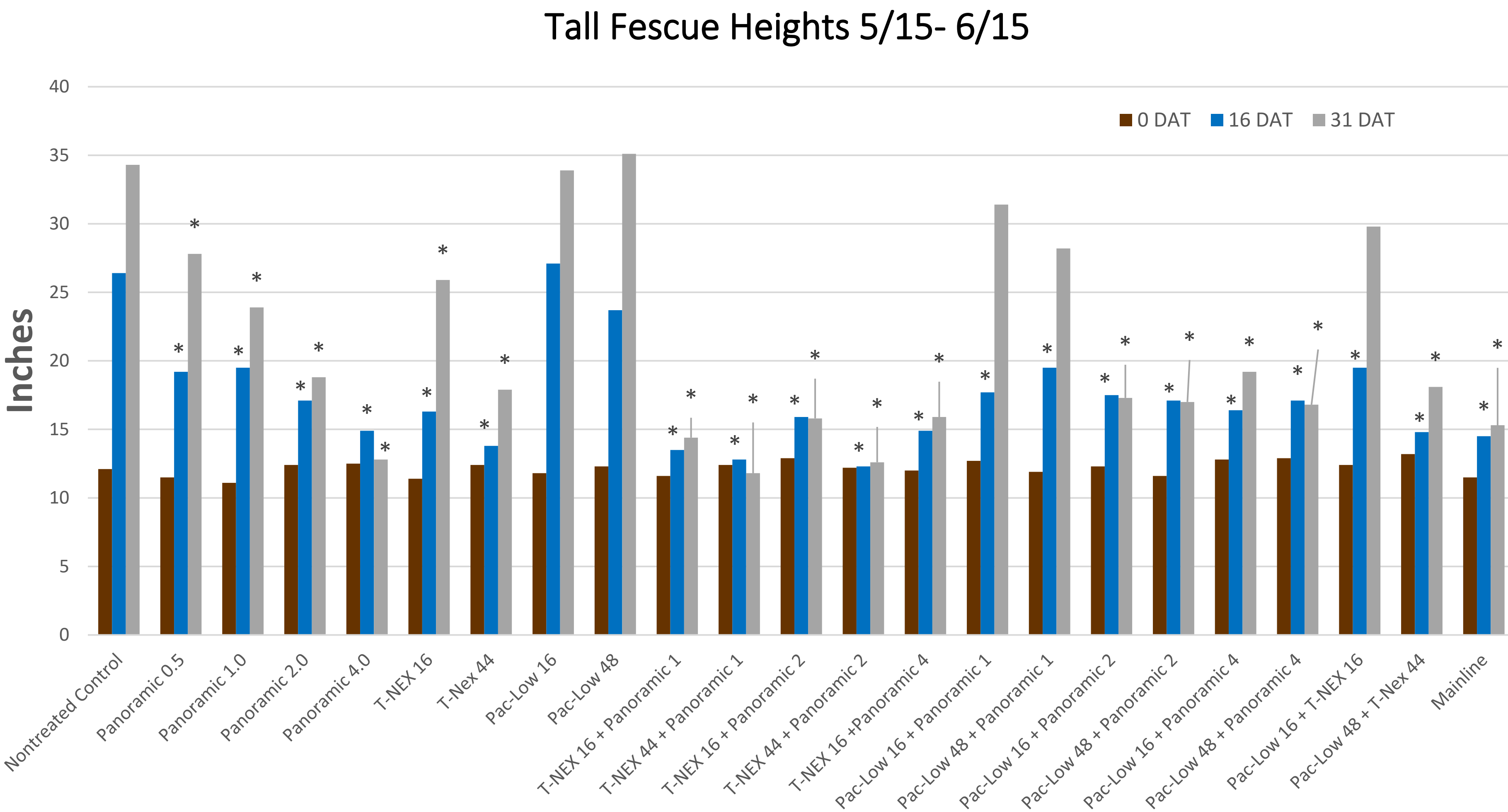
Bold Line = 30 year Normal



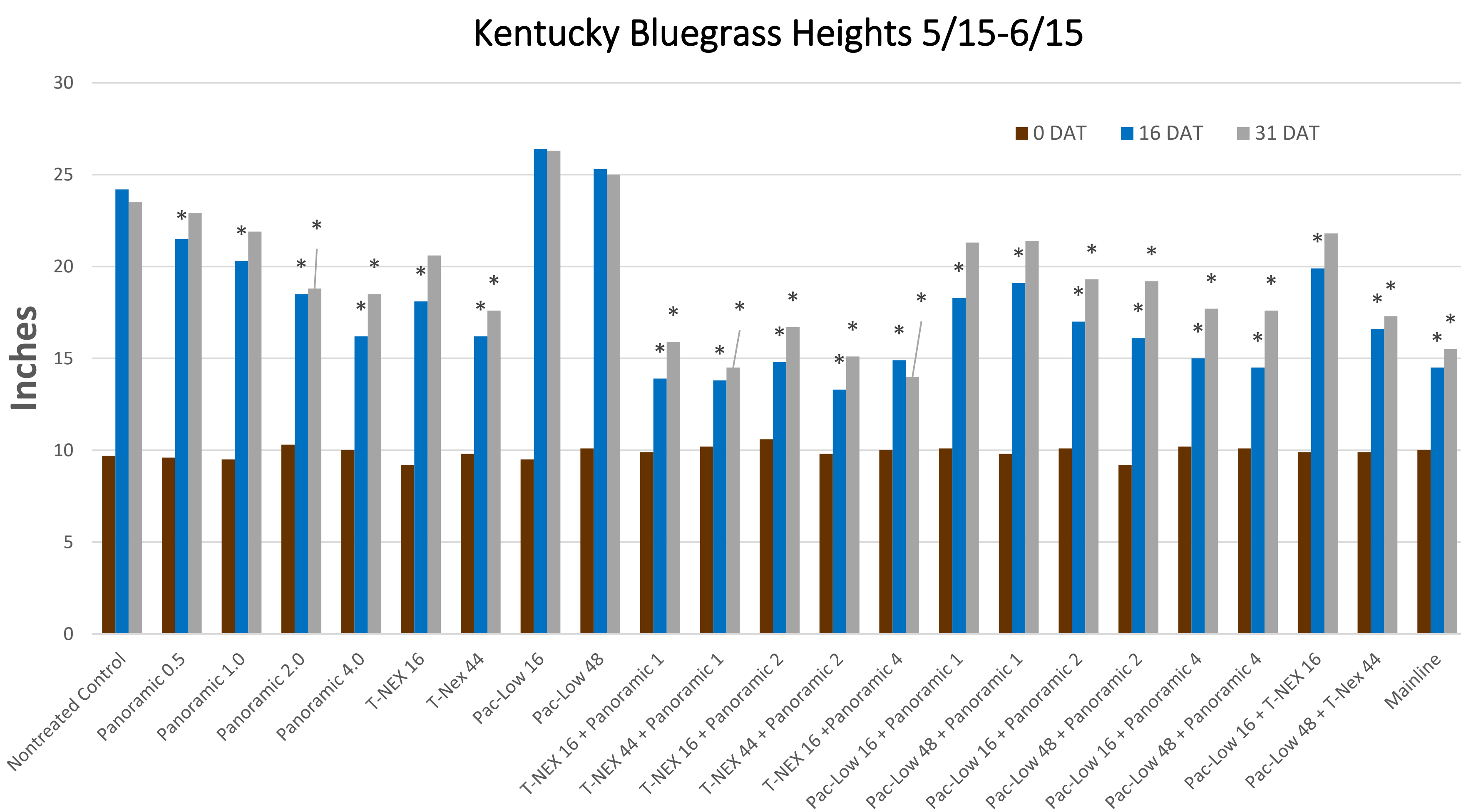
Graph created and provided by Dr. MD Rayhan Shaheb

During the 2023 growing season Arlington Agricultural Research Area experienced and uncharacteristically low amount of precipitation starting in June and lasting until the end of the growing season. Due to this, growth of plant species may have been affected.

Graph shows dark, bold line as the 30-year average for precipitation at the research station. The thinner black line shows the recorded amounts of precipitation throughout the growing season.



*Treatment showed significant difference from Nontreated Control of their respective date.



*Treatment showed significant difference from Nontreated Control of their respective date.

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Results:

0 Days After Treatment (DAT) – May 15, 2023									
Trt. No.	**Treatment**	**Rate**	**Tall Fecue (% Cover)**	**Kentucky Bluegrass (% Cover)**	**Other Grasses (% Cover)**	**Broadleaf weed (% Cover)**	**Bareground /Litter (% Cover)**	**Tall Fescue Height (Inches)**	**Kentucky Bluegrass Height (Inches)**
1	Nontreated Control (NTC)	-	42.5 -	33.8 -	8.8 -	10.5 -	4.5 -	12.1 -	9.7 -
2	Panoramic 2SL	0.5 fl oz/a	40.0 -	40.0 -	6.3 -	8.8 -	5.0 -	11.5 -	9.6 -
3	Panoramic 2SL	1 fl oz/a	45.0 -	37.5 -	7.5 -	4.0 -	6.0 -	11.1 -	9.5 -
4	Panoramic 2SL	2 fl oz/a	38.8 -	38.8 -	8.8 -	8.8 -	5.0 -	12.4 -	10.3 -
5	Panoramic 2SL	4 fl oz/a	41.3 -	37.5 -	10.0 -	6.5 -	4.8 -	12.5 -	10.0 -
6	T-NEX	16 fl oz/a	42.5 -	42.5 -	7.5 -	5.3 -	4.8 -	11.4 -	9.2 -
7	T-NEX	44 fl oz/a	41.3 -	40.0 -	10.0 -	4.0 -	4.8 -	12.4 -	9.8 -
8	Pac-Low	16 fl oz/a	41.3 -	40.0 -	7.5 -	6.3 -	5.0 -	11.8 -	9.5 -
