Plants grown under field conditions often experience stress. The major stresses on forage legumes in the USA result from cold and variable winter temperatures, hot summer temperatures, water saturated soils, water deficits during the growing season, low soil pH, shading, and injury from insects and diseases. Winter injury results from desiccation, flooding, ice encasement, soil heaving, and diseases in addition to the direct effects of freezing temperatures. Prolonged or intensive stress kills plants and reduces stands. In the northern USA, cold-tolerant forages undergo fall hardening by increasing sugar, protein, lipid, and dry matter concentrations, which increases their tolerance to freezing temperatures. Temperature fluctuations during the fall and winter can interfere with or undo the hardening process and cause stand loss. Most forage legumes are not tolerant to drought and survive by drought avoidance. In some species, drought is avoided or minimized by extracting water from deep in the soil profile. A critical need exists to better define physiological processes associated with stress resistance so that these plant characteristics can be altered by plant breeding and used as selection criteria for developing cultivars more resistant to plant stresses.

INTRODUCTION

Climatic and edaphic factors largely determine the geographical regions in which crops can be grown successfully. Most forage legumes are now grown extensively outside of the ecosystems in which they evolved. In these new environments, forage legumes often are confronted with edaphic and climatic stresses for which they may not be well adapted. Under field conditions, almost all plants undergo some environmental stress. Mild stress may be reflected only in yield reduction. Prolonged or intensive stress, however, kills plants and reduces stands. Legumes generally have a narrower range of adaptation and have less resilience to environmental stress and grazing than do grasses. As a result, legumes require better management than grasses to persist and remain productive.

Climate in the United States as well as on a global basis has shown cyclic variation. Thompson (1988) observed a general warming period in parts of the North Central Region of the USA from 1890 until the late 1930s, followed by cooling through the