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Influence of Repeated Annual Burning on a Medusahead Community¹

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Highlight

Three annual burnings near Alturas, California, did not result in a decrease in medusahead. Medusahead increased and downy brome decreased after burning. No changes were observed in perennial grass populations in relation to burning. Changes in densities of annual grasses due to burning apparently were not a result of destroying caryopses; but probably were caused by alteration of the seedbed environment.

Fire is usually considered a low cost method of obtaining range improvement. The use of fire has been given considerable attention in the control of medusahead (*Taeniatherum asperum* (Sim.) Nevski) because many areas infested with this grass are too rocky and steep for the application of other treatments. In general, burning medusahead stands has resulted in more desirable plant communities in cis-montane California (Furbish, 1953; Murphy and Lusk, 1961; Major et al., 1960; McKell et al., 1962), but burning in the intermountain area has resulted in continued medusahead dominance (Sharp et al., 1957; Torell et al., 1961).

On the XL Ranch near Alturas, California there are excellent stands of native perennial grasses which have been repeatedly burned because of their proximity to a steep railroad grade. Adjacent sites with

similar topography and soils but which have not been burned recently (a highway or stream separates them from the railroad), support dense stands of medusahead.

Our purpose was to determine the influence of repeated annual burning on medusahead versus perennial grass dominance of plant communities.

Methods

A portion of a large block of native range infested with medusahead was fenced in 1966. The vegetation was mostly medusahead with a small amount of downy brome (*Bromus tectorum* L.) intermixed. Remnant perennial grasses present were bluebunch wheatgrass (*Agropyron spicatum* (Pursh) Scribn. and Sm.), squirreltail (*Sitanion hystrix* (Nutt.) J. G. Smith), Sandberg bluegrass (*Poa secunda* Presl.), and June-grass (*Koeleria cristata* (L.) Pers.).

We burned three 1-acre blocks at the XL Ranch on August 7, 1968. Blocks were burned in early morning, the only time when a burning permit was available for that area. We burned into the prevailing wind with a rate of fire advance estimated at 2 to 3 ft/minute. McKell et al. (1962) determined that this type of fire was most effective for medusahead control. At time of burning, medusahead caryopses were in the late soft dough stage. The heads were nodding and the plants were a golden brown color. This is the stage of phenological development

when medusahead caryopses are most susceptible to fire damage (McKell et al., 1962). At this stage the caryopses will have about 10% moisture content and the litter considerably less. Very few caryopses had dehisced from the medusahead inflorescences.

Two of the blocks were reburned on July 29, 1969 and one block was burned a third time on August 5, 1970. An additional block was burned for the first time in 1969. Second and third burnings were conducted at the same time of day and at the same stage of phenological development of medusahead. However, with the second and especially the third consecutive burnings, it was necessary to burn with the prevailing wind in order to carry the fire.

In 1970, we burned a stand of intermediate wheatgrass (*Agropyron intermedium* (Host) Beauv.). The intermediate wheatgrass stand had been established in a medusahead infested area by a mechanical fallow (Young et al., 1969b). Medusahead and downy brome had reinvaded between the rows of perennial grass. Intermediate wheatgrass flowers were approaching anthesis at the time of burning.

In all years we divided the large treatment blocks into four subplots for sampling. We employed frequency sampling using the step-point method of Evans and Love (1957). In addition, in each subplot, we clipped four 9.6-sq. ft plots after determining the projected herbage cover of the species present.

We collected 10 one-sq. ft samples of litter down to mineral soil and of soil in 1-inch increments to 3 inches before and after burning. These samples were mixed with vermiculite. Germination tests of the samples were conducted in the greenhouse using methods developed by Young et al. (1969a).

Results and Discussion

The first time a stand of medusahead was burned a slow burning fire was easily achieved by burning into the wind. Care had to be

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taken not to burn with the wind the first year, because the fire would have advanced very rapidly. The height of the flame (1.5 ft) and the rate of advance (2 to 3 ft/min) compared favorably with the optimum suggested by McKell et al. (1962) for burning medusahead.

By the second year, it was very difficult to get the fire to carry in the vegetation growing on the site which had been burned the previous year even though herbage production was higher on the plots burned the previous year (Table 1). Resistance to burning was caused by an increase in poverty weed (*Iva axillaris* Pursh) and a decrease in litter (Table 2). Poverty weed is a creeping root-stocked perennial with succulent green leaves in mid-summer. It is virtually fire proof and would make excellent cover for firebreaks.

