WSARE Final Report Figures

Objective 1

Table 1-1: Herbicide treatment, active ingredients, and application rates for Objective 1. Applied on August 10, 2022 using a CO_2 backpack sprayer that delivered 19.5 gallons water per acre at 290 kPa.

Herbicide name	Active ingredient	Application rate
No Spray	NA	NA
Rejuvra	Indaziflam	5 oz/acre

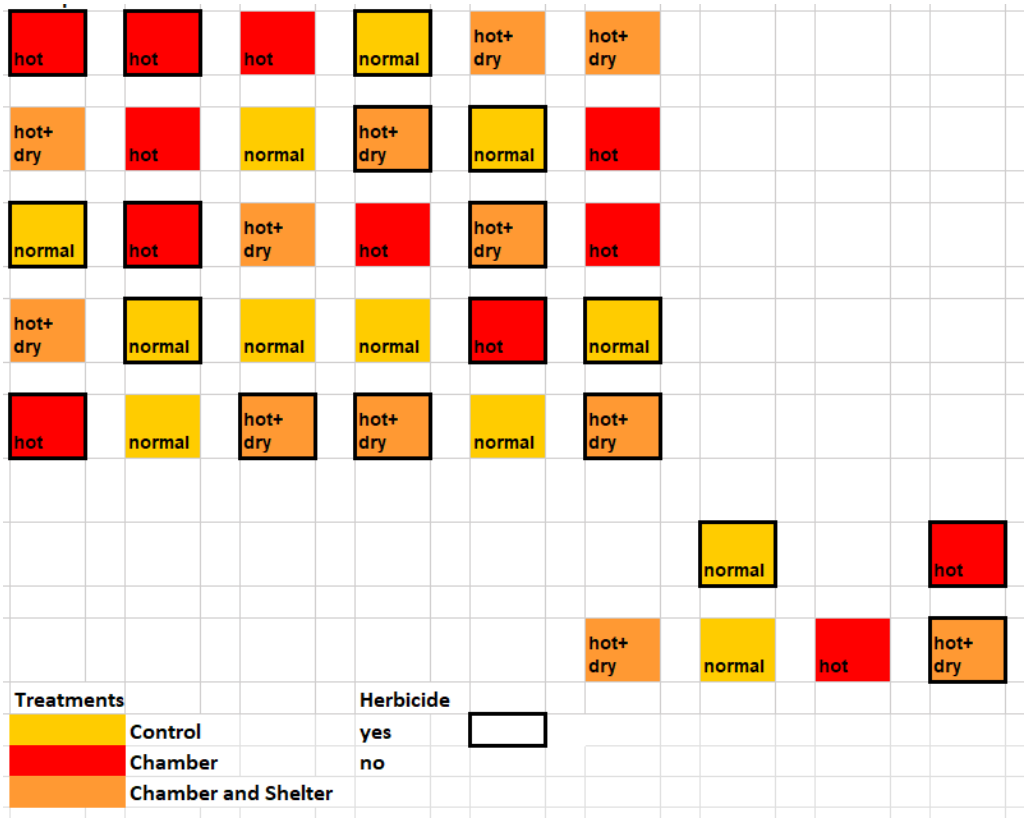

Figure 1-1: Map of study site for Objective 1 located at collaborating producer Amy Cox's property. Control indicates plots where there are no climate treatments present, hot indicates plots with open top chambers, and hot + dry indicates treatments with open top chambers and rain out shelters. Plots with a shaded fill were treated with indaziflam in August 2022. Plots are 2 m^2 with 1 m buffer space between plots.

Figure 1-2. Photo of the "Hot" open top chambers (OTCs) (on left) and "Hot+Dry" OTCs and rain out shelters (ROSs) (on right) for Objective 1.

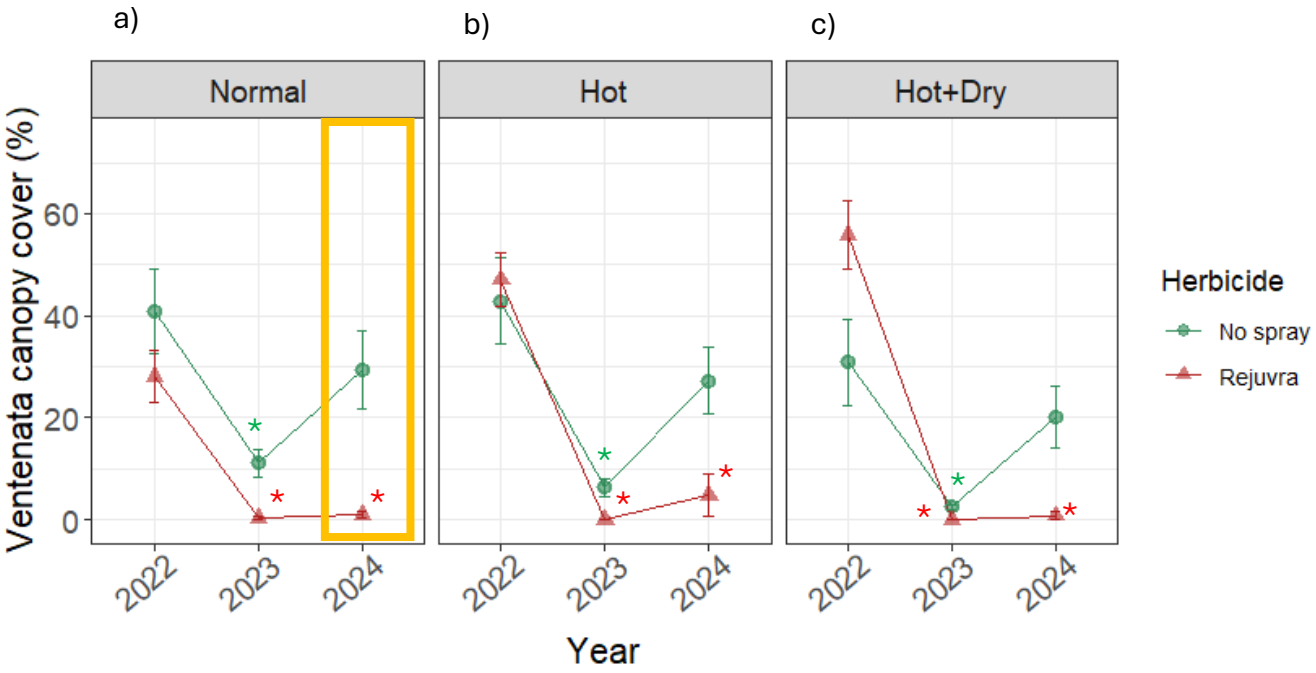

Figure 1-3: Ventenata percent canopy cover over three years (2022-2024) and two herbicide treatments (No spray, Rejuvra) in three climate treatments a) Normal, b) Hot, and c) Hot+Dry. 2022 is before treatment. Each panel represents one climate treatment, where the points are the mean percent canopy cover of ventenata, where the bars represent standard error, asterisks (*) indicate when an herbicide treatment (No spray or Rejuvra) differed from its pre-treatment value (2022) within climate treatments ($p < 0.05$). The orange box highlights that only in the normal treatment in 2024 was there a difference between the no-spray and Rejurva herbicide treatments ($p = 0.02$).

