Burning and 2,4,5-T on Post and Blackjack Oak Rangeland in Oklahoma

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The controlling of brush and weeds for increasing grass production of woodland pastures, open grassland and meadows is a major problem in Oklahoma. Burning has been advocated for improving grazing by suppressing brush and weeds; however, this practice, when not used correctly, kills the desirable grasses and forbs, and may not reduce the brush.

Uncontrolled burning often destroys the vegetative cover and thus allows increased runoff of water and soil losses. Water and soil loss studies reported by Elwell et al. (5) for an 8 year period showed 12 and 31 times more losses respectively on woodland areas burned in early spring than on adjacent unburned areas.

Annual burning of rangeland was found to reduce the water infiltration rate into the soil in Kansas (Bieber and Anderson 2, Hanks and Anderson 8). Fall burning caused the greatest reduction while burning just before the beginning of new spring growth caused the least. Reduction in water infiltration rate was shown to reduce soil-water content in the lower soil profile (McMurphy and Anderson 10). In dry years this caused a critical shortage, but the effect in wet years was negligible because the vegetation made maximum growth without demand on the deeper soil moisture. The recommended date for burning was May 1 which was just before new green growth began.

Increased steer gains averaged 26 pounds per steer as a result of annual burning on May 1 (12). An early spring burning date (March 20) increased the steer gains by 17 pounds per steer even though the range condition deteriorated during a 17-year study.

Controlled burning suppressed such undesirable species as Kentucky bluegrass (*Poa pratensis*), decreased Japanese brome (*Bromus japonicus*), and eliminated some buckbrush (*Symphoricarpos orbiculatus*) in the Kansas studies (10). In an Oklahoma study western yarrow (*Achillea lanulosa*), western ragweed (*Ambrosia psilostachya*), Louisiana sagewort

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(*Artemisia ludoviciana*), blackeyedsusan (*Rudbeckia hirta*), daisy fleabane (*Erigeron strigosus*), and prairie threeawn (*Aristida oligantha*) were controlled to some extent by burning (7).

Accidental fires too long before spring grass growth begins or when the soil was dry often caused the weeds to increase. In Kansas burning earlier than five weeks before start of new spring vegetative growth caused some increase in weeds (1). An August wildfire when soil was very dry in the Wichita Mountains resulted in an increase in western ragweed and horseweed (*Conyza canadensis*) (11).

Controlled burning has been tested for sprout control of shrub live oak (*Quercus turbinella*) in Arizona (9). Burning did not cause a significant increase in numbers of sprouts nor did it affect the weight of total sprouts produced. Penfound (11) observed three years after a Wichita Mountain wildfire that 14 percent of the post oak (*Quercus stellata*) and 70 percent of the blackjack oak (*Q. marilandica*) trees produced sprouts. None of the red cedar (*Juniperus virginiana*) sprouted.

Ranchers who spray their brushland with 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) sometimes burn the areas to remove the dead wood. Elwell (6) found that dead post and blackjack oaks, following 2,4,5-T treatments, break into small segments and fall to the soil over a period of 3 to 5 years. The main trunk of dead trees remained upright for 7 to 10 years. He found that the standing dead trees did not appear to interfere with grazing, management of livestock or production.

The objectives of these studies were to determine the effects of herbicides plus controlled burning upon the soil moisture level and on control of woody plants.

Methods

Experiment 1 was established on a Darnel-Stephenville soil located 7 miles west of Stillwater, Oklahoma, on a savannah range site. The experiment, a randomized complete block with four replications, consisted of six treatments: (1) untreated check, (2) annual spring burning, 1963-1968., (3) spring burning in 1963, 1965, and 1968, (4) sprayed and injected with 2,4,5-T in 1963 and 1964, (5) sprayed and injected with 2,4,5-T in 1963, then burned in 1964 and 1968, and (6) burned in 1963, sprayed and injected with 2,4,5-T in 1964, and burned in 1968. The 2,4,5-T was applied at 2 lb/A with a mist blower for understory brush control. A concentration of 16-lb 2,4,5-T in 100 gallons total volume of diesel oil and herbicide was applied. All trees 3-inches or larger in diameter were injected with 2,4,5-T. A Little[1] injector was used with 5-7

[1]A Little Tree Injector was the trade name of equipment used. Reference to the above trade name injector is made with the understanding that discrimination is not intended and endorsement by the Oklahoma State University or the United States Department of Agriculture is not to be implied.

millileters of an ester of 2,4,5-T in diesel oil per injection. The injections were spaced 1 per inch of tree diameter (about 1 per 3 inch circumference) near the soil. Burning was done in early April just before new grass growth began.

