

PACIFIC SOUTHWEST Forest and Range Experiment Station

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RATING EFFECTIVENESS OF HERBICIDES IN DESICCATING WOODY VEGETATION

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When the effectiveness of herbicide desiccants for killing and drying woody vegetation on many small test plots is rated, the standard procedures for collecting fuel moisture samples are time consuming and costly. Also, the field data often must be recorded when weather is not suitable for collecting moisture content samples. To overcome these limitations, a new procedure was devised for systematically evaluating appearance of leaves, twigs, and small stems and estimating quantitatively the percent of total small-fuel mass that was dead or dying and would eventually dry to low moisture content. This small-fuel rating provides a means of determining an approximate Potential Equilibrium Moisture Content for the small-fuel mass—its moisture content after drying to equilibrium under atmospheric conditions suitable for prescribed burning. With the small-fuel ratings and limited moisture content sampling of larger stems, it is possible to select those herbicide treatments most effective for desiccating the entire mass of woody vegetation.

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Herbicide desiccants have been used to increase the supply of dead, dry woody fuel near ground level before attempts are made to remove shrubby vegetation by prescribed burning. In comparing different herbicides as desiccation treatments, their effectiveness can first be judged by the extent to which leaves, twigs, and small stems have been killed and will eventually become dry fuels. This small-fuel fraction of the vegetation is especially important because of its high surface/volume ratio; if dry and present in adequate amounts with fair continuity, the small fuels contribute strongly to buildup and spread of fire.¹ Secondly, the herbicide effectiveness can be rated by the extent of killing and drying of larger stems; these stems must be dried to promote consumption of the total woody material during burning.²

Field-test conditions did not allow us to follow the standard procedure of repeated sampling of actual moisture contents to determine the extent and speed of dying and drying in leaves, twigs, and stems. Adequate sampling on hundreds of plants would have been prohibitive in both cost and time requirements; furthermore, conduct of studies at widely spaced locations required that data be recorded during times when weather was not suitable for moisture content sampling.

Consequently, we devised a procedure for evaluating the appearance of woody vegetation and recording in quantitative terms the extent to which the total small fuel mass had died or was dying and finally would become dry fuel. We also estimated potential moisture content of the small-fuel mass after it dropped to equilibrium with atmospheric conditions suitable for prescribed burning—this equilibrium moisture content is referred to as "Potential EMC."

RECORDING PLANT DYING

Observations of herbicide-treated shrubs show that the obvious symptoms of dying typically proceed from the leaves and twigs of current growth down into the older stems. The dying may stop at any

point: after only leaves and twigs have died, after small stems also have died, after portions of the larger stems have died, after all above-ground parts have died, or when the root system also has been killed. Dying of leaves, twigs, or small stems may occur on only a few of the branches while other branches have normal green foliage. However, if the main plant stem is dead or dying, all of the leaves, twigs, and small stems above the dead portions of the main stem also will be dead or dying. If green leaves are present, they are on branches originating from stem buds located below dead stem portions, or on sprouts from buds at the root crown.

From these observations the effectiveness of any herbicide desiccant treatment can be expressed quantitatively by estimating the relative numbers of branches showing specific degrees of plant kill. The

scale (fig. 1) for rating plant kill on an individual branch is based on the appearance of only the "small fuels"—leaves, twigs, and stems up to one-half inch diameter. The rating is between 5 and 40 if only part of the leaves and twigs are dead. After all leaves and twigs are dead and the one-fourth-inch stems are dying, the rating is between 45 and 60. After one-half-inch stems start to die the rating increases gradually from 65 to 99, and will be at 100 when all are dead or dying.

This scale was developed from limited sampling of the dry weights of leaves, twigs, and small stems of shrubs and small trees in California, Hawaii, and Puerto Rico. It does not necessarily represent the average proportions of the various plant parts of any one species. But the scale does provide a means for uniformly comparing the effects of a herbicide on each plant species at any location.

The small-fuel rating also indicates the effectiveness of a desiccation treatment in killing and drying of larger stems. For example, most of the larger stems, if not all of them, will still be alive, with high moisture content, if average rating for small fuels is less than approximately 65. Or portions of the larger stems, or all of them, will be dead or dying and will eventually dry to a low moisture content if the small-fuel rating is 90 to 100. Effects of the herbicide treatment on larger stems can also be rated qualitatively while the small fuels on each plot are rated. For treatments most effective on small fuels, we collected and dried samples of the larger stems and determined their final EMC before evaluating total effectiveness of the desiccation treatment.

During each study, one experienced man rated the desiccation of fuels on all plots to assure uniformity in treatment comparisons. For each species, he looked at all of the major branches on the plot and assigned a single rating if all the branches showed a uniform degree of kill. If the herbicide kill was spotty, he stratified the branches according to degree of kill, rated each stratum, and computed a weighted average for all strata on the plot. These records aided in selecting the treatments that produced most uniform plant kill.

