Literature Review of Management Practices for Smooth Sumac *(Rhus glabra)*, Poison Ivy *(Rhus radicans)* and Other Sumac Species

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Introduction

This report summarizes management practices used for members of the sumac family (Anacardiaceae). Although sumacs are native North American taxa, they can present distinct problems to managers of natural areas. In Indiana, one of the few remaining sites of Kankakee mallow (*Iliamna remota*), a federally endangered plant, is threatened by shading from smooth sumac (*Rhus glabra*). Individual sumacs at this site reach a height of seven feet, are two inches in basal diameter, and form a dense canopy. The shading effects on *I. remota* have been demonstrated in field and laboratory experiments. In this instance, management is complicated by concern about the effect certain treatments (e.g. prescribed burning, herbicides) would have on the rare plants (Rex Boner, pers. comm.).

Sumacs also can present problems in wetlands, prairies, and rangeland. Armstrong and Heston (1982) describe the invasion of a bog natural area by woody species including poison sumac (*R. vernix*). Sumac encroachment in the bog has been encouraged by nitrate - and orthophosphate - laden runoff from adjacent farmland (Whitney, 1981) and is shading out characteristic bog species (e.g. *Sarracenia purpurea, Sphagnum magellanicum,* and *Drosera rotundifolia*) (Armstrong and Heston, 1982). Aldous (1929, 1934) discussed the spread of *R. glabra* in native prairies in Kansas. Sumac dominance in rangelands has been shown to increase under heavy grazing pressure (Hetzer and McGregor, 1951) and under prescribed burning management (Anderson et al., 1970; Owensby and Smith, 1973).

Range and Habitat

The range and characteristic habitat of nine *Rhus* spp. is given in Table 1. Descriptions of any of these are available in various taxonomic keys (e.g. Britton and Brown, 1913; Rydberg, 1932; Fernald, 1950). Many sumacs, including *R. copallina* (shining sumac), *R. typhina* (staghorn sumac), *R. glabra* (smooth sumac), *R. aromatica* (fragrant sumac), and *R. microphylla* (little-leaf sumac), are characteristically found in open woodlands, abandoned fields, fence rows, and sandy well-drained soils (Britton and Brown, 1913; Swink, 1974). *R. glabra* is also found along with *R. trilobata* (skunkbush sumac) on rocky ridges, ravines, and in thickets on the Great Plains (Aldous, 1934; Budd and Best, 1969). *R. vernix* (poison sumac) is found in wooded swamps, wetlands, and bogs (Britton and Brown, 1913; Swink, 1974). The two varieties of poison ivy, *R. radicans radicans* and *R. radicans rydbergii*, are found in shaded woods and ravines, with the latter also found in open grasslands on the Great Plains (Rydberg, 1932; Budd and Best, 1969; Swink, 1974).

Table 1. Members of the Family Anacardiaceae (Sumacs) Discussed in This Report, Their Habitat and Range.

SPECIES	COMMON NAME	HABITAT	RANGE
Rhus copallina	Shining, Dwarf, Winged or Mountain Sumac	Dry soil, open woods	Me.-Mn.-Tex.-Fla.
Rhus typhina (*R. hirta*)	Staghorn Sumac	Dry, rocky soil, open woods and fields	N.B.-Mn.-Miss.-Ga.
Rhus glabra	Smooth Sumac	Dry soil, rocky ridges, prairie ravines, woods	N.S.-Man.-N.D.-Kan.-Fla.
Rhus aromatica (*R. crenata*, *R. canadensis*)	Fragrant Sumac	Sandy soil, dunes, rocky areas, woods	Vt.-Mn.-Kan.-La.-Fla.
Rhus trilobata (*Schmaltzia trilobata*	Skunkbush Sumac	Hills, range, grassland	Sask.-Mo.-Tex.-Cal.-Wash.
Rhus vernix (*Toxicodendron vernix*)	Poison Sumac	Swamps, gobs, wetlands	R.I.-Mn.-La.-Fla.
Rhus radicans radicans (*Toxicodendron radicans*)	Poison Ivy	Thickets, open woods, fencelines	N.S.-Man.-Kan.-Ark.-Fla.
Rhus radicans rydbergii (*Toxicodendron rydbergii*)	Poison Ivy	Hillsides, open woods, fencelines, prairies	Mich.-Ia.-Kan.-N.M.-Ariz.-Ore.-B.C.
Rhus microphylla	Little Leaf Sumac	Dry soil, open woods	Southeastern United States

