Autecology of Thickspike Wheatgrass on the Northern Mixed Grass Prairie

Llewellyn L. Manske PhD
Research Professor of Range Science
North Dakota State University
Dickinson Research Extension Center
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The autecology of Thickspike wheatgrass (Northern wheatgrass), *Elymus lanceolatus*, is one of the prairie plant species included in a long ecological study conducted at the NDSU Dickinson Research Extension Center during 67 growing seasons from 1946 to 2012 that quantitatively describes the changes in growth and development during the annual growing season life history and the changes in abundance through time as affected by management treatments for the intended purpose of the development and establishment of scientific standards for proper management of native rangelands of the Northern Plains. The introduction to this study can be found in report DREC 16-1093 (Manske 2016).

Thickspike wheatgrass (Northern wheatgrass), *Elymus lanceolatus* (Scribn. & J.G. Sm.) Gould, is one of the grass family, Poaceae, tribe, Triticeae, syn.: Agropyron dasystachym (Hook.) Scribn., and is a native, long lived perennial, monocot, cool-season, mid grass, that is tolerant of cold, drought, and periodic flooding, has a tolerance to slightly acidic to moderately saline soils, and moderately shade tolerant. The first North Dakota record is Moran 1937. Early aerial growth consists of basal leaves arising from rhizome tiller buds. Leaf blades are 5-25 cm (2-10 in) long, 2-4 mm wide, stiff, with numerous ridges on the upper surface, and tapering to a point. The split sheath has overlapping margins that open towards the top and has short, straight, stiff hairs at the base. The collar is not well defined. The ligule is a short flat membrane 0.6 mm long. The auricles are long and clasping. The creeping rhizome system is extensive. The aggressive rhizomes are primarily in the top 10 cm(4 in) of soil. The frequent branches are about 15 cm (6 in) long produce single or several stems per node at progressive intervals. The extensive root system has tough light colored main roots arising from stem crowns and rhizome nodes growing vertically downward regularly producing profuse quantities of short branches forming a dense mass that inhibits penetration by other species, with the densest roots in the top 83 cm (15 in) of soil. Regeneration is primarily asexual propagation by rhizome tiller buds. Seedling success is low as a result of competition from established plants. Flower stalks are erect, hollow, 15-90 cm(6-35 in) tall. Inflorescence is an erect compact spike, 3-12 cm (1.2-4.7 in) long, with overlapping solitary spikelets of 4 to 7 florets. Flower period is June. Aerial parts are highly palatable to livestock. Fire consumes aerial parts halting the process of the four major defoliation resistence mechanisms and causing great reductions in biomass production and tiller density. This summary information on growth development and regeneration of Thickspike wheatgrass was based on works of Stevens 1963, Zaczkowski 1972, Great Plains Flora Association 1986, Scher 2002, Johnson and Larson 2007, Ogle et al. 2013**.**

Procedures

The 1946-1947 Study

Grass and upland sedge species samples to determine crude protein and phosphorus content were collected weekly during the growing seasons of 1946 and 1947 from two seeded domesticated grasslands and a native rangeland pasture at the Dickinson Research Extension Center located at Dickinson in western North Dakota. Current year's growth of lead tillers of each species was included in the sample; previous year's growth was separated and discarded. Ungrazed samples were collected for each species except for Kentucky bluegrass, which only grew along a watercourse where almost all of the plants had been grazed and remained in an immature vegetative stage, however, a small number of plants escaped grazing and developed normally providing the phenological development data. Crude protein (N X 6.25) content was determined by the procedure outlined in the Official and Tentative Methods of Analysis (A.O.A.C. 1945). Phosphorus content was determined by the method outlined by Bolin and Stamberg (1944). Data were reported as percent of oven-dried weight.

Plant condition by stage of plant development and growth habit was collected for each species on sample dates. These data are reported as phenological growth stage in the current report. The grass nutritional quality and phenological growth data were published in Whitman et al. 1951.

The 1955-1962 Study

Grass and upland sedge tiller growth in height of leaves and stalks were collected from ungrazed plants during the growing seasons of 1955-1962. Basal leaves were measured from ground level to the tip of the extended leaves. Culm leaves were measured from ground level to the apex of the uppermost leaf. Stalk measurements were from ground levels to the tip of the stalk or to the tip of the inflorescence after it had developed. An average of 10 plants of each species were measured at approximate 7 to 10 day intervals from early May until early September. In addition, phenological growth stages were recorded to include stalk initiation, head emergence, flowering (anthesis), seed development, seed maturity, earliest seed shedding, and an estimation of percent of leaf dry in relation to total leaf area. The grass growth in height and phenological data were reported in Goetz 1963.