The first year fire did burn the current year herbage and scorched the surface of old material that was already in contact with the soil. There was a very heavy concentration of pronghorn antelope (*Antilocapra americana*) on the plots during the winter and the resulting

Table 1. Herbage yield (lb./acre) from 1968 through 1970 in relation to burning treatments.^a

Year of herbage yield	Control	Years of burning		
		1968	1968, 69	1968, 69, 70
1968	1400	—	—	—
1969	1160 b	1450 a	—	—
1970	1180 b	1080 b	1520 a	—
1971	1540 b	1600 b	1730 a	1800 a

^a Means followed by the same letter are not significantly different at the 0.05 probability level as determined by Duncan's Range Test. All comparisons are made horizontally.

trampling helped in the disappearance of old litter. However, it appeared that scorched litter decomposed much more rapidly than "litter" on adjacent unburned plots. For the second and third burnings, there was not fragmented litter under the current year's herbage which made burning more difficult.

We have previously demonstrated in annual grass communities that herbage production is increased with reduced density (Young and Evans, 1972). This density reduction apparently accounted for part of the increase in production obtained with burning (Table 1). Unfortunately, the increase in production was composed of medusa-

head and poverty weed (Tables 2 and 3), neither of which are desirable forage species. By 1971 herbage production on the plots burned in 1968 was not markedly higher than on the control plots.

Repeated burning did not markedly influence the perennial grasses (Tables 2 and 3). We have had a very short time base in which to measure any increase in perennial grasses, but failure to obtain any reduction in medusahead makes it improbable that there would be any improvement in the density of perennials.

Burning annual grasses did not appear detrimental to the perennial grasses. The intermediate wheat-grass stand we burned in 1970 produced 2250 lb./acre of herbage in 1971.

There was a significant increase in medusahead after two and three annual burnings (Table 3). When a stand was burned once there was an initial increase of medusahead, but after three years the cover of medusahead had returned to a level not markedly different from the unburned control. The cover of downy brome was reduced by repeated burning. Poverty weed greatly increased after one and two annual burnings, but was reduced by the third burning.

Downy brome is about two weeks ahead of medusahead in phenological development at this location. The caryopses of downy brome were shattered before burning. However, downy brome decreased with repeated burning (Tables 2 and 3), and the first burning did not destroy sufficient caryopses of downy brome to account for the resulting

Table 2. Frequency of plants, litter, and bare ground in relation to repeated annual burning.

Years of sampling and treatment	Medusa-head	Downy brome	Perennial grass	Poverty weed	Other forbs	Litter	Bare ground
1968							
Pretreatment	71	9	7	0	1	12	0
After burning	0	0	9	0	0	84	7
1969							
Burned 1968	81	2	5	7	0	0	5
Reburned 1969 (after burning)			9			0	91
Control	68	11	7	0	4	9	1
1970							
Burned 1968, 69	74	1	4	19		0	2
Burned 1968	82	4	6	5		0	3
Control	64	10	8	0	3	14	1
1971							
Burned 1968, 69 and 70	76	0	6	14	0	0	4
Burned 1968, 69	78	4	3	12	2	1	0
Burned 1968	80	8	4	3	2	3	0
Control	70	6	5	2	5	10	2

Table 3. Projected herbage cover (%) in relation to repeated burning treatments.¹

Years of sampling and treatment	Cover					
	Medusa-head	Downy brome	Perennial grass	Poverty weed	Perennial forbs	Alien forbs
Control-unburned						
1968	65	15	5	5	1	4
1969	54	7	3	1	1	3
1970	67	11	3	4	1	4
1971	60	16	2	3	2	1
Mean	62 b	12 a	3 a	3 b	1	3
Burned 1968						
1968 (Pretreatment)	68	13	4	4	2	4
1969	80	2	4	10	0	2
1970	79	8	3	3	0	2
1971	68	10	2	1	2	2
Mean	74 b	8 ab	3 a	5 ab	1	3
Burned in 1968 & 69						
1970	81	1	2	11	0	0
1971	76	6	3	6	2	1
Mean	79 ab	4 b	3 a	9 a	1	0.5
Burned in 1968, 69 & 70						
1971	86 a	2 b	2 a	2 b	0	0

¹ Means followed by the same letter are not significantly different at the 0.05 probability level as determined by Duncan's Range Test. All comparisons are made vertically.

decrease in this species (Fig. 1). Reduced production of downy brome the first year after burning—coupled with second year burning effects—severely depleted the downy brome population (Fig. 2). Samples before and after the third burn (1970) revealed a further depletion of reproductive potential of downy brome.

Before the initial burn there were some medusahead caryopses in the litter and soil that would germinate at relatively high temperatures (about 20 to 30 C in the greenhouse) (Fig. 1). These caryopses were destroyed in the burn leaving only caryopses which apparently had afterripening requirements that prevented germination at high temperatures (Fig. 1). Medusahead caryopses have severe temperature dependent afterripening requirements which prevent germination at tem-

peratures above 10 C for about 180 days after maturity (Young et al., 1968). When these requirements were satisfied, many medusahead caryopses from the litter and soil

of burned plots were viable. Lack of germination during the afterripening period may have misled Murphy and Turner (1959) into believing they were accomplishing more through burning than actually was the case.

