TECHNICAL NOTES

Precipitation, Temperature, and the Standing Crop of Some Southern California Grassland Species

R. W. HUFSTADER

Highlight: *A strong relationship between precipitation (but not temperature) and standing crop is evident for the dominant species of a southern California grassland. The sub-dominant species showed no relationship to either precipitation or temperature. It was hypothesized that competition for light and variable germination times acts to limit the sub-dominant species. Differential success of sub-dominant species may account for much of the variability in California grasslands.*

Major (1963) stated that during the fall and winter, natural plant growth in the lowlands of California is limited "first by insufficient moisture and then by insufficient heat." The tremendous difference between spring and fall plant growth is a reflection of differences in temperature and water. Since a semiarid mediterranean climate, with a characteristic summer drought, prevails throughout much of the lowlands of California these limiting factors might seem intuitively obvious. Yet, recent literature suggests that water may not be a limiting factor for annual and perennial grass species (Patric, 1974). However, Patric's findings do not directly relate to changes in standing crop; they relate to soil moisture use and suggest that annual precipitation replenishes soil moisture beyond the water needs of grass. The literature does not provide any direct information on the relationship of the standing crop of California grasslands to precipitation and temperature. This paper examines that relationship for four annual plant species in a southern California grassland.

Methods

Standing crop changes were measured by the harvest method (Odum, 1960). The plants from ten random 0.25 m² plots were harvested from a north- and south-facing slope of valley grassland (Munz and Keck, 1959). The study site is located 3 km east of San Juan Capistrano off Highway 74 in southern Orange County, Calif. Plants were harvested six times at 5- to 6-week intervals throughout the 1972–1973 growing season. Standing crop was determined as oven-dry (160°F for 48 hours) living material weight. Daily rainfall data were from Orange County Flood Control District Station No. 86, located near this study site. Daily maximum, minimum, and median air temperature data were from the South Coast Field Station approximately 24 km north of the study site, but with similar distance and protection from the ocean.[1] The study area received higher than normal rainfall, approximately 12 cm more, but temperatures throughout this growing season were very close to normal. Correlation coefficients were determined for standing crop with total rainfall and the means of the total daily temperature data during each harvest period. Other considerations of the site and its ecology are contained in Hufstader (1974).

Author is with VTN Environmental Sciences, Portland, Oregon 97225.
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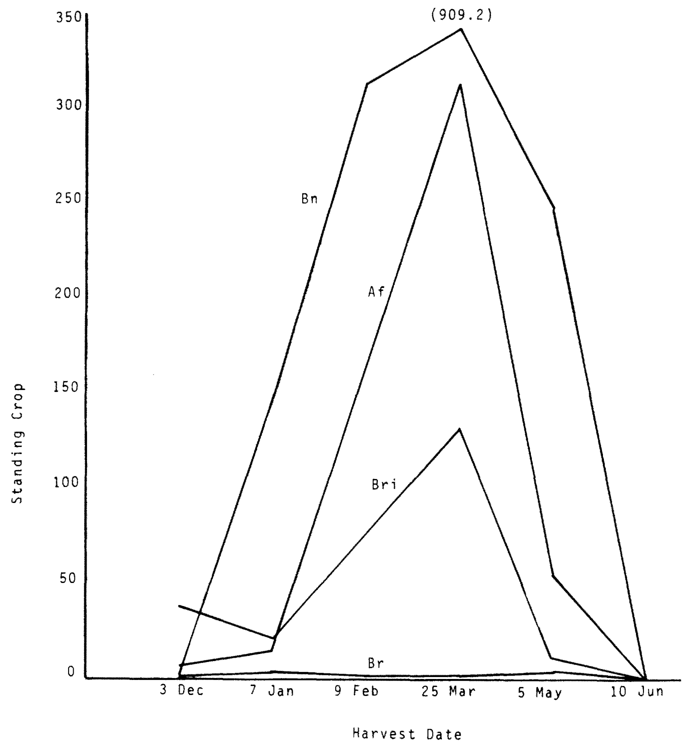

Fig. 1. *Changes in standing crop (g/m²) for black mustard (Bn), wild oats (Af), ripgut grass (Bri), and foxtail chess (Br) during the growing season from December 3, 1972, to June 10, 1973.*

Results

The species encountered were, on the south-facing slope, black mustard (*Brassica nigra*[2]) and foxtail chess (*Bromus rubens*); on the north-facing slope, wild oats (*Avena fatua*) and ripgut grass (*Bromus rigidus*). Wild oats on the south-facing slope, and black mustard, on the north-facing slope, did occur but were too sparse for use in this study.