9	Pac-Low	48 fl oz/a	37.5 -	42.5 -	7.5 -	7.0 -	5.5 -	12.3 -	10.1 -
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a	38.8 -	42.5 -	6.3 -	7.8 -	4.8 -	11.6 -	9.9 -
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a	42.5 -	41.3 -	6.3 -	5.3 -	4.8 -	12.4 -	10.2 -
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a	41.3 -	36.3 -	6.3 -	11.5 -	4.8 -	12.9 -	10.6 -
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a	37.5 -	35.0 -	10.0 -	10.3 -	7.3 -	12.2 -	9.8 -
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a	36.3 -	43.8 -	7.5 -	7.5 -	5.0 -	12.0 -	10.0 -
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a	42.5 -	40.0 -	7.5 -	5.5 -	4.5 -	12.7 -	10.1 -
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a	37.5 -	38.8 -	10.0 -	8.8 -	5.0 -	11.9 -	9.8 -
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a	38.8 -	37.3 -	8.8 -	10.0 -	5.0 -	12.3 -	10.1 -
18	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a	43.3 -	43.3 -	6.7 -	3.7 -	4.7 -	11.6 -	9.2 -
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a	38.8 -	38.8 -	8.8 -	8.8 -	4.8 -	12.8 -	10.2 -
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a	41.3 -	37.5 -	10.0 -	6.5 -	4.8 -	12.9 -	10.1 -
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a	42.5 -	42.5 -	7.5 -	5.3 -	4.5 -	12.4 -	9.9 -
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a	41.3 -	40.0 -	10.0 -	4.0 -	4.8 -	13.2 -	9.9 -
23	Mainline	24 fl oz/a	41.3 -	40.0 -	7.5 -	6.3 -	5.3 -	11.5 -	10.0 -
Statistics[1]									
Least Significant Difference (LSD) P=.05			8.55	8.96	3.83	6.87	1.78	1.32	1.14
Standard Deviation			6.05	6.36	2.71	4.86	1.26	0.94	0.81
Coefficient of Variation (CV)			14.73	16.16	35.52	68.63	25.16	7.7	8.16
Treatment Prob(F)			0.7619	0.8535	0.3489	0.5612	0.6036	0.1605	0.8764

