Arthropods and their Management

Injury Caused by Arthropod Pests

Forage crops are grown and managed to provide desirable quantities of biomass of satisfactory quality without reducing stand persistence. Forage biomass production is determined by plant genotype, environment, and genotype–environment interactions. Biotic and abiotic stresses occur in the environment that reduce dry matter production, herbage quality, and/or stand persistence of forages. Stresses that reduce forage yield or quality affect the amount of hay, silage, or pasture that is available to livestock. Stresses that affect stand persistence of perennial forages can make a forage crop uneconomical to grow or maintain unless stress is alleviated.

Understanding plant stress caused by arthropod pests is essential for developing forage management systems that optimize production and minimize pest-induced losses. This section provides a conceptual framework to understanding stresses on forage plants caused by arthropod pests by focusing on the physiological effects of pest injury to the plant. In the following section, I consider the application of knowledge about plant stress to the development of decision rules for pest management.

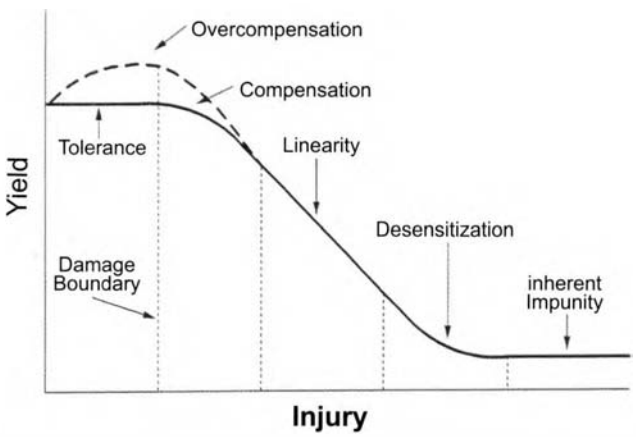

Fig. 1. Generalized relationship between intensity of pest injury and plant damage as measured by yield (from Pedigo et al. 1986).

Stress, Injury, and Damage

What is plant stress? Stress is a departure from optimal physiological condition of the plant caused by an external agent. Stress may be transient or long term. Plant stress results from any deleterious effect caused by any external agent whether biotic or abiotic. Distinguishing between injury and damage is important to the understanding of plant stress in terms of human utility or value in human enterprise. Damage is "the measurable loss of utility," which for forages refers to losses of forage yield, quality, or stand life. Injury may occur without causing damage, and injury typically must reach a certain level before damage occurs. Any plant part can be injured, but damage occurs only if the harvestable product is affected adversely to the point that a measurable loss occurs. The point at which injury produces damage has been called the damage boundary or damage threshold (Fig. 1). The damage boundary can be quite large in forage plants because forages can tolerate a substantial amount of injury before damage is measurable. These definitions of injury and damage emphasize crop losses in an agricultural setting, but the distinction between injury and damage also is useful in native pasturelands where damage causes a loss of plant fitness and/or utility.

Plant Response to Pest Injury

Plant response to pest injury is complex. Five factors that affect the plant's response to injury are the part of the plant injured, type of injury, time of injury in relation to plant growth and development, intensity of injury, and environmental conditions.

Injured Plant Part

The part of the plant that is injured affects the plant's response to injury. Generally, direct injury to yield-forming organs causes more severe damage than indirect injury to non-yield–forming organs. Plants usually are less sensitive to indirect injury because the plant can physiologically compensate for injury to non-yield–forming organs. Because forage crops often are maintained in a vegetative state to provide forage production, they probably are more easily damaged by foliar injury than root injury; foliar injury directly affects the harvestable portion of the plant. Root injury is indirect and may be tolerated for some time but probably affects long-term stand persistence more than foliar injury.