[1]Personal communication with R. Keim.

[2]Nomenclature follows Munz and Keck, 1959; Hitchcock, 1950.

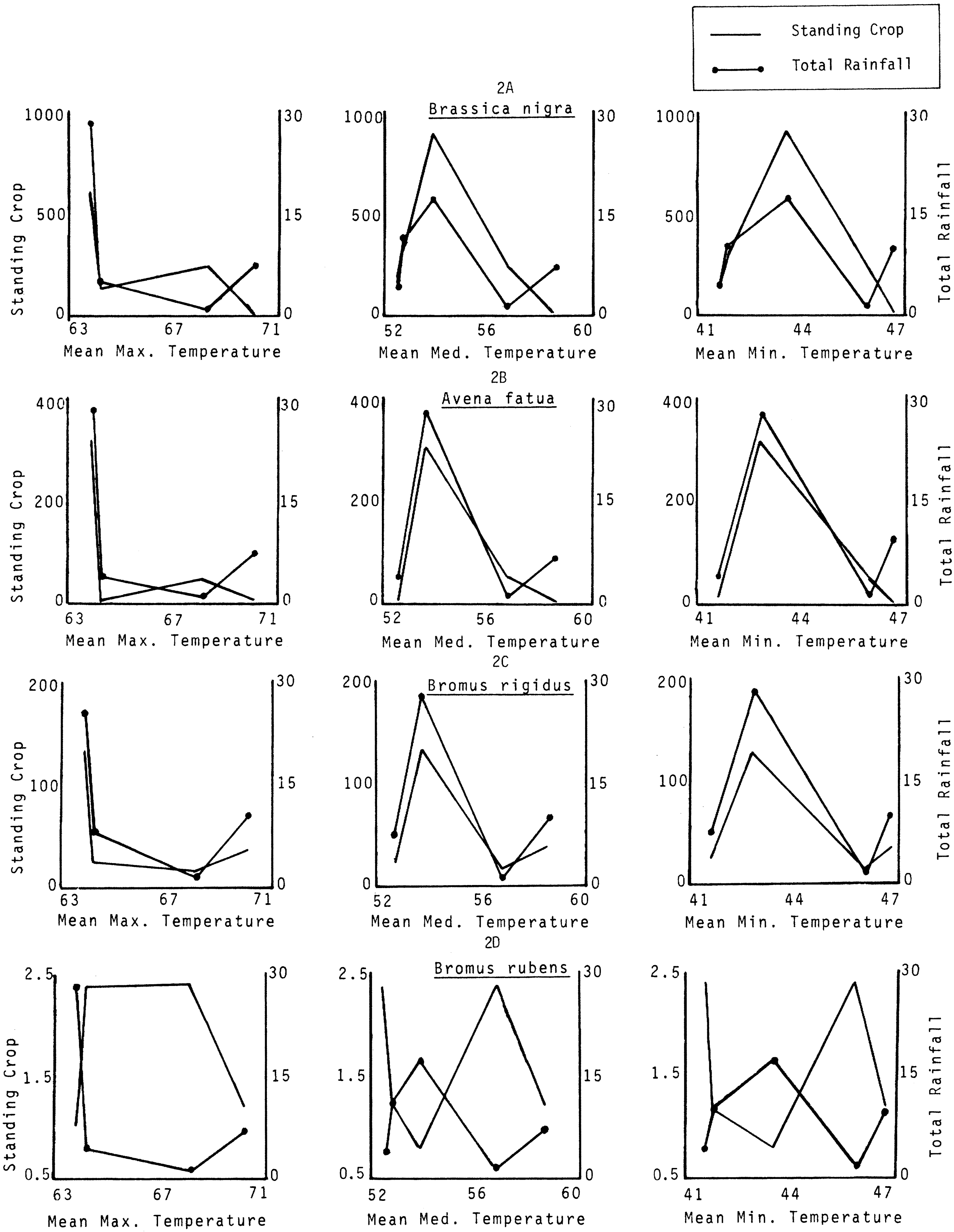

Fig. 2. *Relationship of mean maximum, median, and minimum temperatures (°F), total rainfall (cm), and standing crop (g/m²) for: 2A—black mustard; 2B—wild oats; 2C—ripgut grass; 2D—foxtail chess.*

None of the species, except foxtail chess, showed an increase of standing crop during the single spring sample period from March 25 to May 5, 1973 (Fig. 1). This is apparently due to decreasing precipitation during the sample period. The sample periods during fall and winter exhibited continuous and in some cases rapid increases in the standing crop of most species.