[1] All statistical analyses were conducted in ARM software and assumptions of ANOVA were not evaluated.

16 DAT – May 31, 2023

Trt. No.	Treatment	Rate	Tall Fecue (% Cover)	Kentucky Bluegrass (% Cover)	Other Grasses (% Cover)	Broadleaf weed (% Cover)	Bareground /Litter (% Cover)
1	NTC	-	33.8 -	32.5 -	16.3 -	12.5 cde	5.0 d
2	Panoramic 2SL	0.5 fl oz/a	28.8 -	47.5 -	10.0 -	8.8 de	5.0 d
3	Panoramic 2SL	1 fl oz/a	23.8 -	38.8 -	12.5 -	18.8 a-d	6.3 cd
4	Panoramic 2SL	2 fl oz/a	20.0 -	35.0 -	16.3 -	20.0 abc	8.8 bcd
5	Panoramic 2SL	4 fl oz/a	23.8 -	43.8 -	12.5 -	12.5 cde	7.5 bcd
6	T-NEX	16 fl oz/a	25.0 -	45.0 -	12.5 -	8.8 de	8.8 bcd
7	T-NEX	44 fl oz/a	31.3 -	41.3 -	8.8 -	11.3 cde	7.5 bcd
8	Pac-Low	16 fl oz/a	31.5 -	41.3 -	12.5 -	10.0 cde	5.0 d
9	Pac-Low	48 fl oz/a	35.0 -	42.5 -	11.3 -	6.3 e	5.0 d
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a	21.3 -	43.8 -	16.3 -	8.8 de	10.0 abc
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a	32.5 -	31.3 -	13.8 -	11.3 cde	11.3 ab
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a	21.3 -	33.8 -	13.8 -	26.3 a	7.5 bcd
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a	22.5 -	33.8 -	18.8 -	17.5 a-d	6.3 cd
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a	26.3 -	36.3 -	12.5 -	18.8 a-d	6.3 cd
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a	28.8 -	35.0 -	13.8 -	16.3 a-e	6.3 cd
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a	25.0 -	40.0 -	15.0 -	15.0 b-e	5.0 d
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a	30.0 -	37.5 -	17.5 -	10.0 cde	5.0 d
18	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a	20.0 -	41.7 -	13.3 -	16.7 a-e	8.3 bcd
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a	21.3 -	33.8 -	15.0 -	21.3 abc	8.8 bcd
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a	18.8 -	36.3 -	10.0 -	25.0 ab	10.0 abc
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a	27.5 -	41.3 -	13.8 -	11.3 cde	6.3 cd
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a	26.3 -	36.3 -	17.5 -	15.0 b-e	5.0 d
23	Mainline	24 fl oz/a	26.3 -	36.3 -	11.3 -	12.5 cde	13.8 a
Statistics[2]							
Least Significant Difference (LSD) P=.05			11.18	13.03	7.79	10.85	4.02
Standard Deviation			7.92	9.23	5.52	7.68	2.85
Coefficient of Variation (CV)			30.28	24.03	40.32	52.98	38.98
Treatment Prob(F)			0.1544	0.5768	0.6105	0.0214	0.0009

Note: Means followed by same letter or symbol do not significantly differ (P=.05, LSD).

[2] All statistical analyses were conducted in ARM software and assumptions of ANOVA were not evaluated.