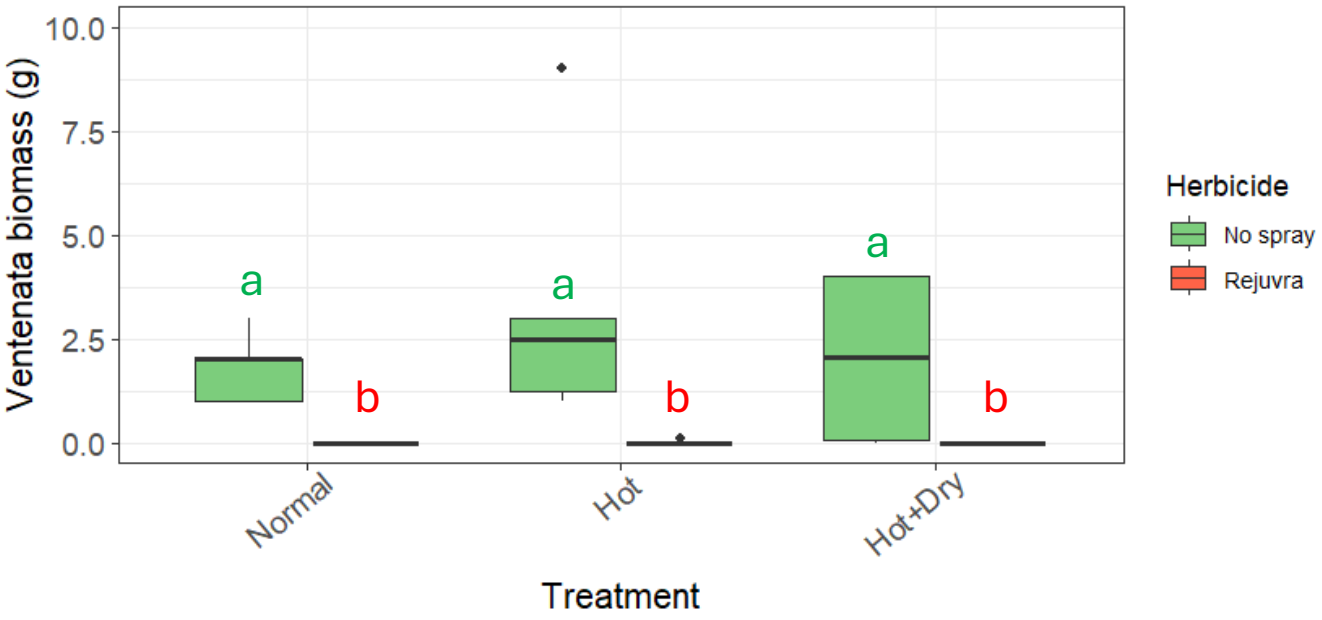

Figure 1-4: Ventenata biomass (g) among three climate treatments (Normal, Hot, Hot+Dry) and two herbicide treatments. Biomass was collected in 2024. Boxes are the interquartile range, the horizontal line indicates the median, whiskers reach the span of 95% of the data, points are outliers, and letters are the compact letter display of Tukey-Kramer pairwise comparisons ($p < 0.05$).

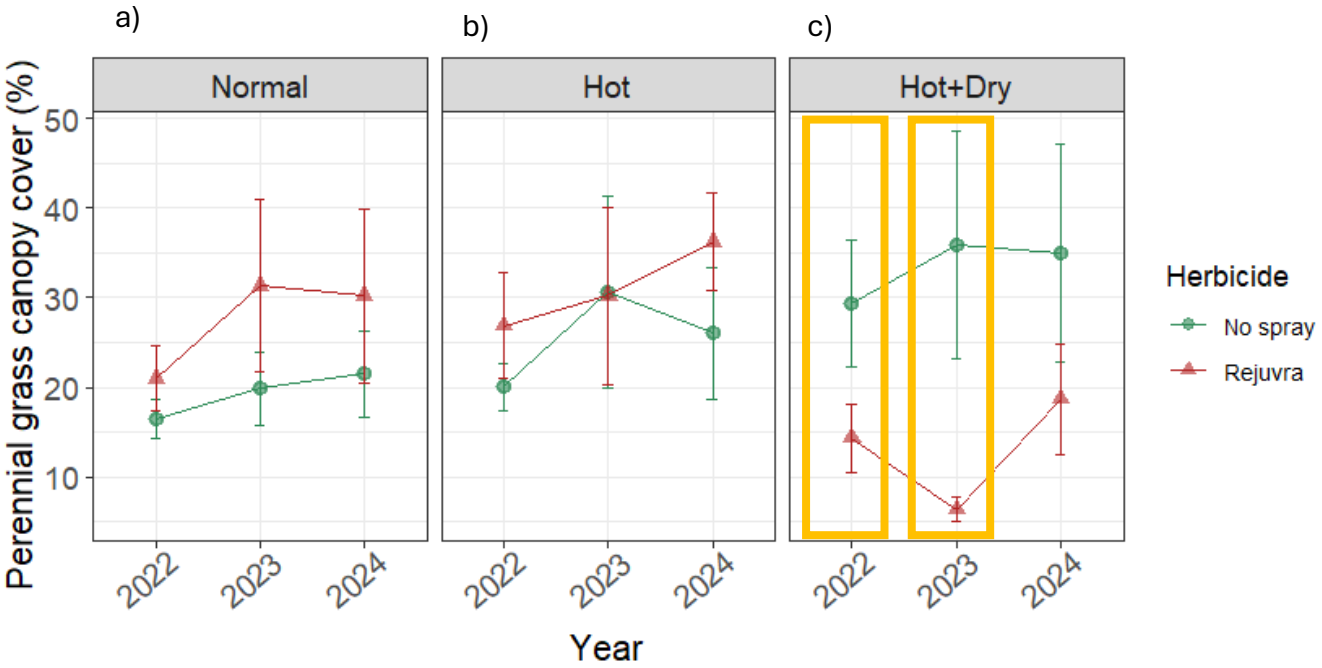

Figure 1-5: Perennial grass percent canopy cover over three years (2022-2024) and two herbicide treatments (No spray, Rejuvra) in three climate treatments a) Normal, b) Hot, and c) Hot+Dry. 2022 is before treatment. Each panel represents one climate treatment, where the

points are the mean percent canopy cover of perennial grasses, where the bars represent standard error. There were no differences in cover except in the Hot+Dry climate treatment, where no herbicide application had higher perennial grass cover than the sprayed plots both before treatments were applied (2022) and one year after (2023), depicted by orange boxes (p = 0.03, both).

