

Effects of Environmental Factors on Range Plants

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Summary

In western North Dakota, environment factors have produced drought years during 12.4% of the past 105 years, drought growing seasons during 16.2% of the past growing seasons, and water deficiency conditions during 33.0% of the growing season months.

Environmental factors affect range plant growth and need to be understood and considered by rangeland managers. The three most ecologically important environmental factors affecting rangeland plant growth are light, temperature, and water (precipitation). Plant growth and development are controlled by internal regulators, which are modified according to environmental conditions. A research project was conducted to describe the three most important environmental factors in western North Dakota and identify some of the conditions and variables that limit range plant growth which should be considered during the development of long-term rangeland management strategies (Manske 1997).

Light is the most important ecological factor affecting plant growth. Light is necessary for photosynthesis, and changes in length of daylight (photoperiod) regulate the phenological development of rangeland plants. Changes in day length are used by plants as the timer or trigger that activates or stops physiological processes initiating growth and flowering and starts the process of hardening for resistance to low temperatures in fall and winter. The length of daylight changes during the growing season, increasing from about 13 hours in mid April to nearly 16 hours in mid June, then decreasing to around 11 hours in mid October. Cool-season plants reach flower phenophase before 21 June, and warm-season plants reach flower phenophase after 21 June.

Temperature is an approximate measurement of the heat energy available from solar radiation. Both low and high temperature levels limit plant growth. Most plant biological activity and growth occur only within a narrow range of temperatures between 32 F and 122 F. The growing season for perennial plants is 6 months, from about mid April to mid October. The frost-free growing season for annually seeded plants is 120-130 days, from mid to late May to mid to late September. Perennial grassland plants are capable of growing for periods longer than the frost-free period, but in order to continue active growth they require temperatures above the level that freezes water in plant tissue and soil. Winter dormancy in perennial plants is not total inactivity but reduced activity.

Water (precipitation) is essential for all plants and is an integral part of living systems. Water is ecologically important because it is a major force in shaping climatic patterns, and water is biochemically important because it is a necessary component in physiological processes in plants. Plant water stress limits growth. Water stress can vary in degree from a small decrease in water potential to the lethal limit of desiccation.

Temperature and precipitation act together to affect the physiological and ecological status of range plants. The biological situation of a plant is determined by the balance between rainfall and potential evapotranspiration. When rainfall is lower than potential evapotranspiration demand, a water deficiency exists. The ombrothermic graph technique, which plots mean monthly temperature and monthly precipitation on the same axis, was used to identify months with water deficiency conditions during the period of 1892-1996 (Manske 1997). Drought years have occurred during 12.4% of the past 105 years, and drought growing seasons have occurred during 16.2% of the past growing seasons. Water deficiency has occurred during 33.0% of the growing season months. Water deficiency has occurred in the months of May and June 15% and 10% of the time, respectively. July has had water deficiency conditions less than 40% of the time. August, September, and October have had water deficiency conditions more than 50% of the time. Water deficiency periods lasting for a month place plants under water stress that is severe enough to reduce herbage biomass production. These levels of water stress are a major factor limiting the quantity and quality of plant growth in western North Dakota and can limit livestock production if not considered during the development and implementation of long-term grazing management strategies.

Literature Cited

Manske, L.L. 1997. Effects from environmental factors of light, temperature, and precipitation on range plants in the Dickinson, North Dakota, region. NDSU Dickinson Research Extension Center. Range Research Report DREC 97-1015 (Compressed). Dickinson, ND. 22p.

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