16 DAT Continued – May 31, 2023						
Trt. No.	**Treatment**	**Rate**	**Tall Fescue Height (Inches)**	**Kentucky Bluegrass Height (Inches)**	**Tall Fescue Seed Suppression (%)**	**Kentucky Bluegrass Seed Suppression (%)**
1	NTC	-	26.4 a	24.2 a	20.0 ef	10.0 ghi
2	Panoramic 2SL	0.5 fl oz/a	19.2 b	21.5 b	43.8 cde	11.3 f-i
3	Panoramic 2SL	1 fl oz/a	19.5 b	20.3 bc	77.5 abc	27.5 b-h
4	Panoramic 2SL	2 fl oz/a	17.1 b-e	18.5 cde	85.0 ab	30.0 b-g
5	Panoramic 2SL	4 fl oz/a	14.9 c-g	16.2 e-i	90.0 a	17.5 d-i
6	T-NEX	16 fl oz/a	16.3 b-f	18.1 c-f	20.0 ef	10.0 ghi
7	T-NEX	44 fl oz/a	13.8 d-g	16.2 e-i	66.3 a-d	15.0 e-i
8	Pac-Low	16 fl oz/a	27.1 a	26.4 a	3.8 f	3.8 i
9	Pac-Low	48 fl oz/a	23.7 a	25.3 a	5.0 f	5.0 hi
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a	13.5 efg	13.9 ij	95.0 a	33.8 a-f
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a	12.8 fg	13.8 ij	88.8 a	56.3 a
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a	15.9 b-g	14.8 g-j	76.3 abc	38.8 a-d
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a	12.3 g	13.3 j	94.8 a	48.8 ab
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a	14.9 c-g	14.9 g-j	95.0 a	43.8 abc
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a	17.7 bc	18.3 c-f	51.3 b-e	16.3 d-i
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a	19.5 b	19.1 cd	63.8 a-d	15.0 e-i
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a	17.5 bcd	17.0 d-g	87.5 ab	28.8 b-h
18	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a	17.1 b-e	16.1 f-i	90.0 a	21.7 c-i
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a	16.4 b-f	15.0 g-j	93.8 a	48.8 ab
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a	17.1 b-e	14.5 hij	68.8 a-d	31.3 b-g
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a	19.5 b	19.9 bc	35.0 def	20.0 d-i
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a	14.8 c-g	16.6 e-h	67.5 a-d	36.3 a-e
23	Mainline	24 fl oz/a	14.5 c-g	14.5 hij	95.0 a	46.3 ab
Statistics[3]						
Least Significant Difference (LSD) P=.05			3.63	2.38	34.27	22.68
Standard Deviation			2.57	1.69	24.27	16.06
Coefficient of Variation (CV)			14.74	9.49	37.03	59.89
Treatment Prob(F)			0.0001	0.0001	0.0001	0.0001

Note: Means followed by same letter or symbol do not significantly differ (P=.05, LSD).

[3] All statistical analyses were conducted in ARM software and assumptions of ANOVA were not evaluated.

31 DAT –June 15th, 2023

Trt. No.	Treatment	Rate	Tall Fescue (% Cover)	Kentucky Bluegrass (% Cover)	Other Grasses (% Cover)	Broadleaf weed (% Cover)	Bareground /Litter (% Cover)	Tall Fescue Height (Inches)
1	NTC	-	35.0 -	35.0 -	10.0 -	13.8 -	5.0 e	34.3 ab
2	Panoramic 2SL	0.5 fl oz/a	33.8 -	45.0 -	5.0 -	10.0 -	6.3 de	27.8 cde
3	Panoramic 2SL	1 fl oz/a	31.3 -	45.0 -	11.3 -	6.3 -	6.3 de	23.9 ef
4	Panoramic 2SL	2 fl oz/a	30.0 -	41.3 -	15.0 -	11.3 -	7.5 cde	18.8 fgh
5	Panoramic 2SL	4 fl oz/a	21.0 -	47.5 -	6.3 -	14.0 -	11.3 a-d	12.8 hij
6	T-NEX	16 fl oz/a	39.8 -	35.0 -	8.8 -	9.0 -	7.5 cde	25.9 de
7	T-NEX	44 fl oz/a	33.8 -	46.3 -	5.0 -	8.8 -	6.3 de	17.9 f-j
8	Pac-Low	16 fl oz/a	32.5 -	43.8 -	8.8 -	10.0 -	5.0 e	33.9 abc
9	Pac-Low	48 fl oz/a	37.5 -	40.0 -	5.0 -	10.3 -	5.0 e	35.1 a
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a	21.3 -	47.5 -	6.0 -	11.5 -	13.8 ab	14.4 g-j
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a	32.3 -	37.5 -	10.0 -	7.8 -	12.5 abc	11.8 j
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a	27.5 -	37.5 -	8.8 -	15.0 -	11.3 a-d	15.8 g-j
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a	26.0 -	42.5 -	6.3 -	15.3 -	10.0 a-e	12.6 ij
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a	27.5 -	43.8 -	7.5 -	8.8 -	12.5 abc	15.9 g-j
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a	33.5 -	37.3 -	11.3 -	9.3 -	8.8 a-e	31.4 a-d
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a	25.0 -	40.0 -	7.5 -	13.8 -	7.5 cde	28.2 b-e
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a	30.0 -	37.5 -	10.0 -	18.8 -	6.3 de	17.3 f-j
18	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a	20.0 -	41.7 -	8.3 -	12.0 -	10.0 a-e	17.0 g-j
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a	21.3 -	33.8 -	7.5 -	12.8 -	8.8 b-e	19.2 fg
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a	18.8 -	36.3 -	8.8 -	6.5 -	8.8 b-e	16.8 g-j
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a	27.5 -	41.3 -	6.3 -	6.8 -	6.3 de	29.8 a-e
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a	26.3 -	36.3 -	8.8 -	24.0 -	6.3 de	18.1 f-i
23	Mainline	24 fl oz/a	26.3 -	36.3 -	6.3 -	6.8 -	15.0 a	15.3 g-j
Statistics[4]								
Least Significant Difference (LSD) P=.05			13.89	15.21	6.22	13.38	11.18	13.03
Standard Deviation			9.83	10.77	4.40	9.48	7.92	9.23
Coefficient of Variation (CV)			31.7	26.36	53.84	83.24	30.28	24.03
Treatment Prob(F)			0.3787	0.8893	0.2759	0.7092	0.1544	0.5768