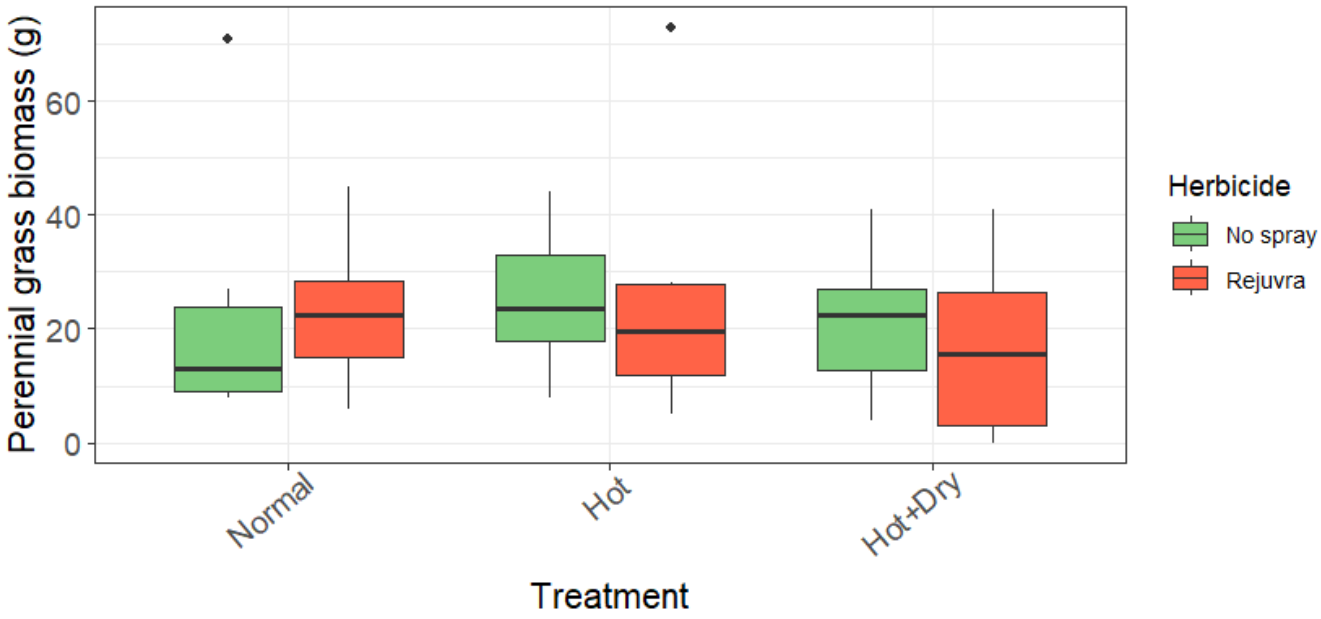

Figure 1-6: Perennial grass biomass (g) following two herbicide treatments (No spray, Rejuvra) in three climate treatments (Normal, Hot, and Hot+Dry). Biomass was collected in 2024. Boxes are the interquartile range, the horizontal line indicates the median, whiskers reach the span of 95% of the data, and points are outliers. No differences in biomass were detected given climate treatment or herbicide ($p > 0.30$).

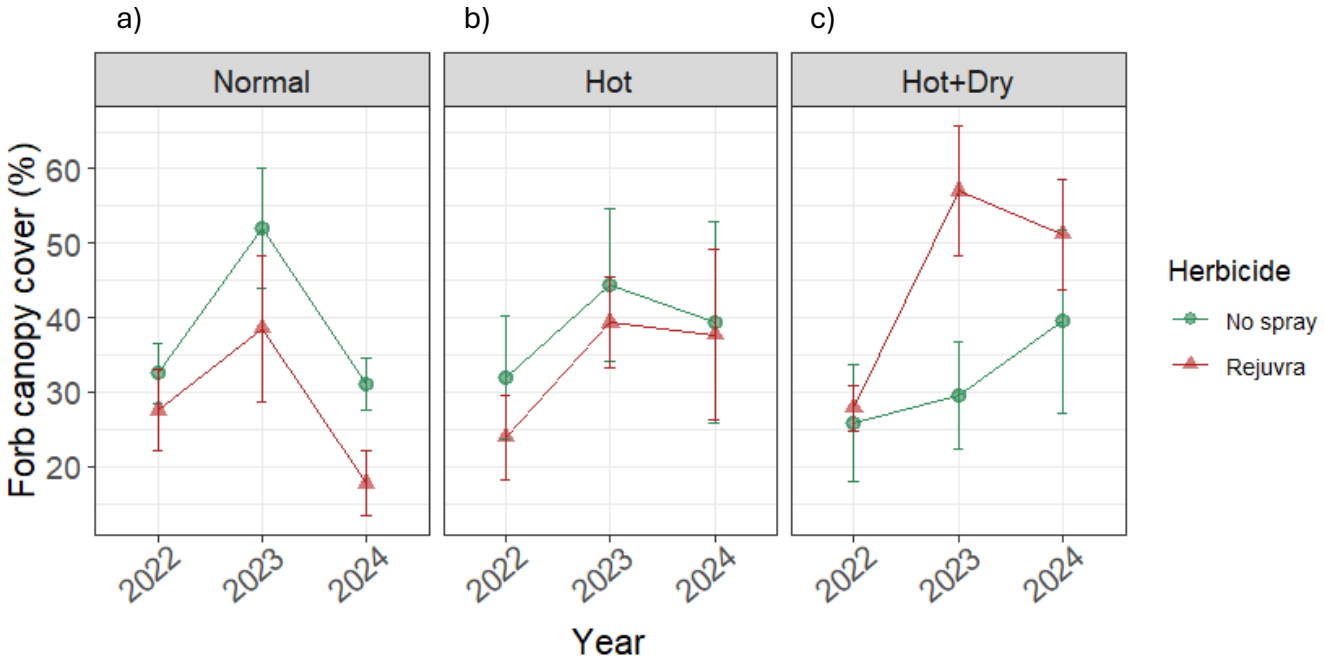

Figure 1-7: Forb percent canopy cover over three years (2022-2024) and two herbicide treatments (No spray, Rejuvra) in three climate treatments a) Normal, b) Hot, and c) Hot+Dry. 2022 is before treatment. Each panel represents one climate treatment, where the points are the mean percent canopy cover of forbs, and the bars represent standard error. No differences were detected within climate treatments over years nor between herbicide treatment ($p > 0.18$).

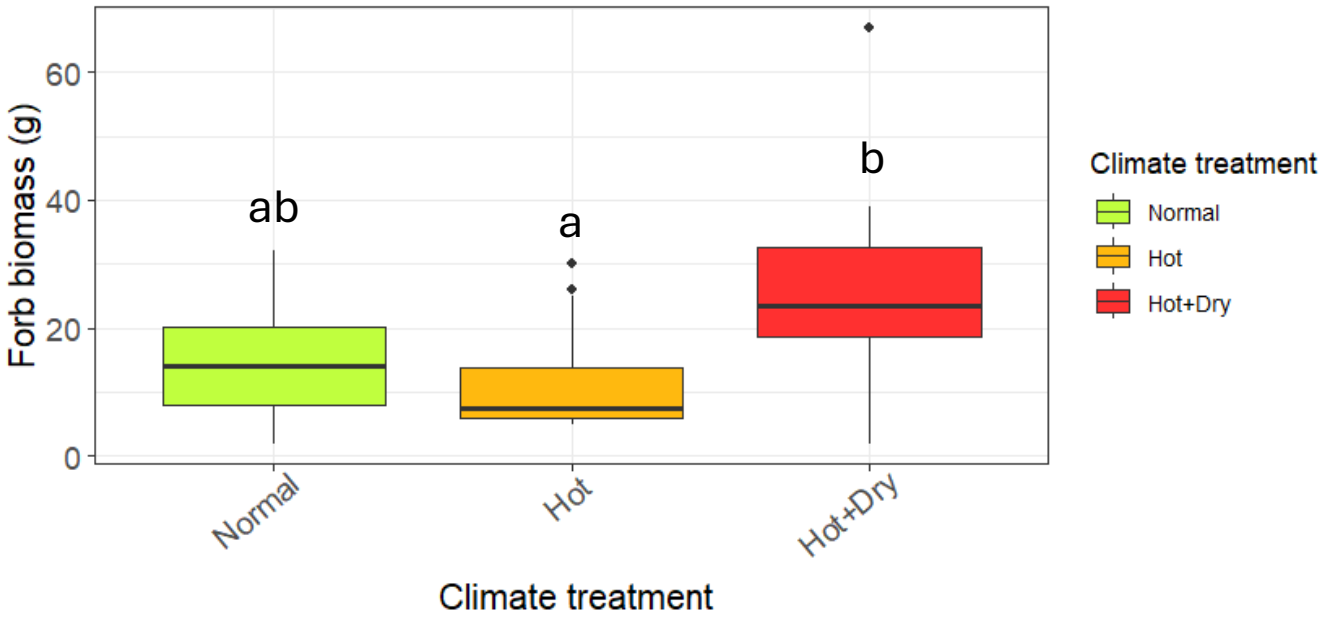

Figure 1-8: Forb biomass (g) among three climate treatments (Normal, Hot, Hot+Dry). Biomass was collected in 2024. Boxes are the interquartile range, the horizontal line indicates the median, whiskers reach the span of 95% of the data, and points are outliers, and letters are the

compact letter display of Tukey-Kramer pairwise comparisons ($p < 0.05$). No differences in forb biomass were detected given herbicide treatment ($p > 0.40$).

