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UW – Madison Weed Science Renz Lab

Evaluation of Kudos + Fungicide and Insecticide Rates on Alfalfa Stand Density in Interseeded Corn – Alfalfa

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Objective:

Optimize the use of Kudos (prohexadione) to enhance establishment of alfalfa interseeded into silage corn in Wisconsin by determining the benefit of increasing rates of Kudos applied either alone or partnered with fungicide + insecticide (FI) on alfalfa establishment in interseeded systems.

Summary:

Despite extremely difficult conditions for alfalfa establishment in 2019 (high alfalfa disease, competitive corn, high potato leaf hopper pressure) results indicated that fall alfalfa plant density of both cultivars responded linearly to increasing rates of Kudos (Fig. 1 and 2). Varieties behaved differently as 26 oz wt A^{-1} of Kudos resulted in 6.4 plants ft^{-2} of cultivar 55H94 but only 4.7 plants ft^{-2} of cultivar 3420 (Table 3). The addition of fungicide (Priaxor) and insecticide (Warrior II) to the increasing rates of Kudos enhanced the overall performance of the management practice (Fig. 1 and 2). Averaged across Kudos rates, the addition of FI increased alfalfa plant density by approximately 8.0 and 7.0 plants ft^{-2} for cultivars 3420 and 55H94, respectively. Furthermore, all rates of Kudos + FI resulted in more than 10 plants ft^{-2} for alfalfa 55H94, whereas only the two highest rates of Kudos (16 and 26 oz wt A^{-1}) resulted in more than 10 plants ft^{-2} for alfalfa 3240. Although alfalfa cultivars were not statistically compared in our study, these findings corroborate previous research conducted in Wisconsin where alfalfa 55H94 demonstrated greater ability to establish in this system compared to 3240. Results also confirm that disease and insect presence can impact establishment success and should be monitored and managed to ensure success in addition to kudos applications.

Experimental Design and Treatments Information:

This experiment was conducted near Arlington, WI (43°18' N, 89°20' W) on a Plano silt loam (fine-silty, mixed, superactive, mesic Typic Argiudoll). Following fertilization with 200 pounds of N per acre and ample P and K, corn was planted at 35,100 seeds per acre on May 13, 2019. Two alfalfa varieties were sown at 16 pounds per acre one day after planting corn (May 14, 2019). Corn was planted using a 30 inches between-rows spacing and four rows of alfalfa were interseeded between corn rows. The experiment was set up as a randomized complete block design with four replicates. Treatments were the combinations of two alfalfa cultivars (3240 and 55H94), six Kudos rates (0, 4, 8, 12, 16 and 26 oz wt $acre^{-1}$) and two pest management strategies (fungicide + insecticide [Priaxor at 4.0 fl oz $acre^{-1}$ + Warrior II at 1.0 fl oz $acre^{-1}$] or no fungicide + insecticide), plus an untreated control (no Kudos and no fungicide + insecticide). However, the combinations of Kudos at 4.0 and 12 oz wt A^{-1} plus fungicide + insecticide were not included in the experiment. Therefore, there were a total of 20 different treatments, which are listed in Table 1. Plots were 5 feet wide by 20 feet long (100 square feet).

Table 1. Treatment's description.

Treatment Nº	Alfalfa variety	Kudos[1] (oz wt A^{-1})	Priaxor[2] (fl oz A^{-1})	Warrior II[3] (fl oz A^{-1})
1	3420	Untreated	Untreated	Untreated
2	55H94	Untreated	Untreated	Untreated
3	3420	8	0	0
4	3420	16	0	0
5	3420	26	0	0
6	3420	0	4	1
7	3420	4	4	1
8	3420	8	4	1
9	3420	12	4	1
10	3420	16	4	1
11	3420	26	4	1
12	55H94	8	0	0
13	55H94	16	0	0
14	55H94	26	0	0
15	55H94	0	4	1
16	55H94	4	4	1
17	55H94	8	4	1
18	55H94	12	4	1
19	55H94	16	4	1
20	55H94	26	4	1

[1] prohexadione; [2]pyraclostrobin+fluxapyroxad; [3]lambda-cyhalothrin+benzisothiazolin.

Table 2. Treatment's application information.