Note: Means followed by same letter or symbol do not significantly differ (P=.05, LSD).

[4] All statistical analyses were conducted in ARM software and assumptions of ANOVA were not evaluated.

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31 DAT Continued – June 15th, 2023

Trt. No.	Treatment	Rate	Kentucky Bluegrass Height (Inches)	Tall Fescue Seed Presence (0=no/1=yes)	Kentucky Bluegrass Seed Presence (0=no/1=yes)	Tall Fescue Seed Suppression (%)	Kentucky Bluegrass Seed Suppression (%)	Need to mow (0=no/1=yes)
1	NTC	-	23.5 abc	1.0 -	1.0 a	0 h	0.0 g	1.0 a
2	Panoramic 2SL	0.5 fl oz/a	22.9 bc	1.0 -	1.0 a	3.8 h	0.0 g	1.0 a
3	Panoramic 2SL	1 fl oz/a	21.9 cd	1.0 -	1.0 a	25.0 fgh	3.8 efg	1.0 a
4	Panoramic 2SL	2 fl oz/a	18.8 e-i	1.0 -	0.6 b-e	52.5 c-f	12.5 c-g	0.5 b
5	Panoramic 2SL	4 fl oz/a	18.5 f-j	1.0 -	0.1 g	72.5 a-d	8.8 d-g	0.3 bc
6	T-NEX	16 fl oz/a	20.6 c-g	1.0 -	0.9 ab	6.3 gh	1.3 fg	1.0 a
7	T-NEX	44 fl oz/a	17.6 g-k	1.0 -	1.0 a	36.3 efg	7.5 d-g	0 c
8	Pac-Low	16 fl oz/a	26.3 a	1.0 -	1.0 a	1.3 h	0.0 g	1.0 a
9	Pac-Low	48 fl oz/a	25.0 ab	1.0 -	1.0 a	1.3 h	0.0 g	1.0 a
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a	15.9 i-m	1.0 -	0.2 fg	86.3 ab	16.3 b-e	0 c
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a	14.5 lm	1.0 -	0.1 g	95.0 a	38.8 a	0 c
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a	16.7 h-m	1.0 -	0.5 c-f	47.5 def	18.8 bcd	0 c
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a	15.1 klm	0.9 -	0 g	93.8 a	18.8 bcd	0 c
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a	14.0 m	0.8 -	0.5 c-f	65.0 a-e	26.3 abc	0 c
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a	21.3 c-f	1.0 -	1.0 a	10.0 gh	5.0 d-g	1.0 a
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a	21.4 c-f	1.0 -	0.9 ab	25.0 fgh	2.5 efg	1.0 a
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a	19.3 d-h	0.9 -	0.3 d-g	55.0 b-f	13.8 c-g	0.3 bc
18	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a	19.2 d-h	1.0 -	0.7 a-d	58.3 b-e	5.0 d-g	0 c
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a	17.7 g-k	1.0 -	0.8 abc	55.0 b-f	10.0 d-g	0.5 b
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a	17.6 g-k	0.9 -	0.3 efg	82.5 abc	12.5 c-g	0 c
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a	21.8 cde	1.0 -	1.0 a	5.0 gh	2.5 efg	1.0 a
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a	17.3 h-l	1.0 -	1.0 a	36.3 efg	15.0 c-f	0.3 bc
23	Mainline	24 fl oz/a	15.5 j-m	0.8 -	0.3 efg	86.0 ab	30.0 ab	0 c
Statistics[5]								
Least Significant Difference (LSD) P=.05			7.79	10.85	0.40	31.34	14.24	0.34
Standard Deviation			5.52	7.68	0.29	22.20	10.08	0.24
Coefficient of Variation (CV)			40.32	52.98	43.56	51.28	92.66	51.63
Treatment Prob(F)			0.6105	0.0214	0.0001	0.0001	0.0001	0.0001

Note: Means followed by same letter or symbol do not significantly differ (P=.05, LSD).

[5] All statistical analyses were conducted in ARM software and assumptions of ANOVA were not evaluated.