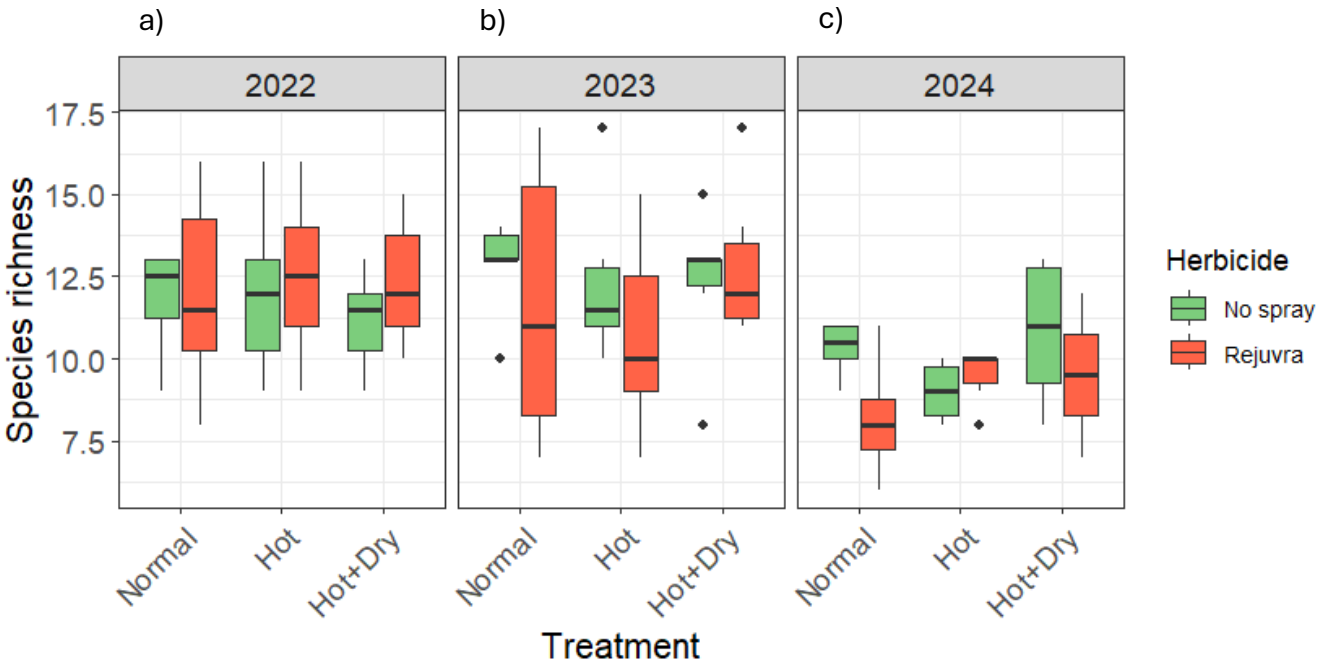

Figure 1-9: Species richness in three climate treatments a) Normal, b) Hot, and c) Hot+Dry and two herbicide treatments (No spray, Rejuvra), over three years a) 2022, b) 2023, and c) 2024. 2022 is before treatment. Boxes are the interquartile range, the horizontal line indicates the median, whiskers reach the span of 95% of the data. There were no differences in richness given climate ($p = 0.49$) or herbicide ($p = 0.15$), but there were differences based on year ($p < 0.01$) in which 2024 had lower richness than 2022 and 2023 ($p < 0.01$ both).

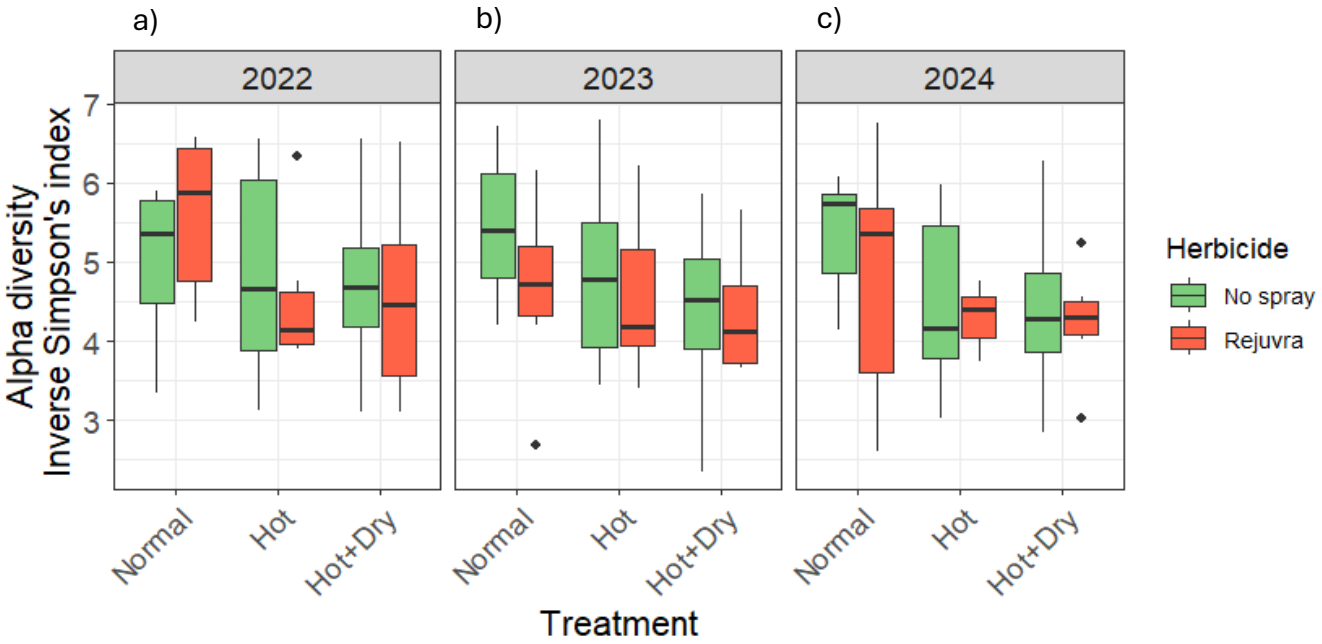

Figure 1-10: Alpha diversity calculated using the Inverse Simpson's index in three climate treatments a) Normal, b) Hot, and c) Hot+Dry and two herbicide treatments (No spray, Rejuvra), over three years a) 2022, b) 2023, and c) 2024. 2022 is before treatment. Boxes are the interquartile range, the horizontal line indicates the median, whiskers reach the span of 95% of the data. There were no differences in alpha diversity given climate treatment ($p = 0.23$) nor herbicide ($p = 0.51$) but was impacted by year ($p = 0.02$), where there was moderate evidence 2023 was greater than 2024 ($p = 0.06$).

Objective 2

Table 2-1: Herbicide treatment names, active ingredients, and application rates for Objective 2. Rejuvra and Axiom were applied pre-emergent on August 1-5, 2022, and Plateau was applied post-emergent on October 19-21, 2022 using a CO_2 backpack sprayer that delivered 16 mL/acre at 290 kPa.

Herbicide name	Active ingredient	Application rate
No Spray	NA	NA
Axiom	Flufenacet + metribuzin	4 oz/acre & 1 oz/acre
Rejuvra	Indaziflam	5 oz/acre
Rejuvra + Plateau	Indaziflam + imazapic	5 oz/acre & 6 oz/acre

Table 2-2: Fertilizer names and application rates for Objective 2. Treatments applied on August 1-5, 2022.