Date: Prohexadione: June 20th, 2019, 4pm – 5pm. Fungicide + insecticide: July 4th, 2019, 9 – 10am		
Equipment: Single-nozzle boom calibrated to deliver 20 gallons per acre		
Nozzles: One (1) Flat Tip XR Teejet XR11005VS		
Boom PSI: 40 PSI		
Application Timing:	Prohexadione	Fungicide + Insecticide
Weather Station:	KWIARLIN2	KWIARLIN2
Temperature:	70°F	76°F
Wind Speed and Direction:	3 mph NE	6mph NW
Relative Humidity:	66%	92%
Previous Rain Event Within 48 Hours:	06.19.19 – 0.15 inches	07.03.19 – 0.12 inches
When ≥ 0.25 inches of precipitation occurred after treatment:	06.24.19 – 1.15 inches	07.04.19, 3pm – 0.82 inches

Statistical Analysis

Previous research conducted by our research group in Wisconsin has demonstrated that alfalfa cultivars 3420 and 55H94 exhibit different establishment levels when interseeded into silage corn; therefore, they were analyzed separately. In addition, separate analyzes were also performed for treatments containing Kudos alone and Kudos + fungicide + insecticide due to the unbalanced treatment's structure (different number of Kudos rates treatments). Statistical analyses were performed using the open-source statistical software R 3.6.1 (R Core Team 2014). Alfalfa plant density was analyzed by fitting mixed-effects models using the package "lme4" and function "lmer" in R. The statistical model statement included Kudos rate as a fixed effect, whereas block was considered a random effect. Treatments were considered different when $P \leq 0.05$. The effects of increasing Kudos + FI rates were modeled using quadratic regression models ($y= a + bx + cx^2$), whereas the effects of increasing Kudos alone rates were modeled using linear regression models ($y= a + bx$). Model selection was based on the residual sum of squares and adjusted R-squared values (Schabenberger and Pierce 2002). To satisfy the assumptions of analysis of variance, data were square root transformed when necessary, but nontransformed means were reported.

Results

There was a significant effect of increasing Kudos rates in both alfalfa cultivars, applied either alone or partnered with fungicide and insecticide (FI) ($p<0.05$). In general, fall alfalfa plant density increased linearly as Kudos rate increased with both alfalfa cultivars (Fig. 1 and 2).

(Table 3). Fall alfalfa plant density increased from Kudos rates via a quadratic response when fungicides and insecticides were applied to alfalfa of both varieties (Fig.1 and 2) (Table 3). Untreated alfalfa plant density was less than 1.0 plants ft^{-2} for both cultivars.

Table 3. Alfalfa plant density mean and standard error (± SE) for each treatment.

Treatment number	Alfalfa variety	Kudos[1] (oz wt A^{-1})	Priaxor[2] (fl oz A^{-1})	Warrior II[3] (fl oz A^{-1})	Fall alfalfa stand (plants sf^{-2})
1	3420	Untreated	Untreated	Untreated	0.4 (± 0.29)
2	55H94	Untreated	Untreated	Untreated	0.5 (± 0.19)
3	3420	8	0	0	1.6 (± 0.80)
4	3420	16	0	0	2.0 (± 0.77)
5	3420	26	0	0	4.7 (± 0.74)
6	3420	0	4	1	7.0 (± 1.02)
7	3420	4	4	1	9.7 (± 1.66)
8	3420	8	4	1	8.8 (± 2.31)
9	3420	12	4	1	9.6 (± 1.2)
10	3420	16	4	1	11.7 (± 2.02)
11	3420	26	4	1	11.6 (± 1.81)
12	55H94	8	0	0	3.0 (± 1.07)
13	55H94	16	0	0	5.5 (± 1.38)
14	55H94	26	0	0	6.4 (± 1.07)
15	55H94	0	4	1	7.1 (± 0.88)
16	55H94	4	4	1	10.8 (± 1.45)
17	55H94	8	4	1	10.7 (± 1.14)
18	55H94	12	4	1	12.4 (± 2.64)
19	55H94	16	4	1	11.4 (± 1.65)
20	55H94	26	4	1	14.1 (± 1.54)

[1] prohexadione; [2]pyraclostrobin+fluxapyroxad; [3]lambda-cyhalothrin+benzisothiazolin.

References

Schabenberger O, Pierce FJ (2002) Contemporary Statistical Models for the Plant and Soil Sciences. Washington, DC: CRC Press. Pp 504–512.