The 1964-1969 Study

Phenological data of grass and upland sedge at anthesis stage was determined by recording observation dates. Leaf senescence by date was determined as an estimation of percentage of dry leaf in relation to total leaf area. Grass and upland sedge tiller growth in height of leaves were collected from ungrazed plants during the growing seasons of 1964-1966. Basal leaves were measured from ground level to the tip of the extended leaf. Culm leaves were measured from ground level to the apex of the uppermost leaf. An average of 20 plants at approximately 7 to 10 day intervals during the growing season from mid April to late August from control treatment on sandy, silty, overflow, and thin claypan ecological sites. Phenological data of anthesis stage, leaf senescence, and growth in leaf height were reported in Goetz 1970. Crude protein content of grasses and upland sedges was determined from a composite of 10 samples of each species collected systematically at biweekly intervals from mid May to early September, 1964-1969 on sandy, silty, overflow, and thin claypan ecological sites. Plant material was oven dried at 105°F. Analysis of the samples were made by the Cereal Technology Department, North Dakota State University, using standard crude protein determinations and reported in Goetz 1975.

The 1969-1971 Study

The range of flowering time of grasses and upland sedges were determined by recording daily observations of plants at anthesis on several prairie habitat type collection locations distributed throughout 4,569 square miles of southwestern North Dakota. The daily observed flowering plant data collected during the growing seasons of 1969 to 1971 from April to August were reported as flower sample periods with 7 to 8 day duration in Zaczkowski 1972.

The 1983-2012 Study

A long-term change in grass and upland sedges species abundance study was conducted during active plant growth of July and August each growing season of 1983 to 2012 (30 years) on native rangeland pastures at the Dickinson Research Extension Center ranch located near Manning, North Dakota. Effects from three management treatments were evaluated: 1) long-term nongrazing, 2) traditional seasonlong grazing, and 3) twice-over rotation grazing. Each treatment had two replications, each with data collection sites on sandy, shallow, and silty ecological sites. Each ecological site of the two grazed treatments had matching paired plots, one grazed and the other with an ungrazed exclosure. The sandy, shallow, and silty ecological sites were each replicated two times on the nongrazed treatment, three times on the seasonlong treatment, and six times on the twice-over treatment.

During the initial phase of this study, 1983 to 1986, the long-term nongrazed and seasonlong treatments were at different locations and moved to the permanent study locations in 1987. The data collected on those two treatments during 1983 to 1986 were not included in this report.

Abundance of each grass and upland sedge species was determined with plant species basal cover by the ten-pin point frame method (Cook and Stubbendieck 1986). The point frame method was used to collect data at 2000 points along permanent transect lines at each sample site both inside (ungrazed) and outside (grazed) each exclosure. Basal cover, relative basal cover, percent frequency, relative percent frequency, and importance value were determined from the ten-pin point frame data. Point frame data collection period was 1983 to 2012 on the twice-over treatment and was 1987 to 2012 on the long-term nongrazed and on the seasonlong treatments. However, point frame data was not collected during 1992 on the sandy ecological sites of all three treatments.

During some growing seasons, the point frame method did not document the presence of a particular plant species which will be reflected in the data summary tables as an 0.00 or as a blank spot.

The 1983-2012 study attempted to quantify the increasing or decreasing changes in individual plant species abundance during 30 growing seasons by comparing differences in the importance values of individual species during multiple year periods. Importance value is an old technique that combines relative basal cover with relative frequency producing a scale of 0 to 200 that ranks individual species abundance within a plant community relative to the individual abundance of the other species in the community during the growing season. Basal cover importance value ranks the grasses, upland sedges, forbs, and shrubs in a community. The quantity of change in the importance value of an individual species across time indicates the magnitude of the increases or decreases in abundance of that species relative to the changes in abundance of the other species.

Results

Thickspike wheatgrass and Western wheatgrass are difficult to separate in the field during ecological data collection. The standard morphological separation characteristics with Western wheatgrass having stiff blue-green leaves, single stems not tufted, no hairs on glumes, and purple auricles and thickspike wheatgrass having light green leaves, tufted stems, fine hairs on glumes, and white auricles are not truly definitive separators. All of these characteristics are highly variable with changing environmental conditions. As a result Western wheatgrass and Thickspike wheatgrass have become an ecological complex during these studies, with Western wheatgrass composing much greater than 50% of the complex. The ecological study results have been placed with the Western wheatgrass report, DREC 17-1155.

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