# The Mulch Layer of California Annual Ranges

D. W. HEDRICK

*231 Giannini Hall, Univ. of Calif., Berkeley*

THE past few years of below average precipitation have emphasized the importance of a mulch layer on annual ranges in California. It has been apparent that where sufficient mulch was found germination was better, and early growth and total production of forage was greater than on ranges lacking enough mulch cover. It was observed also that where grazing animals had old forage in fall and early winter to eat along with the new, they scoured less and made better gains than where only new growth was available. A mulch layer also helps to maintain the percolating capacity of soils and prevent erosion.

In studying the mulch layer near Berkeley it was found that terminology applied to it varies among different workers (*1*, *4*, *6*, *7*, *8*, *10*, *11*, *12*). In an attempt to standardize terms and classification of the mulch layer on annual ranges in accordance with present usage, the writer proposes adoption of the terms—mulch, forage residue, and humic mulch. Applied in this way, mulch is a collective term which refers to the whole protective blanket of vegetation after the forage has dried. Forage residue includes all dried herbage of the past year's growth that might be used for grazing. Humic mulch is used only in referring to semi-decomposed materials which constitute but a thin layer on the surface of the soil.

Considerable work has already been done in determining the amount of forage residue which should be left on annual ranges to keep them in productive condition (*6*, *10*, *13*). This varies from about 400 to 1000 pounds per acre. However, few, if any, measurements of the humic mulch layer are available even though it has been used as an important factor in determining range condition (*6*, *7*, *10*, *12*). Since humic mulch on annual ranges is so thoroughly mixed with mineral soil, separation of it is difficult and time consuming. Accordingly, some method other than those used in other forage types (*4*, *9*) had to be devised for measuring the effect of intensity of grazing on the humic mulch layer of annual ranges.

Several workers have noted the increase in volume weight of soils brought about by grazing and cultural practices (*2*, *5*). In view of these results it seemed reasonable to assume that measures of volume weight of thin layers of surface soil might give usable measurements of the amount of humic mulch. If so, the effect of intensity of grazing on humic mulch could be determined indirectly by sampling the top layer of soil.

This was accomplished by using a 10-inch length of $1\frac{1}{2}$-inch water pipe sharpened on one end. After first clearing away green plants and residue, the sampling tube was sunk into the surface layer of soil to a depth of about 1 inch. Rotating the tube while sampling helped to avoid compaction and shear off the sample near the end of the cylinder. Volume of the sample collected was then determined by filling the hole with sand as described by Daubenmire (*3*). After drying in an oven for 24 hours at 105 degrees Centigrade, the samples were weighed and volume weights determined by the ratio of dry weight of soil and humic mulch in grams/volume in cubic

centimeters. Sampling was best accomplished when the soil moisture was about 20 per cent. If the moisture content was higher the samples were compacted; if much drier, the samples could not be retained in the tube. When the sample volume was between 30 and 40 cc., results with as few as 8 or 10 samples were fairly uniform. After dry weights were determined, the samples were placed in a muffle and ignited at red heat for 1½ to 2 hours. Percentage loss by ignition was computed and this figure was used in correlating volume weights with approximate organic content of the top inch of soil and humic mulch.

Before extensive sampling was begun, Professor R. E. Storie of the Soils Department of the University of California prepared profiles from areas of Los Osos soil from which most of the samples were taken. These clearly show the effects of grazing in decreasing the amount of humic mulch (fig. 1). Close examination of these profiles revealed the humic mulch layer to be a heterogeneous mixture of partially decayed vegetation, including disintegrated parts of grasses and herbs, seeds, and mineral soil, interwoven by a fine mass of roots. Trampling by grazing animals and activity of earthworms were instrumental in mixing the humic mulch with mineral soil and making segregation of it impractical.