Fertilizer name	Application rate
None	NA
Macronutrient (NPK)	40 lbs/acre
Micronutrient (Nutrafix)	25 lbs/acre

Table 2-3: Soil nutrient content of Nitrate (lb/acre) and Boron (ppm). Soil samples were collected May 28-29, 2024. Mean, standard error, and compact letter display of Tukey-Kramer pairwise comparisons ($p < 0.05$). Pairwise comparisons only made within that nutrient type.

Nutrient	Fertilizer	Mean*	SE	CLD
Nitrate	None	2.25	1.290	A
	Macronutrient	2.75	1.270	A
	Micronutrient	3.91	1.280	B
Boron	None	0.212	0.342	A
	Macronutrient	0.193	0.078	A
	Micronutrient	0.813	0.342	B

*mean Nitrate measured in lbs/acre and mean Boron is measured in ppm

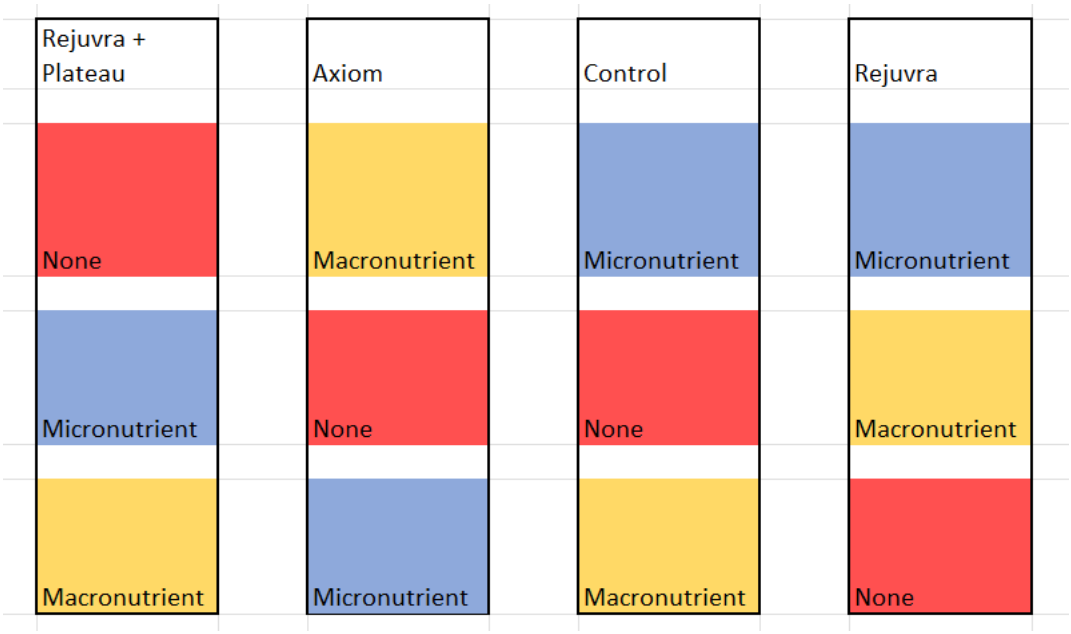

Figure 2-1: Map of one block for Objective 2 located at three properties in Sanders and Cascade Counties, where each site had four blocks. None indicates plots where there are no fertilizer treatments present, Macronutrient indicates plots where NPK fertilizer was applied, and Micronutrient indicates treatments where Nutrafix micronutrient fertilizer was applied. Fertilizer treatments were applied in fall 2022. Herbicide treatments were applied in columns, where Control is the non-sprayed control, Rejuvra received 5 oz/acre indaziflam, Rejuvra + Plateau received 5 oz/acre indaziflam and 6 oz/acre imazapic, and Axiom received 4 oz/acre flufenacet and 1 oz/acre metribuzin. Herbicides were applied pre-emergent in fall 2022. Plots

are 3 m² with 0.75 m buffer space between plots.

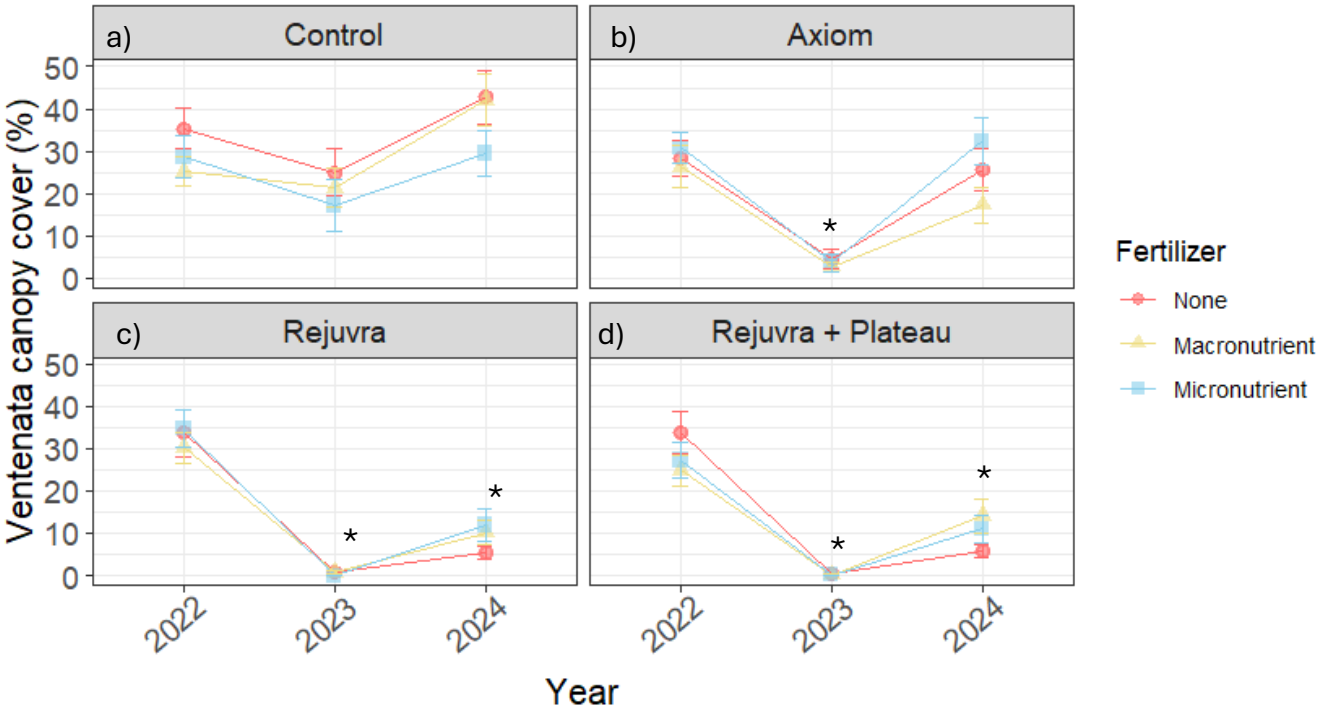

Figure 2-2: Ventenata percent canopy cover over three years (2022-2024) and three fertilizer treatments (None, Macronutrient, Micronutrient) in four herbicide treatments a) Control, b) Axiom, c) Rejuvra, and d) Rejuvra + Plateau. 2022 is before treatment. Each panel represents one herbicide treatment, where the points are the mean percent canopy cover of ventenata, where the bars represent standard error, asterisks (*) indicate when an herbicide treatment (Control, Axiom, Rejuvra, and Rejuvra + Plateau) differed from its pre-treatment value (2022) within herbicide treatments ($p < 0.05$). There were no differences among fertilizer treatments ($p = 0.19$).

