TECHNICAL NOTES

Effect of Litter Treatment on Germination of Species Found Under Manzanita *(Arctostaphylos)*

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Factors controlling the germination of seeds on disturbed chaparral sites in Arizona have not been critically studied. However, Glendening et al. (1961), and Pase and Pond (1964) have reported that seedlings of several species not common prior to burning may be abundant in the early stages of vegetation recovery after a fire. Similar findings have been reported by Sampson (1944), Horton and Kraebel (1955) and Horton (1960), with regard to California chaparral. Sweeney (1956), Stone and Juhren (1951), and others have shown that seeds of some California chaparral species require heat, or scarification and heat, for germination.

In Arizona, the authors have observed widespread emergence of a fairly predictable array of plant seedlings on areas where disturbance of soil and litter accompanied mechanical removal of chaparral shrubs, as well as on burned sites. This paper reports the findings from a recent greenhouse study of seedling emergence in the natural soil-litter substrate collected under a dense, mature, nearly pure stand of Pringle manzanita *(Arctostaphylos pringlei)*[2] in central Arizona.

[1] *Forest Service, U. S. Department of Agriculture, with central headquarters at Fort Collins, Colorado, in cooperation with Colorado State University. Research reported here was conducted at Tempe in cooperation with Arizona State University.*

[2] *All plant names used are as given in "Arizona Flora" second edition with supplement, University of California Press, 1960.*

Experimental Procedure

In late November 1962, samples of the litter and top 2 to 2.5 inches of soil were carefully removed in 6x12-inch sections. Four such sections were placed in each of sixteen 12x24x4-inch wood flats. After 4 months storage in a lath house at Tempe, the flats were moved to a greenhouse and randomly assigned to treatments as follows:

Designation	*Treatment applied to litter*
Check	Litter left in place on soil surface
Burn	Litter burned under 3 inches of excelsior
Remove	Litter carefully removed by hand
Scarify	Litter and top of soil scarified with hand-garden tool

Based on litter taken from the 4 "remove" flats, the average air-dry litter weight was 429.9 grams/square foot (41,277 pounds per acre). Depth, based on 27 measurements at systematically spaced points in each of the same four flats, averaged 1.4 inches.

Litter was burned by igniting 400 grams of aspen excelsior placed over the litter and inside an asbestos shield along the sides and ends of the flats (Figure 1). Fusion pyrometers (Fenner and Bentley 1960) showed that temperatures of 400° F. or greater were recorded in the litter and to 0.26 inch depth in the soil. Temperatures of 200° and 250° F. were recorded at soil depths of 0.87 and 0.59 inch, respectively. Average burning time of the excelsior and litter was 3.46 minutes.

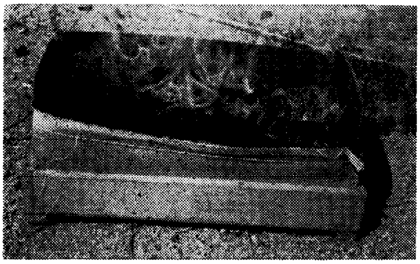

FIGURE 1. Fire burning in excelsior and leaf litter two minutes after ignition.

The flats were randomly arranged on the greenhouse bench (Figure 2), and on March 26, the day after burning, sprinkling with tap water was begun. Seedling emergence was tallied every 2 or 3 days during the subsequent 72-day irrigation period.

Results

A total of 81 grass, 39 broad-leaved herb, and 8 shrub seedlings were tallied (Table 1). Of these, 17 grass and 20 broad-leaved herb seedlings died while too small to be identified. Exclusive of weeping lovegrass *(Eragrostis curvula)* and Bermudagrass *(Cynodon dactylon)*, all of the nine identified species have been observed on chaparral sites following shrub canopy removal and disturbance of surface soil. Seeds of weeping lovegrass, sand dropseed, and Bermudagrass were probably introduced when an adjacent area was aerially seeded two months prior to collection of the soil samples.

Only 3 grass seedlings emerged under the burn treatment as compared with 21 or more in each of the other treatments. By contrast, fewest broad-leaved herbs occurred in the check flats, while emergence of both classes of herbaceous plants was greatest where all litter was removed and only mineral soil remained (Table 1).

The reduced grass seedling emergence on the burned flats differs sig-

FIGURE 2. Arrangement of flats on greenhouse bench.

nificantly from that under each of the other treatments. The apparent greater emergence under the "scarify" and "remove" treatments is not significantly different from that in the check.

With the broad-leaved herbs, removal of litter by hand caused a significant increase in emergence as compared with the check. None of the other differences between treatments is significant.

Shrub seedlings were notably scarce, with a total of eight plants of yerba-santa *(Eriodictyon angustifolium)* being tallied for all treatments. Of these, five were in the burned flats.

Conclusions

1. More grass and broad-leaved herb seedlings emerged under complete litter removal than under any other treatment. This could suggest that the litter contained some inhibiting substance, but because differences in numbers of grass seedlings were found "not significant" at the 5 percent confidence level, no firm conclusion can be drawn.

2. Destruction of part of the litter by burning reduced grass emergence significantly, and, with the exception of the morningglory *(Convolvulus linearilobus)*, was not required for the germination of several broad-leaved herbs regularly seen in early post-fire successional stages in chaparral.

3. Burning of litter may have enhanced germination of yerba-santa, which is considered to be a "fire" species. Fire was not a requirement, however, because seedlings of this shrub emerged under two other treatments. Lack of emergence of other shrub seedlings must imply that the required germinating conditions did not exist under any of the treatments, or that no viable seeds were present. The latter is unlikely, because the soil was collected in a dense stand of Pringle manzanita, and seedlings of this shrub have been observed within the past year on disturbed areas near the collection site.

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Table 1. Number of seedlings that emerged during 72-day watering period.

Species	Litter treatment[1] Check	Burn	Removed	Scarify	Total
Grasses:					
Sporobolus cryptandrus	10	0	19	8	37
Eragrostis curvula	4	2	6	9	21
Cynodon dactylon	3	0	0	3	6
Unidentified	4	1	7	5	17
Total	21	3	32	25	81
Broad-leaved herbs:					
Verbena wrightii	0	0	0	1	1
Convolvulus linearilobus	0	4	0	0	4
Lotus wrightii	0	1	1	0	2
Portulaca coronata	0	0	4	1	5
Gnaphalium wrightii	0	0	5	2	7
Unidentified	2	3	10	5	20
Total	2	8	20	9	39
Shrubs:					
Eriodictyon angustifolium	0	5	1	2	8
Total Plants	23	16	53	36	128

[1] Numbers under each treatment represent the totals from four flats containing 2 square feet of soil surface each.

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