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Vegetation changes ten years after catclaw mimosa (*Mimosa laxiflora*) control with tebuthiuron in a short grass prairie at northern Sonora, Mexico

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Introduction

Catclaw mimosa (*Mimosa laxiflora*) is a native, perennial half-size brush, which invades short grass prairie and competes with desirable species for water, nutrients and light interferes with cattle grazing and reduces range productivity. Tebuthiuron [1-(5-*tert*-Butyl-1,3,4-thiadiazol-2-yl)-1,3-dimethylurea; chemical formula $C_9H_{16}N_4OS$] is a granular herbicide used to control invasive shrubby species on rangelands with sustainable forage responses (McGinty *et al*., 2009). Research trials conducted in the Chihuahuan and Sonoran deserts show that tebuthiuron at rates of 0.5 to 1.5 kg a.i./ha effectively controlled most shrubby species and significant increase forage in the Matorral area in Mexico and USA. Local information regarding catclaw mimosa control and forage production increases sustain after bush control in the short grass prairies does not exist. This study was conducted to evaluate vegetation changes after the application of tebuthiuron at rates of 0 and 1.5 kg a.i./ha to control high infestations of catclaw mimosa in the short grass prairies.

Materials and Methods

The study was conducted at Cananea, Sonora, Mexico (Latitude 30° 58´ 26.1" N; Longitude 110° 08´ 22"W), on a short grass prairie in regular condition highly infested with catclaw mimosa. Mean shrub density averaged 6,560 plants/ha. Pelleted tebuthiuron (Grasslan, 20P) herbicide was hand applied at rates of 0 and 1.5 kg a.i./ha on triplicated 20 by 30 meter plots during May of 2005.

Variables evaluated were brush density and mortality, grass density, height, basal cover and forage production of main grass species present: blue grama (*Bouteloua gracilis*), hairy grama (*B. hirsuta*) and sidoats grama (*B. curtipendula*). Brush density was estimated by counting catclaw mimosa plants on three permanent quadrats 60 m^2 each by plot. Brush density changes (brush mortality) were estimated by difference at each sampling date. Grass density was estimated by counting plants on five 1 m^2 quadrats, randomly selected per plot. Grass height was measured with a tape in all plants within these five quadrats. Plant basal cover was estimated in the same quadrats by individually measuring the basal area of each plant. Forage production was estimated by clipping forage on 20 subsamples of 1 m^2 quadrats per plot. Forage samples were taken to the University of Sonora Laboratory and weighted after they were dried at 60 ^oC in an air forced oven for 72 hours. All variables were measured during 2005, the year of herbicide application and at years 3, 5 and 10 following treatment application. Plots remained excluded from cattle grazing and small lagomorphs from 2005 to 2014. The experimental design was a Randomized Complete Block. All data was analyzed by ANOVA ($P \leq 0.05$), and means were compared by Duncan´s Multiple Range Test.

Results and Discussion

Precipitation was close to the long term mean during the study period (425 mm). There were 6,560 plants/ha of catclaw mimosa in 2005, 95.5% of which were controlled by the end of 2007. New mimosa seedlings emerged and died shortly during the summer rainy seasons of 2005 to 2009 on herbicide treated plots. A severe chlorosis followed by intensive total plant defoliation was evident on all new emerging plants. Most seedlings emerging during the summers of 2010 to 2014, on tebuthiuron treated plots survive herbicide damage. By the summer of 2014 an average of 2,085 new plants/ha was recorded in chemically treated plots, while plant densities remained similar ($P \leq 0.05$) over time in the untreated checks. Chemically treated plots recover 31.8% of the original brush density populations during the last five years of evaluation. Results show that tebuthiuron is an effective herbicide for catclaw mimosa control during the first five years but additional brush control practices may be required for long-term plant control. These results agree with Morton *et al*.

(1990), which reports significant mortality of most brush species in the Chihuahuan and Sonoran deserts. Similar results are reported by McGinty *et al*. (2009), in Texas. Brush density increases on tebuthiuron treated plots 5 to 10 years following herbicide application may be due to herbicide disappearance enhanced by plant removal, lixiviation and runoff. Tebuthiuron persistence in soils is affected by precipitation, soil clay and organic matter and declines over time (Emmerich *et al*., 1984; Duncan and McDaniel, 2009). Half-life of tebuthiuron in soils is three to four years (Emmerich *et al*., 1984; Morton *et al*., 1990).

Plant density of main grass species significantly ($P \leq 0.05$) increased from 2.8 to 8.9 plants/m^2 on herbicide treated plots (Table 1), but grass density was very similar ($P \geq 0.05$) over time in the controls. Plant height was similar over time across all treatments and varied from 63.5 to 91.5 cm. Grass basal cover was 5.2 to 10.4% greater ($P \leq 0.05$) on herbicide treated plots as compared with the untreated checks. Although total forage production has been 0.295 to 1.185 t D.M./ha greater ($P \leq 0.05$) during all years on herbicide treated plots (Table 1), forage increase differences tend to be less dramatic over time. Most significant changes ($P \leq 0.05$) in forage production occurred five years following herbicide application. Annual forage production in the controls varied from 0.215 to 0.387 t D.M/ha during the study period (0.265 t/ha average). Total forage production increases on herbicide treated plots during the last five years were about one fifth of the production obtained during the first five years following herbicide application. Results in this study show that brush competition reduction significantly increases forage production in short grass prairies as indicated by (McDaniel and Duncan, 1995; Morton *et al*., 1990). However, forage increases may be only temporal and productivity will tend to balance over time as soon as new plants reinvade the treated areas (Morton *et al*., 1990; McGinty *et al*., 2009). Although, in this study tebuthiuron residues were not measured in soils, Emmerich *et al*. (1984), and Morton *et al*. 1990), suggest no significant levels of the herbicide 4 years after its application in rangelands. When brush density increases after tebuthiuron application, a new plant control strategy may be selected to increase forage productivity.

Table 1: Grass density, height, basal cover and forage production at the time of treatment and 3, 5, and 10 years following tebuthiuron application at 1.5 kg a.i/ha for catclaw mimosa control on short grass prairies at Cananea, Sonora, Mexico.

Variable	**Year of herbicide application**			
	2005	**2007**	**2009**	**2014**
Plant density (pl/m^2)	9.3 c*	15.5 ab	18.2 a	12.1 b
Plant height (cm)	63.5 a	82.5 a	91.5 a	84.6 a
Basal cover (%)	6.9 c	12.1b	17.3 a	13.4 b
Forage production (t/ha)	0.265 c	1.39 a	1.45 a	0.56 b

* For each variable means flowed by similar letter are not significantly different ($P \leq 0.05$; Duncan).

Conclusion

Short grass prairies infested with catclaw mimosa require brush control treatments to restore productivity. Tebuthiuron at rates of 1.5 kg a.i. /ha will effectively control catclaw mimosa and produce 1.185 t/ha of additional forage annually, five years following herbicide application. Forage increases 5 to 10 years following brush control were less significant as new seedlings reinvade herbicide treated plots. Ten years of grazing protection do not cause significant vegetation changes and will not enhance forage production increases.

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