Data adapted from Britton and Brown (1913), Rydberg (1932), Budd and Best (1969) and Swink (1974).

Table 2. Food reserves in smooth sumac roots from Flint Hills bluestem range on dates indicated. 1928 to 1932.

Date		Average total starch and sugars in smooth sumac roots
		% of total dry matter
Mar	15	23.28
Apr	10	16.86
May	12	17.87
	23	13.69
Jun	7	9.45
	21	12.92
Jul	2	17.25
	16	17.13
Aug	1	24.23
	14	20.22
	28	19.84
Sep	10	24.71
	24	20.47

FROM: Aldous, 1934.

Table 3. Average stem numbers of smooth sumac and increases or decreases as a result of mowing Flint Hills bluestem range on dates indicated, 1928 to 1932.

Mowing date		Smooth sumac stem number		
			After mowing	
		Before mowing	Increase or decrease	Decrease
		Stems/square rod		%
Apr	27	21	+45	
May	10	86	+48	
	25	75	-34	45
Jun	8	61	-37	60
	10	73	-24	33
Jul	6	94	-28	30
	18	116	-23	19
Aug	1	140	+ 3	
	15	109	+31	
	24	36	+59	
Sep	8	26	+41	
	22	40	+59	
Oct	5	33	+44	

FROM: Aldous, 1934

Management Practices

1. Mowing or Cutting. Aldous (1929) conducted some of the earliest experiments on sumac control. Sample plots were cut at two-week intervals in bluestem prairies near Manhattan, Kansas. The number and heights of stems and the stem and root carbohydrate reserves were measured in each plot before and after cutting. These measurements (see Tables 2 and 3) showed that the carbohydrate reserves for *R. glabra* are minimal immediately after flowering (June 18 in Kansas, July 3 in North Dakota; phenological data from Stevens, 1975). At this time sumac has a reduced capacity to respond to top-removal. The most effective treatment involved a sequence of cutting in early-June, September, and early-June the following year and led to a reduction of 60% in the number of stems (Aldous, 1929). The effect of fall cutting may have been minimal, as carbohydrate reserves in roots and stems are maximum at this time (see Table 3). Launchbaugh and Owensby (1978) recommend mowing two or three successive years in early-June to control *R. glabra* in Kansas.

Kline (1982) conducted a cutting experiment on sand prairie in Wisconsin. A large clone of *R. glabra* was cut and burned in 1978. Half of the clone was allowed to resprout and serve as control. The other half was cut on July 30 and September 6, 1979, and on June 6, 26, and July 17, 1980. Measurements that were taken included the density, length of current year's growth, and total stem height in subplots. In 1981 the stem density in the cut area was 30% of the density in the control area. Stem height in the cut area was one-half that in the control area, but current year's growth was slightly greater. Kline observed that growth of prairie plants was more vigorous in the cut area, and that this will provide a good fuel base for prescribed burning. She also noted that cutting the entire clone may be more effective than the reported results, since it was not possible in this experiment to cut roots between the control and cut areas.