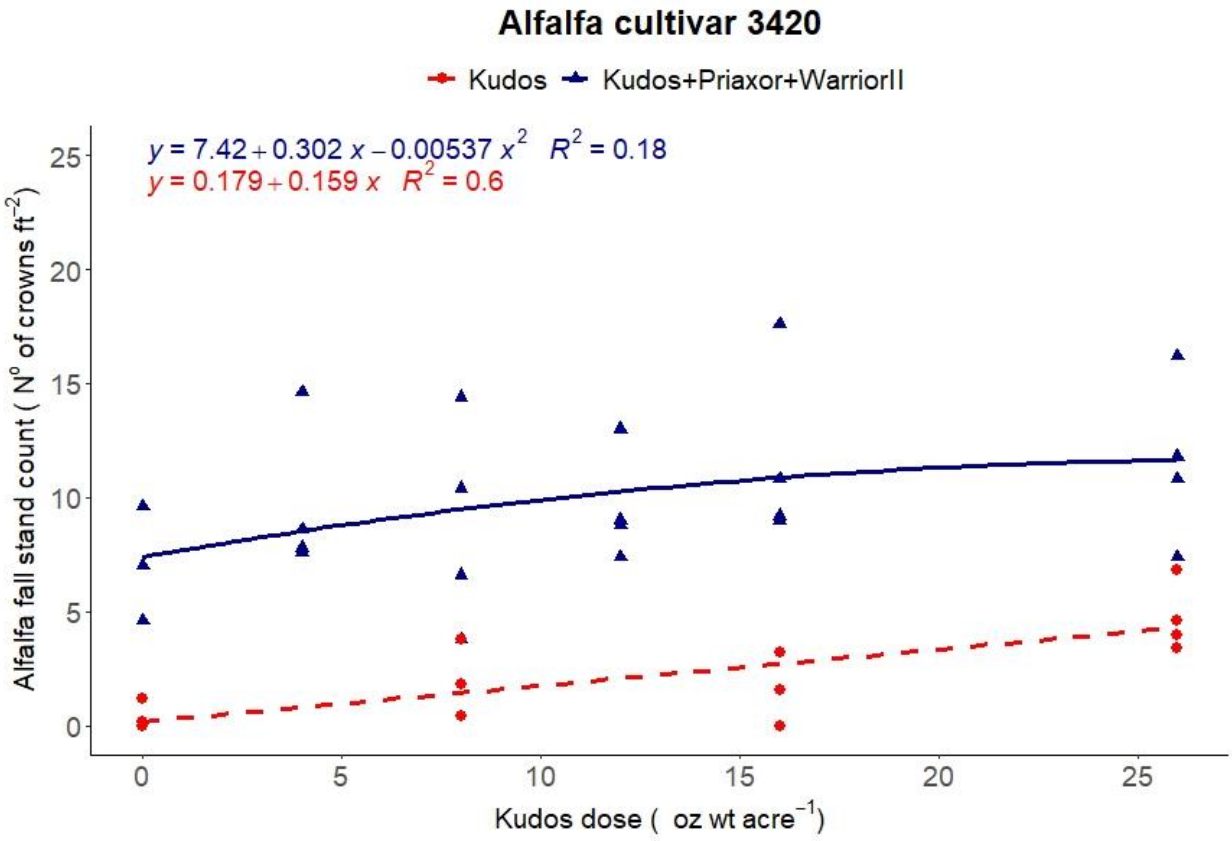

Figure 1. Alfalfa cultivar 3420 plant density:
Number of crowns per square foot as a function of increasing rates of Kudos alone (red dashed line) and Kudos + Priaxor and Warrior II (blue solid line) in October of 2019, Arlington, WI. Alfalfa stand response was fit to the following equations: for Kudos, Yi = a + bx, where a and b and adjusted R^2 were 0.18, 0.16, and 0.6, respectively; and for Kudos + Priaxor and Warrior II, Yi=a + bx + cx 2, where a, b, c, and adjusted R^2 were 7.42, 0.302, −0.005, and 0.18, respectively.