49 DAT – July 3rd, 2023

Trt. No.	Treatment	Rate	Tall Fescue Seed Production (%)	Kentucky Bluegrass Seed Production (%)	Tall Fescue Seed Suppression (%)	Kentucky Bluegrass Seed Suppression (%)	Height of total plot (Inches)	Need to mow (0=no/ 1=yes)	Quackgrass Abundance (Scale 1-10) *
1	NTC	-	0 b	0 e	100 a	100 a	6.2 f	0 d	0.5 ef
2	Panoramic 2SL	0.5 fl oz/a	0 b	0 e	100 a	100 a	7.2 f	0 d	0 f
3	Panoramic 2SL	1 fl oz/a	0 b	0 e	100 a	100 a	7.0 f	0 d	0.3 ef
4	Panoramic 2SL	2 fl oz/a	23.8 b	36.3 cd	76.3 a	63.8 bc	11.9 ef	0.5 bc	1 def
5	Panoramic 2SL	4 fl oz/a	26.3 b	61.3 abc	73.8 a	38.8 cde	15.7 cde	0.8 ab	0.8 ef
6	T-NEX	16 fl oz/a	0 b	0 e	100 a	100 a	6.5 f	0 d	0 f
7	T-NEX	44 fl oz/a	70.0 a	91.3 a	30.0 b	8.8 e	20.9 a-d	1.0 a	2.3 c-f
8	Pac-Low	16 fl oz/a	0 b	0 e	100 a	100 a	6.3 f	0 d	0.5 ef
9	Pac-Low	48 fl oz/a	0 b	0 e	100 a	100 a	6.4 f	0 d	0.8 ef
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a	25.0 b	82.5 ab	75.0 a	17.5 de	18.8 a-d	0.5 bc	4.3 abc
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a	1.3 b	66.3 abc	98.8 a	33.8 cde	15.6 de	0 d	2.8 b-e
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a	5.0 b	70.0 ab	95.0 a	30.0 de	22.9 a	0.8 bc	6 a
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a	1.3 b	67.5 abc	98.8 a	32.5 cde	15.4 de	0.3 cd	5 ab
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a	1.3 b	55.0 bc	98.8 a	45.0 cd	21.6 abc	0.5 bc	4.3 abc
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a	0 b	0 e	100 a	100 a	7.5 f	0 d	0.3 ef
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a	0 b	0 e	100 a	100 a	6.9 f	0 d	0 f
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a	27.5 b	60.0 abc	72.5 a	40.0 cde	16.6 a-e	0.8 ab	3.8 a-d
18	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a	3.3 b	91.7 a	96.7 a	8.3 e	20.0 a-d	1.0 a	3.7 a-d
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a	3.8 b	18.8 de	96.3 a	81.3 ab	12.0 ef	0 d	1.3 def
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a	1.3 b	63.8 abc	98.8 a	36.3 cde	22.0 ab	1.0 a	5.3 ab
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a	0 b	0 e	100 a	100 a	8.0 f	0 d	0 f
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a	61.3 a	70.0 ab	38.8 b	30.0 de	16.3 b-e	0.8 ab	3.5 a-d
23	Mainline	24 fl oz/a	2.5 b	65.0 abc	97.7 a	35.0 cde	16.0 cde	0.3 cd	1.3 def
Statistics[6]									
Least Significant Difference (LSD) P=.05			29.69	32.05	29.69	32.05	5.97	0.47	2.69
Standard Deviation			21.03	22.70	21.03	22.70	4.23	0.33	1.90
Coefficient of Variation (CV)			189.44	58.92	23.65	36.91	31.84	97.95	93.64
Treatment Prob(F)			0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Note: Means followed by same letter or symbol do not significantly differ (P=.05, LSD).

* Quack grass data was taken on a scale of 1-10 depending on the abundance in each plot. 1 being low and 10 being high.

[6] All statistical analyses were conducted in ARM software and assumptions of ANOVA were not evaluated.

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66 DAT – July 20th, 2023

Trt. No.	Treatment	Rate	Tall Fescue Seed Production (%)	Kentucky Bluegrass Seed Production (%)	Tall Fescue Seed Suppression (%)	Kentucky Bluegrass Seed Suppression (%)	Height of total plot (Inches)	Need to mow (0=no/ 1=yes)	Quackgrass Abundance (Scale 1-10) *
1	NTC	-	0 -	0 d	100 -	100 a	9.3 efg	0 -	1 c
2	Panoramic 2SL	0.5 fl oz/a	0 -	0 d	100 -	100 a	9.4 efg	0 -	1 c
3	Panoramic 2SL	1 fl oz/a	0 -	0 d	100 -	100 a	9.7 d-g	0 -	1 c
4	Panoramic 2SL	2 fl oz/a	0 -	0 d	100 -	100 a	9.1 efg	0 -	1 c
5	Panoramic 2SL	4 fl oz/a	0 -	1.3 d	100 -	98.8 a	9.6 efg	0 -	1 c
6	T-NEX	16 fl oz/a	1.3 -	0 d	98.8 -	100 a	9.5 efg	0 -	1 c
7	T-NEX	44 fl oz/a	1.3 -	0 d	98.8 -	100 a	8.3 g	0 -	1 c
8	Pac-Low	16 fl oz/a	1.3 -	0 d	98.8 -	100 a	9.4 efg	0 -	1 c
9	Pac-Low	48 fl oz/a	1.3 -	0 d	98.8 -	100 a	9.7 d-g	0 -	1 c
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a	0 -	42.5 abc	100 -	57.5 bcd	15.1 ab	0 -	2 abc
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a	0 -	68.8 a	100 -	31.2 d	16.8 a	0 -	2.3 ab
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a	0 -	20.0 cd	100 -	80.0 ab	13.0 bcd	0 -	2 abc
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a	1.3 -	62.5 a	98.8 -	37.5 d	13.4 abc	0 -	3 a
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a	1.3 -	40.0 abc	98.8 -	60.0 bcd	10.6 c-g	0 -	1.8 bc
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a	0 -	0 d	100 a	100 a	9.2 efg	0 -	1 c
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a	0 -	0 d	100 -	100 a	8.9 fg	0 -	1 c
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a	0 -	0 d	100 -	100 a	9.2 efg	0 -	1 c
18	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a	0 -	1.7 d	100 -	98.3 a	8.9 fg	0 -	1 c
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a	3.8 -	27.5 bcd	96.3 -	72.5 abc	11.8 b-f	0 -	1.5 bc
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a	2.5 -	0 d	97.5 -	100 a	8.1 g	0 -	1 c
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a	1.3 -	0 d	98.8 -	100 a	9.0 efg	0 -	1 c
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a	0 -	1.3 d	100 -	98.8 a	8.0 g	0 -	1 c
23	Mainline	24 fl oz/a	0 -	56.3 ab	100 -	43.8 cd	12.4 b-e	0 -	1 c
Statistics[7]									
Least Significant Difference (LSD) P=.05			29.69	32.05	29.69	32.05	5.97	0.47	1.06
Standard Deviation			21.03	22.70	21.03	22.70	4.23	0.33	0.75
Coefficient of Variation (CV)			189.44	58.92	23.65	36.91	31.84	97.95	58.17
Treatment Prob(F)			0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0103