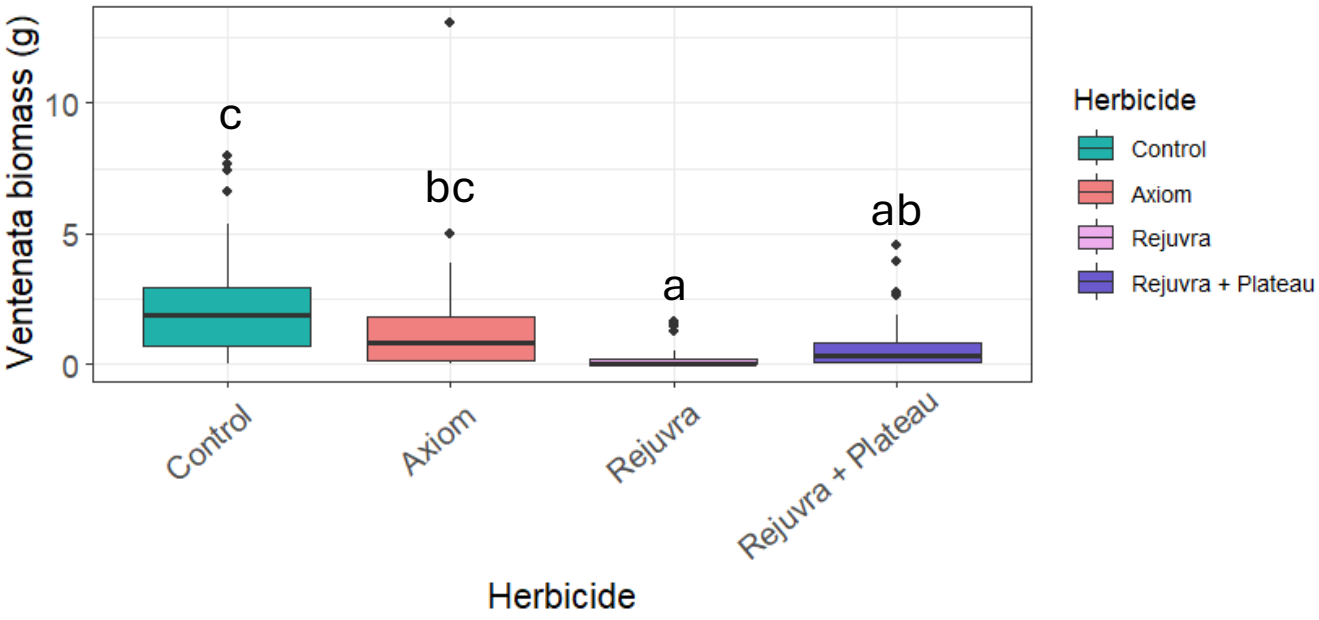

Figure 2-3: Ventenata biomass (g) among four herbicide treatments (Control, Axiom, Rejuvra, and Rejuvra + Plateau). Biomass was collected in 2024. Boxes are the interquartile range, the horizontal line indicates the median, whiskers reach the span of 95% of the data, points are outliers, and letters are the compact letter display of Tukey-Kramer pairwise comparisons ($p < 0.05$). Ventenata biomass (g) did not differ between the Control and Axiom treatments ($p = 0.07$) but was lower in the Rejuvra ($p < 0.01$) and Rejuvra + Plateau ($p < 0.01$) relative to the Control.

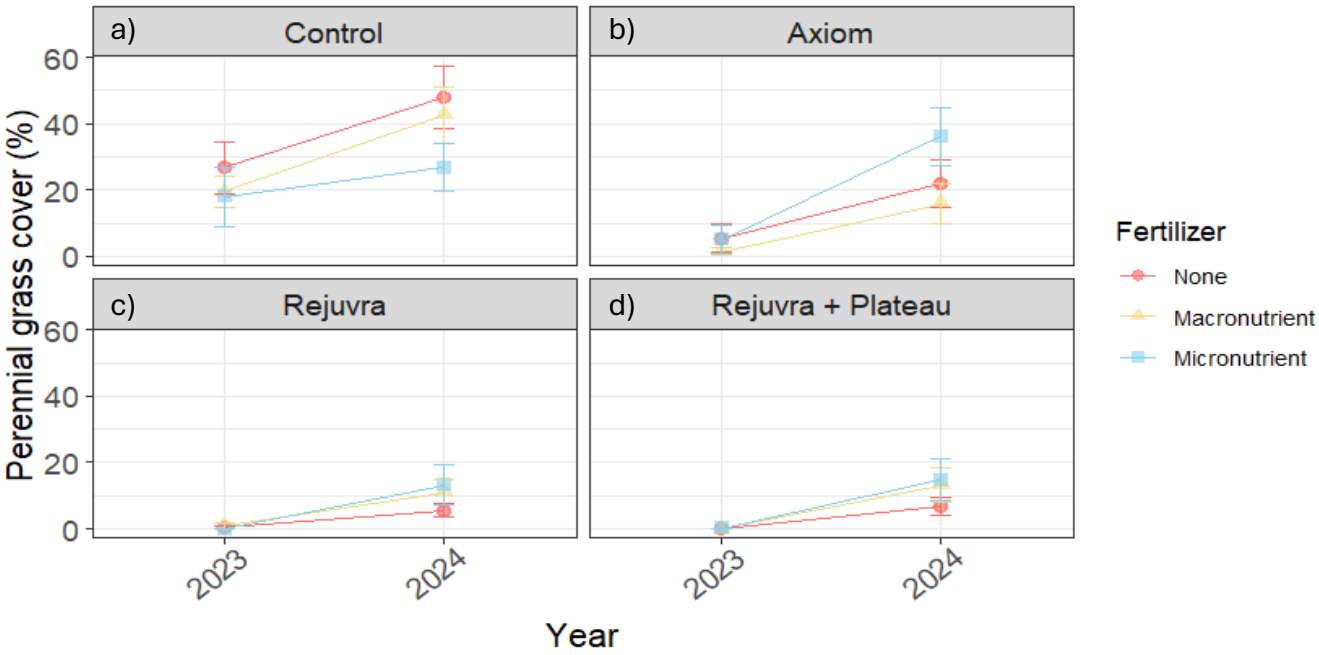

Figure 2-4: Perennial grass percent canopy cover over two years (2023-2024) and three fertilizer

treatments (None, Macronutrient, Micronutrient) in four herbicide treatments a) Control, b) Axiom, c) Rejuvra, and d) Rejuvra + Plateau. Each panel represents one herbicide treatment, where the points are the mean percent canopy cover of ventenata, where the bars represent standard error. Perennial grass cover was not impacted by fertilizer (p = 0.11), herbicide (p = 0.32), nor year (p = 0.90).