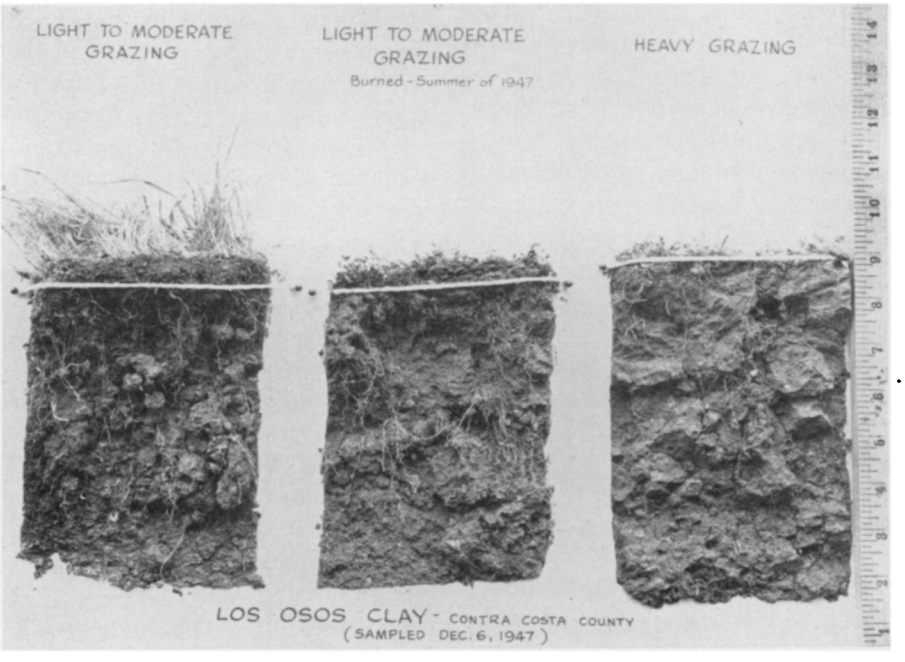


FIG. 1. EFFECT OF GRAZING AND FIRE ON MULCH LAYER OF ANNUAL RANGES
The string marks the approximate depth to which decaying plant materials are intermixed with the surface layer of soil. Fire removed the forage residue but had no apparent effect on the humic mulch.

Most of the sampling was done in an area protected for 14 years and in pastures used lightly, moderately, and heavily for the same length of time. Results obtained on the moderately and lightly grazed pastures were verified by samples taken in 5 other areas. Degree of forage utilization was determined according to

the method used by Hormay (7). Forage cover on the protected and lightly grazed areas consisted chiefly of wild oats (*Avena spp.*) and foxtail fescue (*Festuca megalura*). On the heavily used pasture, the cover was predominantly annual ryegrass (*Lolium multiforum*), Mediterranean barley (*Hordeum gussoneanum*), and red-stem filaree (*Erodium cicutarium*) with but small amounts of wild oats and foxtail fescue. The moderately grazed pasture supported a mixed stand of wild oats, foxtail fescue, annual ryegrass, and red-stem filaree. Effects of various degrees of grazing on the humic mulch layer as measured by volume weight and percent loss by ignition are as follows:

| DATES OF SAMPLING | GRAZING USE | AVERAGE VOLUME WT. | AVERAGE LOSS BY IGNITION | NUMBER OF SAMPLES |
|---|---|---|---|---|
| | | *gms. per cc.* | *Percent* | |
| March 1, May 10, and June 5, 1948 (combined) | None | .97 ±.03 | 10.8 ±.6 | 23 |
| | Light | .95 ±.04 | 10.6 ±.5 | 24 |
| | Moderate | .92 ±.04 | 10.3 ±.5 | 8 |
| | Heavy | 1.11 ±.06 | 8.7 ±.5 | 24 |

The results for moderate grazing are based on samples taken in March only. Volume weights were significantly lower under light and moderate grazing, and the approximate organic content was higher, than under heavy grazing. Differences were considered significant when the ratio of difference in means to standard error of difference was 2 or more. No significant difference existed among volume weights and organic content of samples from protected, lightly grazed, and moderately grazed areas. Volume weights were most variable under heavy grazing. This was attributed chiefly to compaction caused by trampling where only a small amount of humic mulch was found. A fairly good relationship exists between volume weights and percent loss by ignition. Generally speaking low volume weights are associated with high organic content and vice versa. Of course, direct comparison of samples can only be made in the same soil type. Between soil types differences in volume weight and percent loss by ignition could be due to inherent differences in the soils.

## Conclusions and Summary

The mulch layer on annual ranges is comprised of two classes of materials, forage residue and humic mulch. Leaving sufficient forage residue at the end of each grazing season for protection and range improvement is recognized as essential. However, little information is available on the importance and measurement of humic mulch on annual ranges.

Studies reveal that humic mulch seldom forms a discrete layer on annual ranges. A method to measure this layer indirectly by obtaining volume weights of the surface layer of soil was devised. Limited determinations show good correlation between volume weight and loss by ignition of this surface layer. These measurements also bear out the fact that continued heavy grazing reduces the amount of humic mulch on annual ranges. Samples from a pasture heavily used were consistently higher in volume weight and lower in approximate organic content than adjoining protected, and lightly and moderately grazed areas.

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