Waller (1982) combined cutting and herbicide treatments on sand prairie in Wisconsin. In one experiment, several 2- to 7- year old stems were cut in June. Of these, nine of 20 stems in a female clone and three of 13 stems in a male clone resprouted the following year, all of these being at least five years old. In August, 15 stems in the male clone were cut and treated with a 25% glyphosate (Roundup) solution. None of these stems resprouted. In a separate experiment, 25 branches in the female clone were defoliated in July and monitored for subsequent branch development. Most of these died. These experiments suggest that a combination treatment of cutting young (less than five year old) stems and cutting and treating older stems with glyphosate may control *R. glabra*.

2. Prescribed Burning. Many sumac species are vigorous resprouters following fire, including: *R. copallina* (Duvall, 1962; Wright, 1972; Anderson, 1982), *R. microphylla* (Wright, 1972), *R. trilobata* (Wright, 1972), and *R. glabra* (Aldous, 1934; Anderson et al., 1970; Owensby and Smith, 1973; Wright, 1972; Launchbaugh and Owensby, 1978).

Aldous (1934) found that *R. glabra* is slow at initiating spring growth, and that stem carbohydrate reserves remain high until early-June. A series of burns were made in 1929 on April 15, April 29, May 8, May 20, and May 28 on prairies near Manhattan, Kansas. The results showed that early spring burns were not very effective at reducing sumac. Burns made on April 29 from 1926 to 1930 (see Figure 1) showed that the net result of early spring burns was to increase the stem density of *R. glabra* relative to the unburned (control) area.

These results have been confirmed elsewhere. Anderson et. al. (1970) reported that *R. glabra* increased in burned pastures but remained approximately constant in unburned pastures. Hulber (1978) observed that late-spring burns kill the tops of *R. glabra* but do not affect carbohydrate reserves, so that shorter but more numerous stems result. Anderson (1982) reported that *R. copallina* resprouted within two weeks following an experimental burn in July in Oklahoma, but that *R. radicans* did not resprout. The role of fire in controlling *R. radicans* has not been fully examined (Anderson, 1982).

The effect of fire on shrubs should be evaluated in relation to the ecological potential of a community (Wright, 1972). In "healthy" (not heavily grazed) grasslands, competition with grasses, drought, and fire may have a cumulative effect that results in preventing shrub dominance. In heavily grazed grasslands, however, the reduced competition between shrubs and grasses may negate any positive effect burning had on shrub control (Wright, 1972). In those cases, vigorous resprouting after burns may result in increased shrub dominance.

Because sumac carbohydrate reserves remain high until the time of flowering, this essentially precludes the use of spring burns as an effective control practice (Aldous, 1934; Launchbaugh and Owensby, 1978). Since sumac reserve carbohydrates are depleted and stored at the same time as warm-season perennial grass dominants, prescribed burns to favor these also have the effect of favoring sumac (Owensby and Smith, 1973).

One interesting possibility is combined cutting and burning treatments. Martin (1981) burned a mesic prairie in Wisconsin during April, 1975. *R. glabra* responded to burning by vigorous resprouting but was controlled by subsequent mowing twice a year, between mid-June and late-August, for two years. During the late summer the prairie forbs provided dense cover, and sumac was further set back by the shade at ground level. Five years after the initial cutting, sumac is uncommon on this prairie and appears to be under control with the present management being only spring burns (Martin, 1981).

3. Chemical Control. Early research with foliar herbicides showed that these were translocated from the leaves of treated plants to the growing points (Mitchell and Brown, 1946). The optimal spray period for any plant can be determined by the maximum gradient of sugars from leaves to roots, as this represents the period when the mature foliage is manufacturing food and moving it to the roots for storage toward next year's growth (Brady and Hall, 1976). Experimental work by Brady and Hall (1976) had helped discover the optimal spray period for a number of plants, including *R. copallina*. For *R. copallina*, sugars rapidly increased in leaves and roots during May through June (see Figure 2). There was a strong gradient from leaves to roots, and herbicides complexed with sugars would move quickly throughout the plant. After July, sugars in both leaves and roots declined, but a continuingly high gradient implied that sumac would be fairly susceptible to late-summer spraying also (Brady and Hall, 1976).