Sprouts of woody species in Experiment I were counted in a 6 x 100-ft. belt transect in 1968. Herbacious vegetation was evaluated in 1963 and 1968 using the point centered quarter method (3).

A neutron moisture probe was used to determine soil moisture in two replications.

Experiment 2 was on a Darnel-Stephenville soil 6 miles west of Stillwater. The treatments, in a randomized complete block in four replications were: (1) untreated check, (2) 2,4,5-T, (3) burning, and (4) burning plus 2,4,5-T. The herbicide treatments were applied in 1965 using the mist blower and injector (as described in Experiment 1), and retreated in 1966. Burned plots were burned in early April 1965 and 1967.

Stems of woody species were counted in July for 3 years from a 12 x 40-ft. belt transect, and frequency of occurrence of herbacious vegetation in 50 one-foot quadrats was determined in each plot in July each year. Moisture was determined in three replications at monthly intervals, and occasionally bimonthly, with the neutron moisture probe during the growing season.

The woody vegetation of both areas was characterized by a dominant overstory of blackjack and post oaks with lesser amounts of dogwood (*Cornus* spp.), sumac (*Rhus glabra*), grape (*Vitus* spp.), buckbrush, hackberry (*Celtis* spp.) and blackberry (*Rubus* spp.). The major decreaser grasses in sparse stand were big bluestem (*Andropogon gerardi*), little bluestem (*A. scoparius*), Indiangrass (*Sorghastrum nutans*) and switchgrass (*Panicum virgatum*). Other grasses present were the rosette panicums (*Panicum oligosanthes* and *P. scribnerianum*), broomsedge (*Andropogon virginicus*), fall witchgrass (*Leptoloma cognatum*), purpletop (*Tridens flavus*), and foxtails (*Setaria* spp.). A detailed description of soils and vegetative cover of areas used for Experiments 1 and 2 was previously made by Dwyer and Santelmann (4).

Results and Discussion

A significant increase occurred in the soil moisture in plots treated with 2,4,5-T to control brush (Table 1 and 2). This was particularly shown in Experiment 1. In Experiment 2 there was no difference between 2,4,5-T treated and untreated plots the first year, but significant increases in soil moisture were detected in all 2,4,5-T treated plots the second and third year. Burning significantly increased soil moisture in

the burned plots when compared with the untreated in Experiment 2, but not in Experiment 1.

Table 1. Soil Moisture As Influenced by Burning and 2,4,5-T Treatments of Scrub Oak Woodland, Experiment 1.[1]

Treatments	Inches of water in the soil[1]			
	Spring	Summer	Fall	Average[2]
Untreated check	9.7	8.3	8.9	9.0 c
Annual spring burning	9.1	8.0	8.6	8.6 c
Spring burn, 1963, '65 and '68	9.2	8.1	9.2	8.8 c
2,4,5-T in 1963 and '64	13.6	12.3	12.9	12.9 a
2,4,5-T in 1963; burn '64 and '68	12.6	9.5	10.4	10.9 b
Burn 1963 and '68; 2,4,5-T in '64	13.0	11.3	10.4	11.6 b

[1]Average of six years (1963-1968), soil moisture in the top 48″ of soil.
[2]Averages not followed by the same letter are significantly different (.5 level of probability).

Table 2. Soil Moisture As Influenced by Burning and 2,4,5-T Treatments of Scrub Oak Woodland, Experiment 2.