We periodically sampled germination and establishment of the annual grasses in an undisturbed site at the XL Ranch in 1969. These data, reported in a previous publication (Young and Evans, 1972), revealed peak downy brome and medusahead populations of about 600 and 1000 seedlings per sq. ft, respectively. There is close agreement between the field population of downy brome and germination obtained from the samples processed in the greenhouse (Fig. 1). We only obtained roughly 50% of the medusahead germination in the greenhouse that was previously reported for the field (Fig. 1). The extremely long incubation period may have caused some of the caryopses to rot or afterripening requirements were not satisfied in the greenhouse as they were under colder field conditions.

Burning apparently gives medusahead a greater competitive advantage over downy brome. This advantage probably is expressed during the germination and early establishment stage, for if medusahead is initially controlled with a herbicide during the germination period, downy brome will suppress medusa-

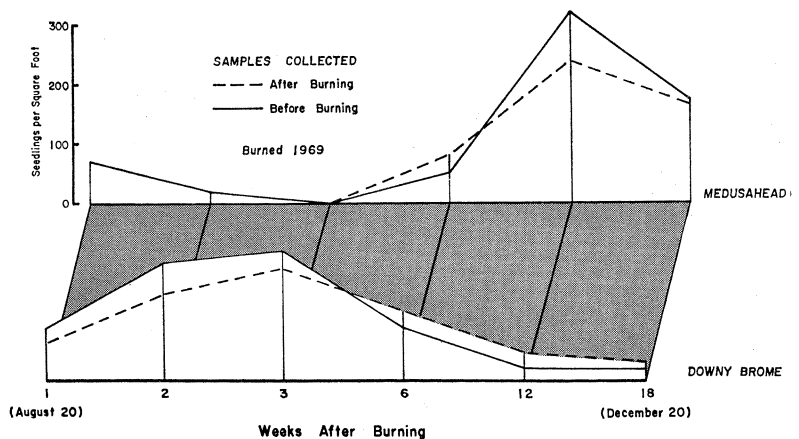


FIG. 1. Germination of downy brome and medusahead from litter and soil samples before and after burning from plots burned the first time in 1969.

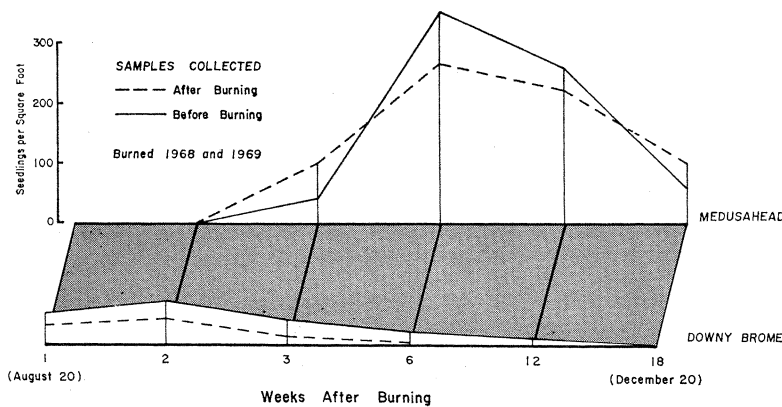


FIG. 2. Germination of downy brome and medusahead from litter and soil samples before and after burning from plots burned in 1968 and 1969.

head on this site (Young and Evans, 1972) and continue this suppression for at least 3 years. Evans and Young (1970) have investigated the influence of litter on seedbeds and its effect in controlling population size of these species. It would seem from this information that burning profoundly affects establishment of these species by altering litter accumulation and possibly other factors of the seedbed.

Results from the collection of litter and soil samples illustrate that viable medusahead caryopses are almost entirely located in the litter and on the soil surface. This same relationship was previously demonstrated for downy brome (Young et al., 1969a).

Results of three years of burning leave us a long way from the observed high condition native perennial grass stands that have been repeatedly burned in areas adjacent to the experimental location. The differences between these sites are apparently ones dealing with different seral stages in time. If a good stand of perennial grasses is present, the community is relatively stable even under repeated burning for the burning serves to reduce competition from woody species. If the density of perennial grasses is depleted, then burning leads to dominance by medusahead. This

has been demonstrated in previous investigations of medusahead communities (Young and Evans, 1970 and 1971). The adjacent stands were burned in wildfires, but studies by McKell et al. (1962), have shown that fast moving fires with short periods of maximum temperatures are not effective in killing medusahead caryopses. During much of the wildfire season medusahead caryopses are on the ground and relatively protected from fire. The conversion to perennial grass-dominated communities from annual grass-dominated ones, has been accomplished by tillage and seeding (Young et al., 1969a) or herbicide application and seeding (Evans et al., 1969). A partial successional shift from medusahead to downy brome is also possible with herbicide application (Young and Evans, 1972). Repeated burning in the environment of this investigation only leads to more medusahead. In cismontane California where there are many native and alien annual species growing with medusahead, there are more opportunities for manipulation of species composition through burning.

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