Glyphosate is a non-selective herbicide that has been used to control *R. radicans*. Glyphosate has the advantage of being biodegradable and leaves no soil residue. Mulligan and Junkins (1977) found that the best time for herbicide treatment of *R. radicans* is during flowering (May 30 to June 22 in Wisconsin, Leopold and Jones, 1947). Application rates vary between 1 and 4 lb/A (see Table 4).

R. glabra has been controlled by foliar sprays of Tordon (picloram +2, 4, 5-T, 1:1 solution), 2, 4-D, and triclopyr (see Table 4). Application dates were early- to mid-summer. Triclopyr showed great promise for *R. glabra* control, at rates of 4 to 8 lb/A (Fears, 1980).

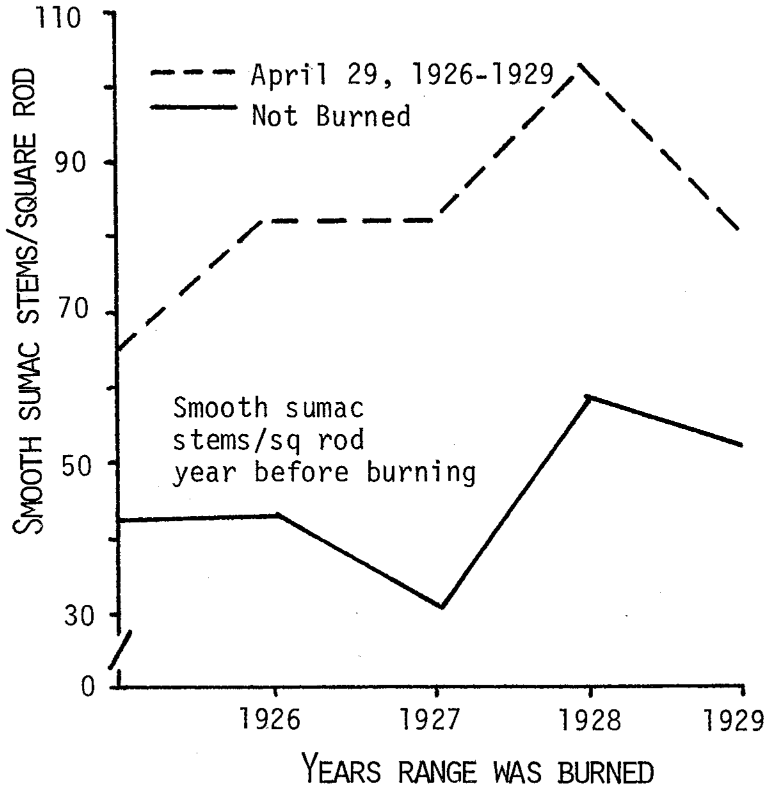

Figure 1. Density of *Rhus glabra* stems on Flint Hills bluestem prairies, showing yearly change in burned and control plots, due to fire management. Burns were on April 29, from 1926 to 1930. From Aldous, 1934.