Reading Date	Inches of water in the top 30″ of soil[1]			
	Check	Burn	2,4,5-T	Burn + 2,4,5-T
1965:				
April 15	8.9	8.9	8.7	8.7
May 5	8.0	8.0	7.8	7.7
March 12	8.6	8.7	8.2	8.4
June 11	5.8	6.4	6.0	5.8
July 2	5.5	6.7	6.9	6.9
July 15	4.6	5.2	6.4	6.4
Sept. 24	7.2	7.4	8.0	8.2
Average	6.9 a	7.3 a	7.4 a	7.4 a
1966:				
May 4	8.0	9.2	11.9	11.1
June 8	7.2	7.6	8.8	8.5
June 23	4.9	5.4	7.4	7.3
July 28	7.2	7.6	8.1	8.1
Aug. 16	4.5	4.8	5.7	5.8
Aug. 27	5.8	6.2	6.7	7.1
Average	6.3 c	6.8 b	8.1 a	8.0 a
1967:				
Feb. 24	6.0	6.9	7.7	7.6
April 6	5.6	7.0	8.2	7.8
April 27	6.9	7.8	8.9	8.6
May 18	8.2	8.7	9.1	9.1
June 8	7.0	7.3	8.4	8.2
June 26	8.1	8.6	9.5	9.4
July 7	6.8	7.4	8.8	8.7
July 31	5.2	5.7	7.3	7.7
Aug. 28	3.1	3.4	3.4	3.8
Sept. 13	3.6	4.2	4.9	5.0
Average	6.0 c	7.0 b	7.6 a	7.6 a

[1]Yearly averages followed by the same letter are not significantly different (.05 level of probability).

Burning tended to promote sprouting of blackjack oak, post oak, dogwood and sumac (Table 3). However, very few sprouts of post oak and blackjack oak lived to reach ½-2 inches diameter. Fire annually, for 6 years, and burning in 1963, 1965 and 1968 kept the sprouts of oak from developing into larger plants. While no dogwood occurred in the plots burned, in 1963, 1965, and 1968 its abundant sprouting in plots annually burned and plots treated with 2,4,5-T plus burning indicated that dogwood sprouting was encouraged by fire. The use of 2,4,5-T tended to decrease sprouting of blackjack oak if used in years before burning. It also reduced the number of oak sprouts that reached ½ to 2 inches in diameter (Table 3).

In Experiment 2 the number of oak sprouting increased in burned plots but the number of larger oak did not. This seemed to be a trend in the three years of observation. When used without burning, 2,4,5-T caused a greater decrease in the small oaks. It completely eliminated the sumac, and most oaks over 5-ft. tall (Table 4).

The number of herbaceous plants/yd^2 was determined at the beginning of the experiment in 1963 and also in 1968 in Experiment 1 (Table 5). The bluestems increased most in plots that were both burned and treated with 2,4,5-T but decreased in the untreated. Burning or spraying 2,4,5-T separately moderately increased these species. Scribner panicum was the dominant grass in all 2,4,5-T plots. There was some evidence that sedges might be favored with fire, and western ragweed by burning and 2,4,5-T.

One of the most striking vegetative changes in Experiment 2 occurred the second year. Horseweed dominated many burned plots and grew to heights of six feet or more the first year following treatment. Ecologically this annual weed seems to thrive on disturbed areas such as those

Table 3. Number of Basal and Root Sprouts in 1968 from Various Woody Species As Influenced by Burning and Herbicide Treatments, Experiment No. 1.

	Numbers in 6 x 100 transect						
	Blackjack oak		Post oak			Dog-	
Treatments	Total	½-2"[1]	Total	½-2"[1]	Sumac	wood	Grape
Untreated	25	11	105	42	30	15	5
Burned annually	80	14	110	12	94	55	0
Burned in 1963, '65, '68	65	11	208	19	100	0	3
2,4,5-T, 1963 & '64	15	14	80	25	17	0	0
2,4,5-T, 1963; burned '64, '68	5	0	150	0	102	199	0
Burned 1963, & '68; 2,4,5-T in '64	31	1	190	9	52	25	0

[1]Number of sprouts ranging in diameter from ½ to 2 inches at the base.

Table 4. Numbers of Scrub Oak and Sumac Stems Within a 12 x 40 Foot Transect After Various Burning and 2,4,5-T Treatments. Experiment 2.