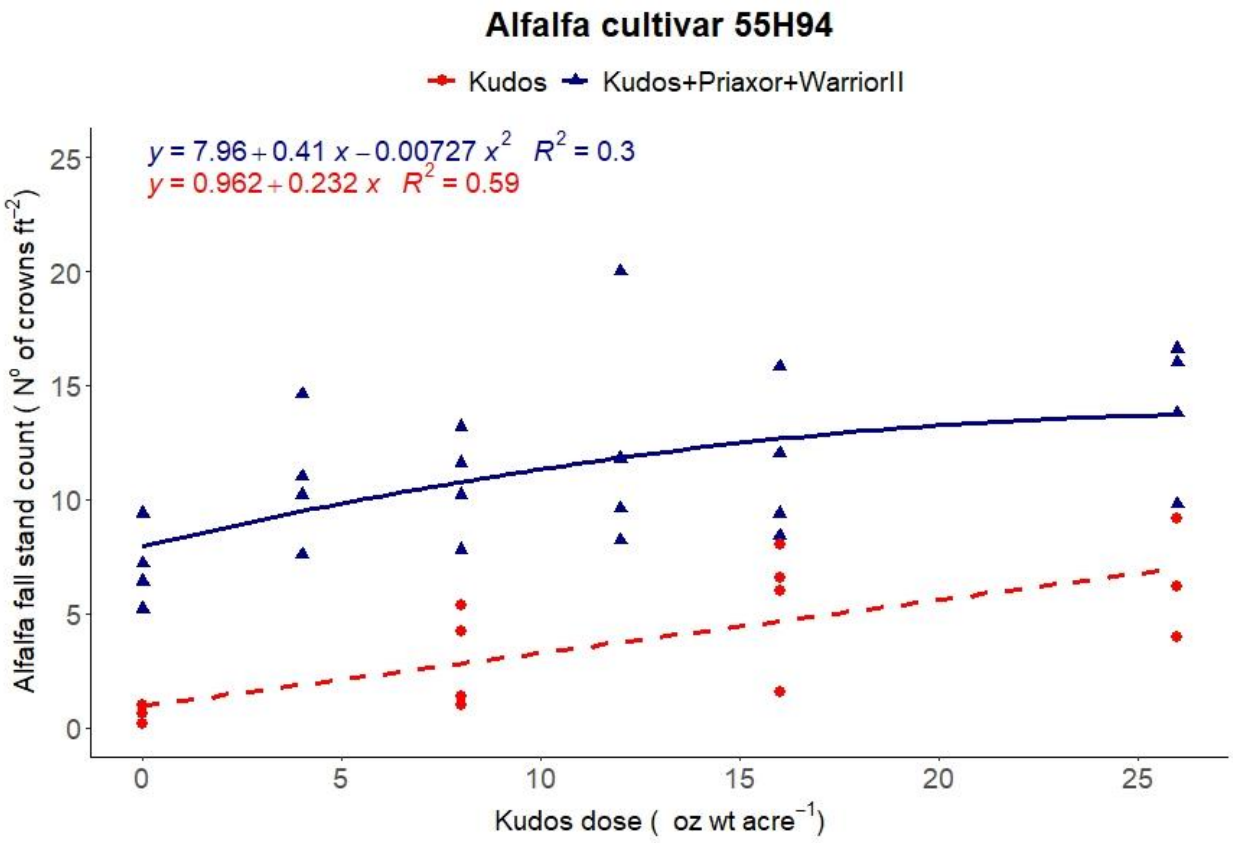

Figure 2. Alfalfa cultivar 55H94 plant density:
Number of crowns per square foot as a function of increasing rates of Kudos alone (dashed red line) and Prohexadione plus Priaxor and Warrior II (solid blue line) in October of 2019, Arlington, WI. Alfalfa stand response was fit to the following equations: for Kudos, Yi = a + bx, where a and b and adjusted R2 were 0.96, 0.23, and 0.59, respectively; and for Kudos + Priaxor and Warrior II, Yi=a + bx + cx 2, where a, b, c, and adjusted R2 were 7.96, 0.41, −0.007, and 0.3, respectively.

Figure 3. a-e (3420): a) Untreated, **b)** Kudos (16 oz wt A^{-1}), **c)** Kudos (26 oz wt A^{-1}); **d)** Kudos (16 oz wt A^{-1}) + FI; **e)** Kudos (26 oz wt A^{-1}) + FI.
f-j (55H94): f) Untreated, **g)** Kudos (16 oz wt A^{-1}), **h)** Kudos (26 oz wt A^{-1}); **i)** Kudos (16 oz wt A^{-1}) + FI; **j)** Kudos (26 oz wt A^{-1}) + FI.