Introduction

Grasshoppers are a natural component of native rangelands and domesticated grasslands of the Northern Plains. Grasshopper population densities ordinarily remain at levels that can be supported by the resources of the ecosystem. At low densities, grasshoppers are not a problem. However, when favorable conditions decrease mortality rates, increase available food plants, and/or increase access to direct sunlight, pestiferous rangeland grasshopper populations can increase to problem densities.

Pestiferous rangeland grasshopper population densities are regulated by the mortality rates caused by natural enemies, by the availability of nutritious food plants, and by the level of access to direct sunlight throughout the day. Grasshoppers living on arid rangelands of the intermountain west region and of the southern short grass region have abundant access to direct sunlight but are limited by the availability of adequate nutritious food plants except during growing seasons with above normal precipitation. Grasshoppers living on rangelands of the Northern Plains have adequate nutritious food plants available even during dry growing seasons but are limited by restricted access to direct sunlight except during growing seasons with high water deficiencies or drought conditions or on heavily grazed, poorly managed, or double used grazinglands with considerable bareground areas and reduced grass plant stature.

Habitat favorable for pestiferous grasshopper production in the Northern Plains has the canopy cover reduced to less than 40% of the ordinary with relatively short stature grass plants and numerous bareground areas. Direct sunlight saturates the majority of the bareground locations during most of the day for the entire growing season.

Grasshoppers are ectothermal (cold blooded), unable to regulate their body temperature metabolically. Grasshoppers must bask on bareground sites in direct sunlight to raise their body temperature to the optimal high levels above 95° F (35° C) and must constantly adjust their exposure in and out of direct sunlight to maintain the body temperature within a few degrees throughout the day. The greater proportion of hours per day that a grasshopper can achieve optimal body temperature, the greater the rate of growth and development because of the accompanying greater rates of metabolism, nutrient assimilation, food plant ingestion, and activity levels; in addition, the grasshopper has greater speed to escape predators. The length of time nymphs are at each instar stage is reduced, a greater percent of the nymphs reach the adult stage, maturation time after adults fledge is reduced, and the quantity of viable eggs produced by each adult female is increased.

All, except one, of the pestiferous rangeland grasshoppers in the Northern Plains deposit egg pods below the soil surface in bareground sites. Bareground areas provide ideal egg pod deposition sites because abundant direct sunlight reaches the soil surface maximizing the day-degrees of heat accumulation by the eggs resulting in increased embryo development rates, earlier hatch initiation, and reduced hatch period duration. The remuneration to the land manager that provides favorable habitat with abundant access to direct sunlight for pestiferous rangeland grasshoppers is the multifold increase in the number of hatchlings produced during the next growing season.

Beef producers that use the old traditional range management concepts to mange the aboveground perennial grass resources for a single primary use as forage for livestock or for the products removed cause spiraling degradation of the ecosystem that results in reduced grass plant density, increased size and number of bareground areas, and decreased grass herbage biomass production creating habitat favorable for pestiferous grasshoppers. Traditional range management has one solution for this common problem; reduced stocking rate.

Fortunately, there are new technologies that can manage grazingland ecosystems as complete systems that include all of the aboveground and belowground components and improve ecosystem functionalities that result in greater grass plant densities, decreased size and number of bareground areas, and increased grass herbage biomass production creating habitat unfavorable for pest grasshopper production.

Rangelands are complex ecosystems consisting of numerous interactive biotic (living) and abiotic (nonliving) components. The biotic components are the plants, soil microorganisms, and large grazing graminivores that have biological and physiological requirements. The abiotic components include the major and minor essential elements that have transformable characteristics between organic and inorganic forms. The major essential elements are carbon, hydrogen, nitrogen, and oxygen and the minor essential elements consist of seven macrominerals and ten microminerals. The abiotic components also include radiant energy from the sun. Numerous biological, geological, chemical, and atmospheric pathways transfer the major essential elements into and out of an ecosystem and numerous pathways transfer the minor essential elements out of an ecosystem. Rangeland ecosystems are functioning units of coacting biotic organisms interacting with the abiotic components and the environment. The complex of mechanisms and processes connected with these extensive interactions are the defoliation resistance mechanisms within and around grass plants and the biogeochemical processes within an ecosystem.

The defoliation resistance mechanisms provide important biological and physiological processes permitting grass plants to produce greater herbage biomass that replaces lost leaf material, to restore disrupted vital processes, and to vegetatively reproduce secondary tillers from axillary buds that increase grass tiller density. The soil microorganisms in the rhizosphere and the biogeochemical processes cycle essential elements between the organic and inorganic forms that permit renewable natural resource ecosystems to be functionally renewable.

A biologically effective grazing management strategy has been developed with two grazing periods in each of the 3 to 6 pastures that have rotation dates coordinated with grass phenological growth stages. Partial defoliation by grazing that removes about 25% to 33% of the aboveground leaf material of grass lead tillers between the 3.5 new leaf stage and the flower stage activates the defoliation resistance mechanisms and the biogeochemical processes that improve ecosystem productivity and create conditions favorable for livestock production and unfavorable for pest grasshopper production.