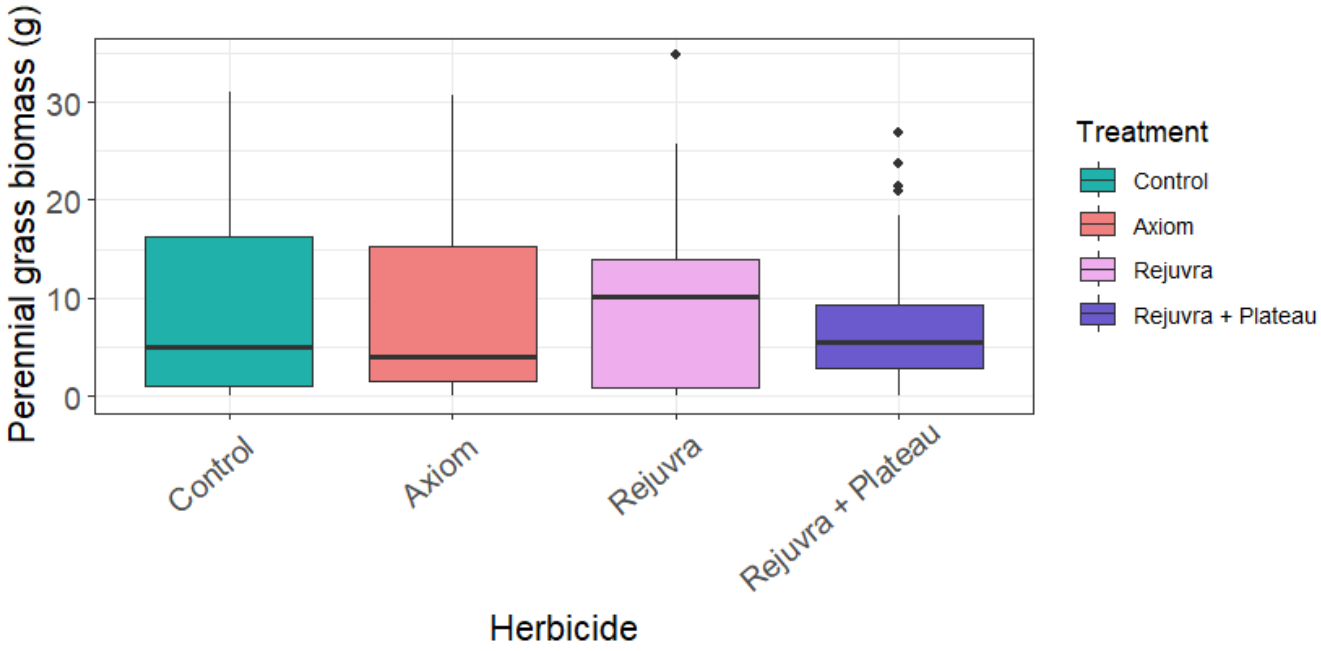

Figure 2-5: Perennial grass biomass (g) among four herbicide treatments (Control, Axiom, Rejuvra, and Rejuvra + Plateau). Biomass was collected in 2024. Boxes are the interquartile range, the horizontal line indicates the median, whiskers reach the span of 95% of the data, and points are outliers. Perennial grass biomass was not impacted by fertilizer (p = 0.47), nor herbicide (p = 0.96).

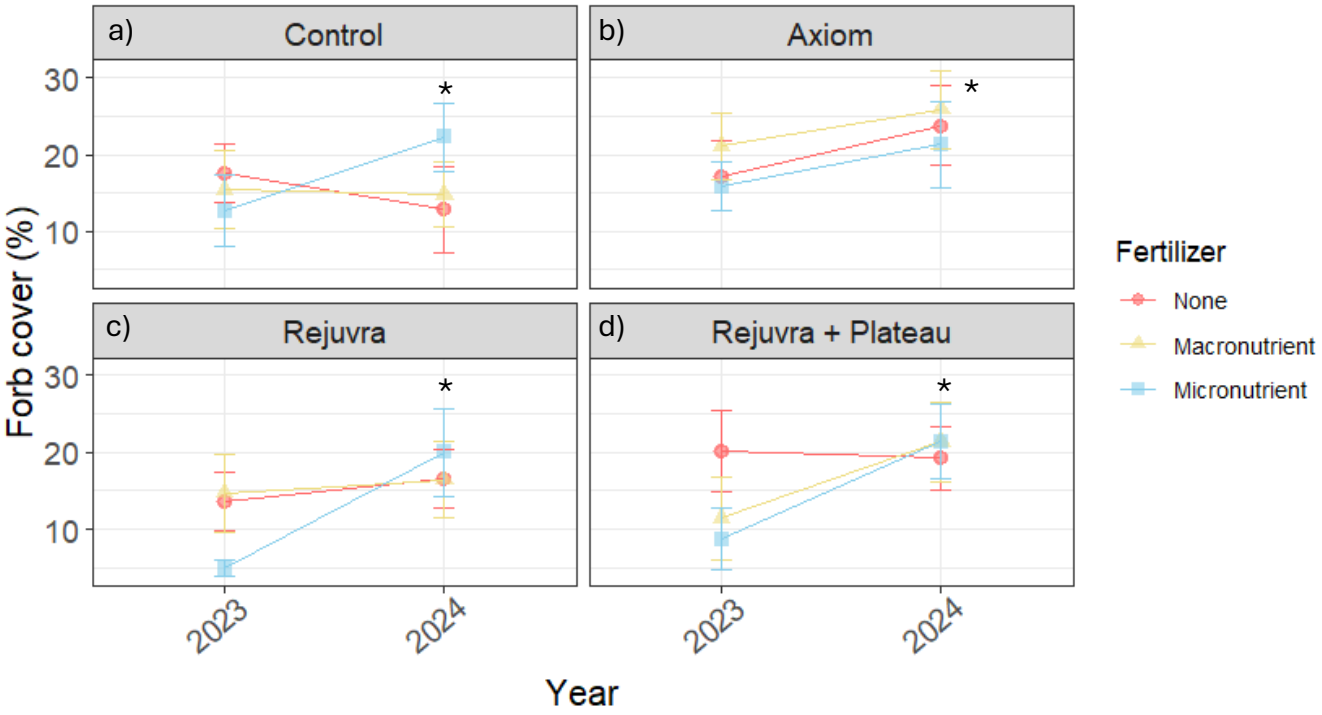

Figure 2-6: Forb percent canopy cover over two years (2023-2024) and three fertilizer treatments (None, Macronutrient, Micronutrient) in four herbicide treatments a) Control, b) Axiom, c) Rejuvra, and d) Rejuvra + Plateau. Each panel represents one herbicide treatment, where the points are the mean percent canopy cover of ventenata, where the bars represent standard error, asterisks (*) indicate when an herbicide treatment (Control, Axiom, Rejuvra, and Rejuvra + Plateau) differed from its pre-treatment value (2022) within herbicide treatments ($p < 0.05$). Forb percent cover was impacted by herbicide ($p = 0.06$), as well as the interaction between fertilizer and year ($p = 0.02$), though there were no pairwise differences in fertilizer and year detected ($p > 0.56$). All treatments increased in forb cover from 2023-2034 ($p = 0.01$, all).