The graph of mean standing crop versus mean maximum, median, and minimum temperatures and total rainfall between harvest dates is shown in Figure 2. The first rainfall total began with the second storm of the season, during the second and third weeks of November 1972, since no germination occurred after the first storm.

Figure 2A shows that changes in black mustard standing crop and total rainfall have similar trends regardless of the temperature regime considered. No clear relationship between temperature and standing crop is exhibited. This same pattern of relationships holds for wild oats (Fig. 2B) and ripgut grass (Fig. 2C). None of these species, which were dominant at this site (Hufstader, 1974), indicate that the temperature range experienced during winter was limiting to production of standing crop. However, they all show clear association with rainfall trends throughout fall and winter. The correlation between total rainfall and standing crop is significant ($p < .05$) for wild oats, $r = 0.88$, and ripgut grass, $r = 0.99$. Black mustard is strongly related at $r = 0.79$. Foxtail chess (Fig. 2D), a sub-dominant on the south facing slope (Hufstader, 1974), does not exhibit the same type of relationship found for the other species. The trends of total rainfall and changes in standing crop are opposite ($r = -0.89$, significant at $p < .05$). No clear relationship between the standing crop of foxtail chess and temperature is evident.

Discussion

There are several possible major factors operating to limit the production of standing crop during fall and winter in Caifornia annual grasslands. Other investigators have indicated water, temperature, and soils to be the most important (Major, 1963; Biswell, 1956; McNaughton, 1968). For dominant species, this is certainly the case, with water being the most crucial factor. However, interference with dominant species may be a major limiting factor to sub-dominants. Competition for light is often of importance when interference between species occurs (Harper, 1964), and when large broad-leaved herbaceous plants, such as black mustard, dominate the upper strata of the canopy (Hufstader, 1974), the habitat of smaller under-canopy plants may often be light limiting.

Another factor which may limit sub-dominant species is different germination times. Many weedy species exhibit variation in germination requirements (Palmblad, 1969) and the plants of the California grasslands may exhibit this through differing germination times (Heady, 1958). Foxtail chess, at this study site, germinated approximately 2 weeks later than black mustard (Hufstader, 1974). For an annual plant that must develop from seed each year, such time lost before germination may be significant in determining its relationship to its neighbors. In a highly variable vegetation such as this (Talbot et al., 1939; Heady, 1956, 1958), much of the variation may be due to differential success of sub-dominant species from year to year and place to place.

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Granular Herbicide Applicator for Brush Control

T. O. FLYNT, R. W. BOVEY, R. E. MEYER, T. E. RILEY, AND J. R. BAUR

Highlight: *An applicator was constructed and mounted on a tractor to accurately apply granular or pelleted herbicides in continuous narrow bands at various spacings to soils supporting infestations of brush. The metering mechanism consisted of a rotating disc suspended directly over an opening in the bottom of a hopper. Uniformity of granule output could be calibrated within < 5% error.*

The application of granular herbicides and other agricultural chemicals is a common practice in many cropping systems. Numerous spray devices have been developed for dispersal of liquid herbicide formulations, but less equipment has been developed for accurate application of granular materials.

Lovely et al. (1966) studied various metering machines for application of granulated insecticides for European corn borer control. Their data indicated that successful metering mechanisms included an auger-type fertilizer distributor, fluted-feed grass seeder, a reciprocating-chain type grass seeder, a fluted-shaft granular applicator, and a reciprocating-rope seeder. Danielsen and Chambers (1957) developed an experimental field distributor for granular herbicides which employed an auger enclosed in a slotted tube as a metering device in the bottom of the hopper.

Wooten and McWhorter (1961) described a subsurface applicator to apply dusts and granules in bands. Air pressure was used to force the dusts and granules into the soil through a boom attached to a horizontal blade pulled by a tractor. Bingham (1964) modified a grass seed attachment to a grain drill to apply granular herbicides. The fluted-feed cup metering mechanism gave positive and precise metering, low physical breakdown of granules and a discharge rate directly proportional to the speed and amount of flute exposed to the granular material. More recently, Anderson (1974) developed an applicator that used the principle of the cone seeder to obtain uniform distribution of granules. The device had the advantage that no calibration or adjustment was necessary when rates of application were varied or when different formulations of granules were used, providing plot size was held constant.

Previous research by Bovey et al. (1975) indicated that certain herbicides applied to the soil surface as sprays or granules in continuous bands 4 to 6 ft apart were effective for brush control. Application of some soil

Authors are agricultural research technician, research agronomist, plant physiologist, agricultural research technician, and plant physiologist, Agricultural Research Service, U.S. Department of Agriculture, Department of Range Science, Texas A&M University, College Station 77843.

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