Note: Means followed by same letter or symbol do not significantly differ (P=.05, LSD).

* Quack grass data was taken on a scale of 1-10 depending on the abundance in each plot. 1 being low and 10 being high.
[7] All statistical analyses were conducted in ARM software and assumptions of ANOVA were not evaluated.

95 DAT – August 18th, 2023

Trt. No.	Treatment	Rate	Tall Fescue Seed Production (%)	Kentucky Bluegrass Seed Production (%)	Tall Fescue Seed Suppression (%)	Kentucky Bluegrass Seed Suppression (%)	Height of total plot (Inches)	Need to mow (0=no/ 1=yes)	Quackgrass Abundance (Scale 1-10) *
1	NTC	-	0 -	0 d	100 -	100 a	10.3 cde	0 c	1 -
2	Panoramic 2SL	0.5 fl oz/a	0 -	0 d	100 -	100 a	9.7 de	0 c	1 -
3	Panoramic 2SL	1 fl oz/a	0 -	0 d	100 -	100 a	9.6 de	0 c	1.5 -
4	Panoramic 2SL	2 fl oz/a	0 -	0 d	100 -	100 a	9.6 de	0 c	1 -
5	Panoramic 2SL	4 fl oz/a	0 -	0 d	100 -	100 a	10.7 b-e	0 c	1 -
6	T-NEX	16 fl oz/a	0 -	0 d	100 -	100 a	9.8 de	0 c	1.3 -
7	T-NEX	44 fl oz/a	0 -	0 d	100 -	100 a	9.4 e	0 c	1 -
8	Pac-Low	16 fl oz/a	0 -	0 d	100 -	100 a	9.8 de	0 c	1 -
9	Pac-Low	48 fl oz/a	0 -	0 d	100 -	100 a	9.3 e	0 c	1.3 -
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a	5.0 -	37.5 ab	95.0 -	62.5 cd	14.6 a	0 c	1 -
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a	7.5 -	57.5 a	92.5 -	42.5 d	14.6 a	0 c	1.3 -
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a	10.0 -	7.5 cd	90.0 -	92.5 ab	13.9 a	0 c	1 -
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a	17.5 -	50.0 ab	82.5 -	50.0 cd	13.5 ab	0 c	1.5 -
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a	2.5 -	32.5 abc	97.5 -	67.5 bcd	12.2 a-d	0 c	1 -
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a	0 -	0 d	100 -	100 a	11.0 b-e	0 c	1.8 -
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a	0 -	0 d	100 -	100 a	10.1 cde	0.3 bc	2.3 -
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a	0 -	0 d	100 -	100 a	9.5 de	0 c	1.5 -
18	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a	0 -	0 d	100 -	100 a	10.7 b-e	0 c	2 -
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a	7.5 -	27.5 bc	92.5 -	72.5 bc	12.9 abc	0.5 ab	1 -
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a	0 -	0 d	100 -	100 a	9.4 e	0 c	1.3 -
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a	0 -	0 d	100 -	100 a	10.1 cde	0 c	1 -
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a	0 -	0 d	100 -	100 a	9.6 de	0 c	1 -
23	Mainline	24 fl oz/a	2.5 -	52.5 ab	97.5 -	47.5 cd	12.8 abc	0.8 a	1.5 -
Statistics[8]									
Least Significant Difference (LSD) P=.05			29.69	32.05	29.69	32.05	5.97	0.47	0.83
Standard Deviation			21.03	22.70	21.03	22.70	4.23	0.33	0.59
Coefficient of Variation (CV)			189.44	58.92	23.65	36.91	31.84	97.95	46.95
Treatment Prob(F)			0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.1469

* Quack grass data was taken on a scale of 1-10 depending on the abundance in each plot. 1 being low and 10 being high.
[8] All statistical analyses were conducted in ARM software and assumptions of ANOVA were not evaluated.