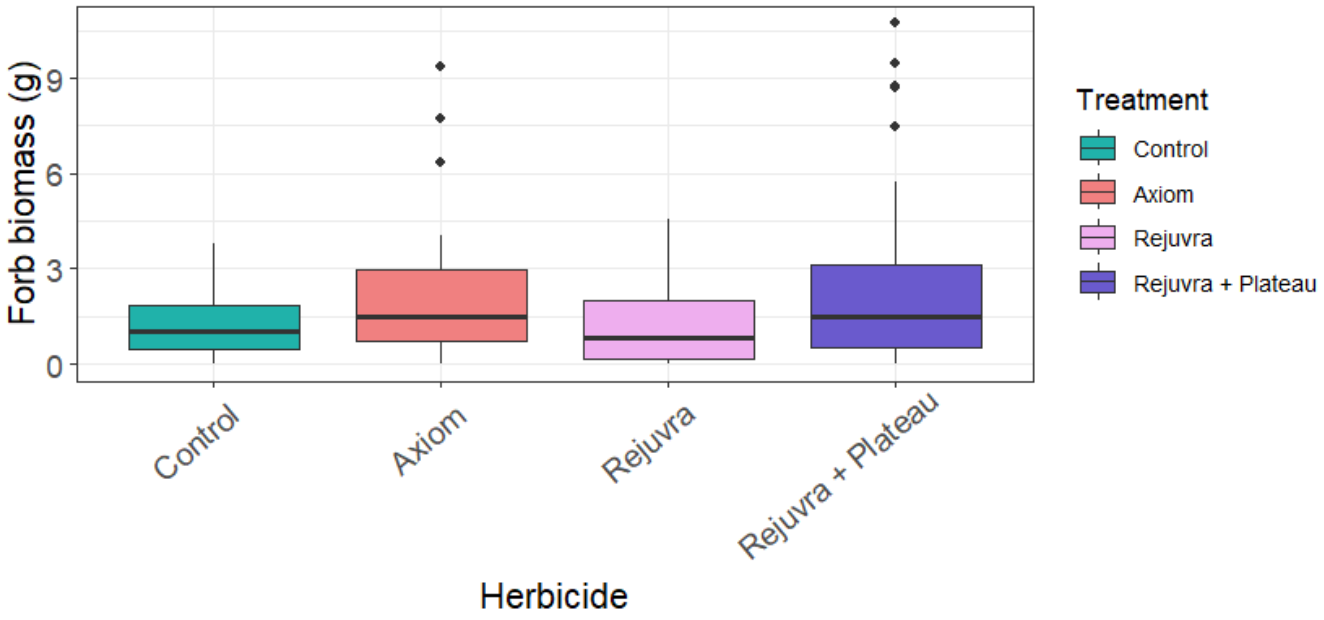

Figure 2-7 Forb biomass (g) among four herbicide treatments (Control, Axiom, Rejuvra, and Rejuvra + Plateau). Biomass was collected in 2024. Boxes are the interquartile range, the horizontal line indicates the median, whiskers reach the span of 95% of the data, and points are outliers. Forb biomass was not impacted by fertilizer (p = 0.65), nor herbicide (p = 0.09).

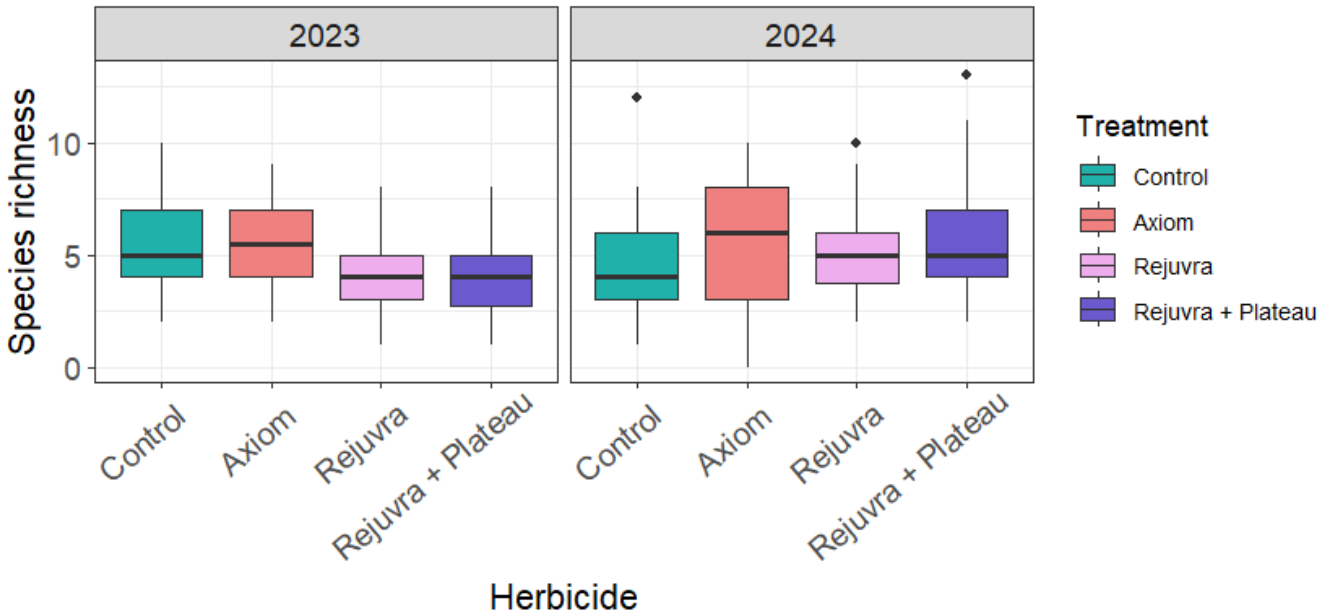

Figure 2-8: Species richness among four fertilizer treatments (Control, Axiom, Rejuvra, and Rejuvra + Plateau) over two years (2023-2024). Boxes are the interquartile range, the horizontal line indicates the median, whiskers reach the span of 95% of the data, and points are outliers. Richness was not impacted by herbicide treatment (p = 0.73) or fertilizer treatment (p = 0.32).

There was an interaction detected between herbicide and year (p = 0.02), though no pairwise differences were detected (p > 0.37).

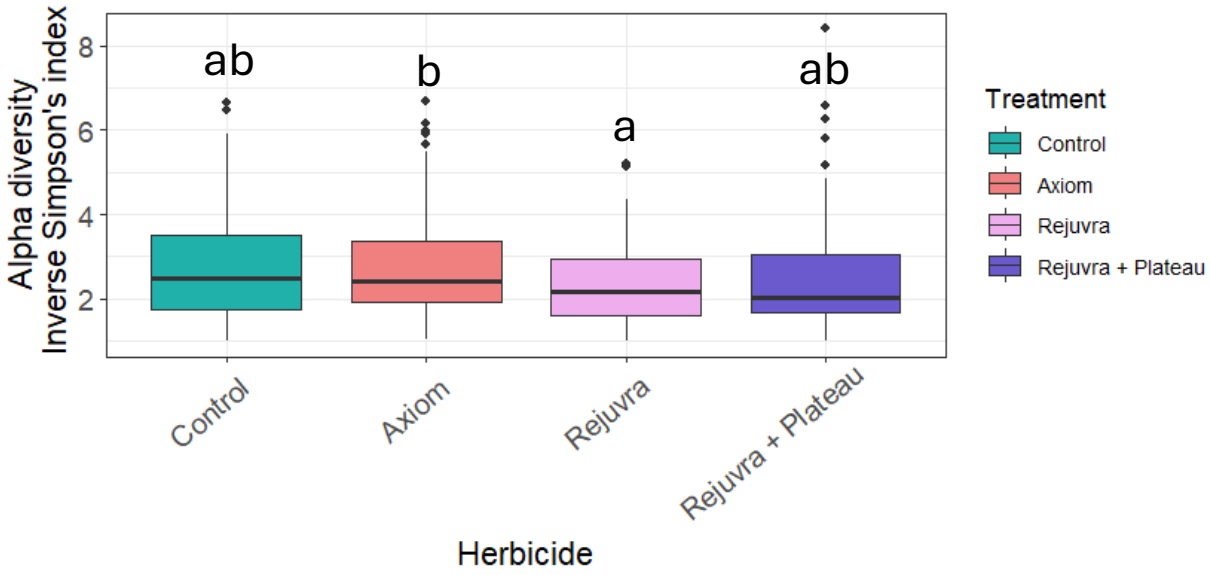

Figure 2-9: Alpha diversity calculated using the Inverse Simpson's index among four fertilizer treatments (Control, Axiom, Rejuvra, and Rejuvra + Plateau) averaged over two years (2023-2024). Boxes are the interquartile range, the horizontal line indicates the median, whiskers reach the span of 95% of the data, points are outliers, and letters are the compact letter display of Tukey-Kramer pairwise comparisons (p <0.05). Alpha diversity was greater in the Axiom treatment relative to the Rejuvra treatment (p = 0.04), but there were no other pairwise differences between herbicides (p > 0.11), and no difference given fertilizer treatment (p = 0.56), year (p = 0.17), nor any interactions (p > 0.13).