On each plot, the observer closely examined a few plants—usually at least four—of each species to check his evaluation of their general appearance. Dying of leaves was rather obvious from their external appearance. The first symptom of stem dying usually was a brownish or reddish discoloration of the cambium. As the stem died the discoloration commonly penetrated into the stem, and often the bark changed color. At this temporary stage the moisture content of the stem

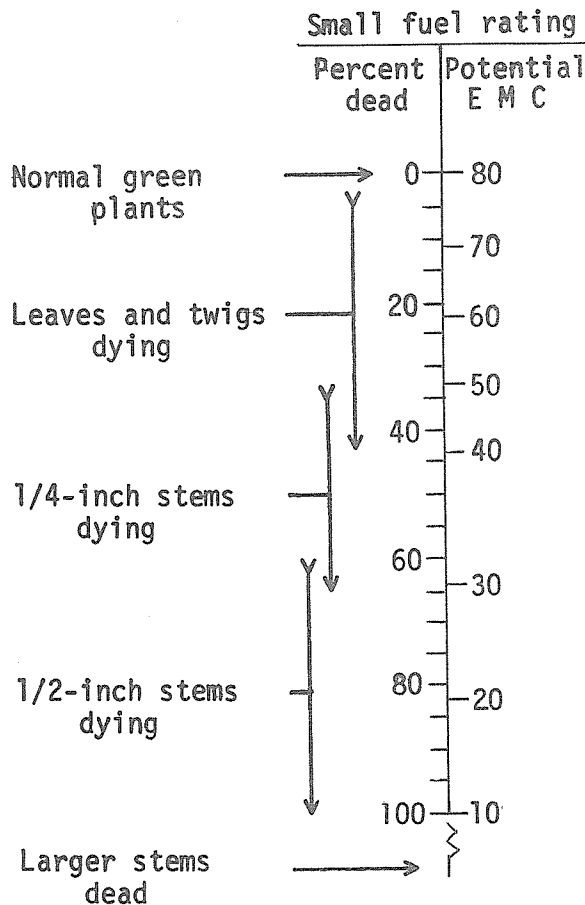


Fig. 1—The effectiveness of desiccation treatment on greenleaf manzanita was rated by appearance of the vegetation. This guide relates appearance to percent of small fuels that are dead or dying and to their potential moisture contents (EMC) when dried to equilibrium under conditions suitable for burning.

was obviously greater than that of unaffected normal stems. The discoloration often disappeared after the stem had died and started to dry, but the dead stem was recognized by lack of greenness, by difficulty in cutting the stem, or by the sheen of a dry cut surface. The short transitional section between dead and living portions of a stem was easily recognized. The changes in appearance of plant tissues as the plant died were not the same for all species, and they were affected by season of the year and by current weather. However, from comparisons of healthy and affected plants of each species, the observer could recognize those dead or dying plant parts which would not start new growth.

During development of the rating system, three observers rated many plots. In almost all cases, the three ratings for a plot were essentially the same. Variations occurred only for treatments which were relatively ineffective and produced spotty results. In all cases, the three observers agreed in selection of the most effective treatments. This system for rating the effectiveness of different herbicides as desiccants proved most useful in conducting tests on hundreds of small plots in California, Hawaii, and Puerto Rico. One observer could judge the general appearance of the vegetation, make the necessary close observations, and rate two or more plots per hour.

ESTIMATING POTENTIAL MOISTURE CONTENT

For a shrub species growing in its characteristic habitat, the approximate potential equilibrium moisture content (EMC) of the small-fuel mass can be

estimated from the small-fuel desiccation rating (fig. 1). During the summer in the California mountains the green manzanita plants have a moisture content of about 80 percent, dry weight basis, as an average for total small fuels—higher for leaves and twigs and lower for stems.³ After all of the small fuels have died and dried, under a weather situation fairly favorable for burning, their average moisture content is near 10 percent—lower for leaves and twigs and higher for stems. If only the leaves and twigs are killed by a treatment, their moisture content will drop to less than 10 percent, but stems will remain green and average EMC for the total small-fuel mass will be about 40 percent. After limited moisture content sampling of the plant parts, an approximate EMC scale can be prepared for each kind of vegetation, under conditions prescribed for burning in a specified climate.

NOTES

¹ Countryman, Clive M. 1969. *Project Flambeau—an investigation of mass fires (1964-1967)*. Final Rep., Vol. 1, 68 p. Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif.

² Bentley, Jay R., C. Eugene Conrad, and Harry E. Schimke. 1971. *Burning trials in shrubby vegetation desiccated with herbicides*. USDA Forest Serv. Res. Note PSW-241, 9 p. Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif.

³ Carpenter, Stanley B., Jay R. Bentley, and Charles A. Graham. 1970. *Moisture contents of brushland fuels desiccated for burning*. USDA Forest Serv. Res. Note PSW-202, 7 p. Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif.

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