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137 DAT – September 29th, 2023								
Trt. No.	Treatment	Rate	Tall Fescue Seed Production (%)	Kentucky Bluegrass Seed Production (%)	Tall Fescue Seed Suppression (%)	Kentucky Bluegrass Seed Suppression (%)	Height of total plot (Inches)	Need to mow (0=no/ 1=yes)
1	NTC	-	0 -	0 -	100 -	100 -	11.8 -	0 -
2	Panoramic 2SL	0.5 fl oz/a	0 -	0 -	100 -	100 -	12.5 -	0 -
3	Panoramic 2SL	1 fl oz/a	0 -	0 -	100 -	100 -	11.6 -	0 -
4	Panoramic 2SL	2 fl oz/a	0 -	0 -	100 -	100 -	11.7 -	0 -
5	Panoramic 2SL	4 fl oz/a	0 -	0 -	100 -	100 -	12.9 -	0 -
6	T-NEX	16 fl oz/a	0 -	0 -	100 -	100 -	11.4 -	0 -
7	T-NEX	44 fl oz/a	0 -	0 -	100 -	100 -	11.8 -	0 -
8	Pac-Low	16 fl oz/a	0 -	0 -	100 -	100 -	11.4 -	0 -
9	Pac-Low	48 fl oz/a	0 -	0 -	100 -	100 -	11.6 -	0 -
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a	0 -	0 -	100 -	100 -	11.2 -	0 -
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a	0 -	0 -	100 -	100 -	10.0 -	0 -
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a	0 -	0 -	100 -	100 -	12.1 -	0 -
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a	0 -	0 -	100 -	100 -	11.1 -	0 -
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a	0 -	0 -	100 -	100 -	11.6 -	0 -
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a	0 -	0 -	100 -	100	12.5 -	0 -
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a	0 -	0 -	100 -	100 -	11.6 -	0 -
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a	0 -	0 -	100 -	100 -	11.7 -	0 -
18	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a	0 -	0 -	100 -	100 -	12.7 -	0 -
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a	0 -	0 -	100 -	100 -	11.1 -	0 -
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a	0 -	0 -	100 -	100 -	11.3 -	0 -
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a	0 -	0 -	100 -	100 -	11.6 -	0 -
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a	0 -	0 -	100 -	100 -	11.7 -	0 -
23	Mainline	24 fl oz/a	0 -	0 -	100 -	100 -	11.2 -	0 -
Statistics[9]								
Least Significant Difference (LSD) P=.05			.	.	.	.	1.50	.
Standard Deviation			0.00	0.00	0.00	0.00	1.06	0.00
Coefficient of Variation (CV)			0.0	0.0	0.0	0.0	9.14	0.0
Treatment Prob(F)			1.0000	1.0000	1.0000	1.0000	0.2051	1.0000

[9] All statistical analyses were conducted in ARM software and assumptions of ANOVA were not evaluated.

Total Number of Plots Mowed per Treatment							
Trt. No.	**Treatment**	**Rate**	**June 15th, 2023**	**July 3rd, 2023**	**July 20th, 2023**	**August 18th, 2023**	**September 29th, 2023**
1	NTC	-	4	0	0	0	0
2	Panoramic 2SL	0.5 fl oz/a	4	0	0	0	0
3	Panoramic 2SL	1 fl oz/a	4	0	0	0	0
4	Panoramic 2SL	2 fl oz/a	2	2	0	0	0
5	Panoramic 2SL	4 fl oz/a	1	3	0	0	0
6	T-NEX	16 fl oz/a	4	0	0	0	0
7	T-NEX	44 fl oz/a	0	4	0	0	0
8	Pac-Low	16 fl oz/a	4	0	0	0	0
9	Pac-Low	48 fl oz/a	4	0	0	0	0
10	T-NEX Panoramic 2SL	16 fl oz/a 1 fl oz/a	0	2	0	2	0
11	T-NEX Panoramic 2SL	44 fl oz/a 1 fl oz/a	0	0	0	2	0
12	T-NEX Panoramic 2SL	16 fl oz/a 2 fl oz/a	0	3	0	1	0
13	T-NEX Panoramic 2SL	44 fl oz/a 2 fl oz/a	0	1	0	2	0
14	T-NEX Panoramic 2SL	16 fl oz/a 4 fl oz/a	0	2	0	2	0
15	Pac-Low Panoramic 2SL	16 fl oz/a 1 fl oz/a	4	0	0	0	0
16	Pac-Low Panoramic 2SL	48 fl oz/a 1 fl oz/a	4	0	0	1	0
17	Pac-Low Panoramic 2SL	16 fl oz/a 2 fl oz/a	1	3	0	0	0
***18**	Pac-Low Panoramic 2SL	48 fl oz/a 2 fl oz/a	0	3	0	0	0
19	Pac-Low Panoramic 2SL	16 fl oz/a 4 fl oz/a	2	0	0	2	0
20	Pac-Low Panoramic 2SL	48 fl oz/a 4 fl oz/a	0	4	0	0	0
21	Pac-Low T-NEX	16 fl oz/a 16 fl oz/a	4	0	0	0	0
22	Pac-Low T-NEX	48 fl oz/a 44 fl oz/a	1	3	0	0	0
23	Mainline	24 fl oz/a	0	1	0	3	0

Statistical analysis was not done on this data.

* Treatment 18 only had 3 replications due to a mistake during application.