Year	Treatment			
	Check	Burned	2,4,5-T[2]	Burned + 2,4,5-T[3]
	Post and blackjack oak less than 5 feet tall			
1965	92	141	21	40
1966	122	183	45	96
1967	98	173	38	45
	Post and blackjack oak over 5 feet tall			
1965	14	15	10	5
1966	13	16	3	1
1967	15	15	4	1
	Sumac			
1965	6	15	0	0
1966	6	9	0	0
1967	3	20	0	0

[1]Burned April 1, 1965 and '67.
[2]Treated with 2,4,5-T June 15, 1965. Retreated June 1, 1966.
[3]Burned April 1, 1965. Treated with 2,4,5-T June 15, 1965 & '66.

Table 5. Change in Stems per yd^2 of Herbaceous Vegetation from 1963 to 1968 Due to Burning and 2,4,5-T Treatments. Experiment 1.

Treatment	Big bluestem	Little bluestem	Rosette Panicums	Purple Top	Sedges	Weeds		
						Western Ragweed	Ironweed	Others[1]
Untreated Check	—12	— 5	6	0	0	—11	0	— 4
Annually burned 1963-'68	12	20	10	2	2	— 1	1	15
Burned irregularly 1963, '65, & '68	10	4	14	— 8	14	1	—7	2
2,4,5-T in 1963 & '64	22	1	60	0	0	7	0	6
2,4,5-T then burned in 1964 & '68	31	36	73	19	101	14	0	30
Burned, 1963 & '68; 2,4,5-T, 1964	43	43	30	3	35	15	2	56

[1]Sunflower, horseweed, pokeberry and croton.

created by burning or 2,4,5-T. These annual broadleaf weeds quickly give way to the perennial grasses. This same phenomena with horseweed was observed in the wildfire areas at the Wichita Mountains (11). The rosette panicums were favored by fire and were present at much greater frequencies on burned plots. Big and little bluestem, indiangrass and switchgrass were not encouraged by burning with 2,4,5-T, but there was a steady increase of these species in plots receiving 2,4,5-T only.

Forage yields were collected from Experiment 1 in September 1968. The untreated plots, and burned plots without 2,4,5-T produced 300-500 lb/acre. Thus, without the 2,4,5-T treatments there was little grass fuel available for the fire. Forage yield from all areas treated with 2,4,5-T was approximately 2000 lb/acre. These results are similar to those reported by Elwell (6). On the 2,4,5-T treated areas most of the dead trees had fallen to the ground by 1968. Many of these fallen trees burned with such intensity that perennial grasses were destroyed in their immediate vicinity. This resulted in disturbed areas where weeds such as annual sunflower, horseweed and pokeberry thrived. These resulted in a low grass yield with a high weed yield on the burned plus 2,4,5-T combination plots.

Table 6. Frequency (percent) of Occurence of Dominant Species in ft.[2] Quadrats as Influenced by Treatments. Experiment 2.

Year	Treatments[1]			
	Check	Burn	2,4,5-T	Burn + 2,4,5-T
		Decreaser Species[2]		
1965	41	44	41	26
1966	43	53	53	28
1967	38	48	61	32
		Horseweed		
1965	1	0	4	2
1966	1	17	50	50
1967	0	0	1	3
		Rosette Panicums		
1965	16	65	11	47
1966	17	64	25	66
1967	28	51	29	72

[2]Big bluestem, little bluestem, Indiangrass, and switchgrass.

Summary

Burning alone without herbicide control of the larger trees contributed little to woody plant control. It increased root sprouting of several species such as blackjack oak, sumac and dogwood. Without herbicides there is little fuel for an effective burn.

Where 2,4,5-T was used the yield of herbacious vegetation increased and provided more fuel for fire. Fire exerted some control over post and blackjack oak sprouts in keeping sprouts from developing large stems, although the small sprouts were present in greater numbers.

Sumac and dogwood sprouting were encouraged by burning.

An important increase in stand of decreaser grass species occurred only in plots treated with 2,4,5-T. Burning alone or in combination with 2,4,5-T resulted in a slight increase in grasses.

The combined effect of herbicides plus fire resulted in an immediate increase in annual weeds. These weeds were controlled by the perennial grasses in succeeding years. Plots which were burned several years after brush control by 2,4,5-T had many tree branches and trunks on the ground. A long hot fire resulted from these. Thus some perennial grass vegetation was killed and the result was an invasion of weeds.

Soil moisture was significantly increased whenever 2,4,5-T was applied to the plots. Woody species are apparently greater users of soil moisture.

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