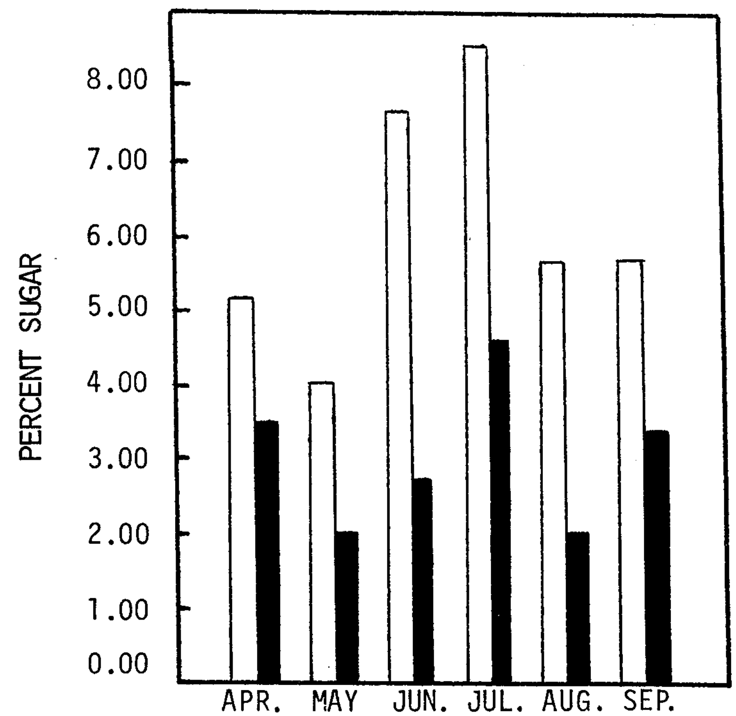

Figure 2. Sugar levels in leaves and roots of the sumacs rated as susceptible to 2,4,5-T sprays. Light bars indicate sugar levels in leaves, solid dark bars indicate sugar levels in roots. From Brady and Hall, 1976.

Picloram and tebuthiuron pellets (individually or in combination) have been used in the southeastern United States to control *R. copallina* and *R. microphylla*. The pellets can be hand-placed at the dripline for individual clones (McLemore, 1977) or broadcast applied (Kitchen and Scifres, 1978). A mixed brush community in southern Texas that had been heavily infested with sumac was studied for response to picloram pellets. Half of the area was mechanically shredded and half left intact. Thirty days later picloram pellets were broadcast from an aircraft. In both areas a high degree of control was obtained (Kitchen and Scifres, 1978).

4. Biological Control. Grazing has been found to favor *R. glabra* dominance in heavily grazed Kansas pastures (Hetzer and McGregor, 1951). Presumably the increased stress grazing places on grasses reduces the competition between these and the shrub community.

Grazing can control *R. radicans* under certain situations. Crouch (1978) demonstrated that under very heavy grazing pressure, cattle will graze *R. radicans* and inhibit fruit and seed production. Release from grazing, however, often results in heavy *R. radicans* infestations (M. Heitlinger, pers. comm.). This would suggest that grazing to control sumac is a stop-gap measure at best.

R. radicans may be vulnerable to biological control. Mulligan and Junkins (1977) summarize research on phytophagous insects found on *R. radicans* in Canada. In particular, the larvae of *Epipaschia zelleri* (Lepidoptera) has been considered very destructive of poison ivy (Criddle, 1927). In the southeastern United States, the larvae of the poison ivy sawfly (*Arge humeralis*, Hymenoptera: Argidae) has been studied as a potential control (Borror et al., 1964; Regas-Williams and Hubeck, 1979). At the present time, however, biological control is still in the research stage.

Summary

Rhus glabra is susceptible to a number of control practices. Cutting in two or three successive years shortly after flowering (late spring-early summer) can control the spread of sumac (Aldous, 1929; Launchbaugh and Owensby, 1978). Kline (1982) demonstrated that cutting five times in a period of two years reduced sumac density by two-thirds compared to a control. Cutting can be used in combination with herbicides or with prescribed burning. Waller (1982) suggests cutting alone to control young (less than 5 year old) stems and cutting and treating with glyphosate to control older stems. Aldous (1934) found that spring burns caused prolific resprouting of *R. glabra* and that fire management is complicated by the need to burn in June or July when sumac carbohydrate reserves are at a minimum. Martin (1981) suggested, however, that combining spring burning with mid-summer mowing could control sumac. Repeated cutting and burning had the additional advantage of restoring prairie plants under the sumac clones, and these served the dual purpose of shading out sumac sprouts and providing a better fuel base for additional burns. If herbicides alone are used, Tordon (0.25 to 0.50 lb/A) or triclopyr (4 to 8 lb/A) have been used successfully (see Table 4).

R. radicans is susceptible to prescribed burning in summer (Anderson, 1982), heavy grazing pressure (Crouch, 1978) or herbicides. Glyphosate (1 to 4 lb/A) in spring or fall has been used to control *R. radicans* (see Table 4). There

Table 4. Summary of Chemical Treatments for various species of sumac (*Rhus*)

SPECIES/HERBICIDE	RATE (lb/A)	DATE	LOCATION	EFFECTIVENESS (% DEFOLIATION)	REFERENCE
Rhus radicans					
Glyphosate	2.0-4.0	early May	n.a.	"control"	Putnam et al., 1974
Glyphosate	1.0-1.5	n.a.	n.a.	"control"	Bing, 1977
Glyphosate	1.0-4.0	Sept.-Nov.	n.a.	40	Skroch, 1978
Silvex, Ammonium Sulphamate, Sodium Chlorate + Sodium Borate, 2,4-D + Dicamba	n.a.	n.a.	W. Canada	"control"	Mulligan and Junkins, 1977
Rhus glabra					
2,4,5-T + picloram (Tordon) (1:1)	0.25-0.50	June-July	n.a.	90-100	Churchill et al., 1976
2,4-D	1.0	June	n.a.	30-100	Churchill et al., 1976
triclopyr	4.0	n.a.	ME., NH., VA., PA., WI., MN., IN., KS., CO., CA., OR., WA.	100	Fears, 1980
	8.0	n.a.	ME., NH., VA., PA., WI., MN., IN., KS., CO., CA., OR., WA.	100	Fears, 1980
Rhus copallina					
2,4,5-T	n.a.	May-July	Louisiana	96	Brady, 1971
Picloram	6.0	March	S.E. U.S.	92	McLemore, 1977
	8.0	March	S.E. U.S.	100	McLemore, 1977
	10.0	March	S.E. U.S.	97	McLemore, 1977

Table 4, continued

SPECIES/HERBICIDE	RATE (lb/A)	DATE	LOCATION	EFFECTIVENESS (% DEFOLIATION)	REFERENCE
Tebuthiuron (small pellets)	6.0	March	S.E. U.S.	100	McLemore, 1977
	8.0	March	S.E. U.S.	100	McLemore, 1977
	10.0	March	S.E. U.S.	100	McLemore, 1977
Tebuthiuron (large pellets)	6.0	March	S.E. U.S.	99	McLemore, 1977
	8.0	March	S.E. U.S.	78	McLemore, 1977
	10.0	March	S.E. U.S.	100	McLemore, 1977
Picloram + Tebuthiuron	6.0	March	S.E. U.S.	73	McLemore, 1977
	8.0	March	S.E. U.S.	100	McLemore, 1977
	10.0	March	S.E. U.S.	100	McLemore, 1977
Rhus Typhina					
Triclopyr	4.0	n.a.	ME., NH., VA., PA., WI., MN., IN., KS., CO., OR., WA.	100	Fears, 1980
	8.0	n.a.	ME., NH., VA., PA., WI., MN., IN., KS., CO., OR., WA.	100	Fears, 1980
Rhus microphylla					
Picloram	1.0-2.0	May	S. Texas	91-100	Kitchen and Scifres, 1978
Rhus spp.					
Triclopyr	3.0-6.0	n.a.	MN., AL., LA., AR.	"highly susceptible"	Byrd et al., 1977
Velpar	4.0-16.0	July	MS., AR., GA.	95-100	Romney et al., 1976

are possible biological control agents, but more research is needed on these.

Sumac control in the southeastern United States (*R. copallina, R. typhina, R. microphylla*) has mostly focused on use of herbicides. Of these, triclopyr as a basal spray (4 to 8 lb/A), tebuthiuron pellets or picloram pellets (6 to 10 lb/A) applied in spring have been most successful (see Table 4).

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