Autecology of White wild onion on the Northern Mixed Grass Prairie

Llewellyn L. Manske PhD
Research Professor of Range Science
North Dakota State University
Dickinson Research Extension Center
Report DREC 17-1126

The autecology of White wild onion, *Allium textile*, 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).

White wild onion, *Allium textile* A. Nelson & J.F. Macbride, is a member of the lily family, Liliaceae, and is a native, perennial, cool season, monocot, herb. The first North Dakota record is Waldron 1904. Annual aerial growth has no stems (acaulescent), only two equal, rounded basal leaves 10-15 cm (3.9-5.9 in) long, 2-4 mm wide, arising from a whorl atop an egg shaped (ovoid) bulb 2-2.5 cm (0.8-1.0 in) in diameter, covered with a coarse fiberous coat, with thick, fleshy, white tunicate scales inside. The root system has numerous short tufted roots arising from the base of the bulb. Regeneration is by vegetative and sexual reproduction. Vegetative growth is by annual leaf shoots from the top of the bulb. A second and third bulb sometimes develop. Inflorescence is a compact, hemispheric umbel of 15-30 flowers on top of a solitary erect leafless peduncle (scape) 10-20 cm (3.9-7.9 in) tall, that is round in cross sections. Flowers are perfect, bell shaped 6 mm in diameter, with white tepals appearing during mid May to mid June. Pollination is by bees and other insects. Fruit is a capsule 2-3 mm long that splits into 3 parts each with 1-2 seeds. Aerial parts are not usually eaten by livestock and are top killed by fire. Damage to aerial leaves and scape activates regrowth shoots from the top of the bulb. This summary information on growth development and regeneration of white wild onion was based on works of Stevens 1963, Zaczkowski 1972, Great Plains Flora Association 1986, Stubbendieck et al. 2003, and Larson and Johnson 2007.

Procedures

The 1955-1962 Study

White wild onion plant growth in height was determined by measuring ungrazed stems from ground level to top of leaf or to the tip of the inflorescence of an average of 10 plants of each species at approximately 7 to 10 day intervals during the growing seasons of 1955 to 1962 from early May until early September. Dates of first flower (anthesis) were recorded as observed. These growth in height and flower data were reported in Goetz 1963.

The 1969-1971 Study

The range of flowering time of White wild onion was 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 study on change in abundance of White wild onion 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 White wild onion was determined with plant species stem density by 0.1 m^2 frame density method and with plant species basal cover by the ten-pin point frame method (Cook and Stubbendieck 1986).

The stem density method was used to count individual stems of each plant species rooted inside twenty five 0.1 m^2 quadrats placed along permanent transect lines at each sample site both inside (ungrazed) and outside (grazed) each exclosure. Stem density per 0.1 m^2 quadrat, relative stem density, percent frequency, relative percent frequency, and importance value were determined from the stem density data. Plant species stem density data collection was 1984, 1986 to 2012 on the twice-over treatment and was 1987 to 2012 on the long-term nongrazed and seasonlong treatments. However, stem density data was not collected during 1991, 1993 to 1997 on the sandy, shallow, and silty ecological sites of all three management treatments, stem density data was not collected during 1992 on the sandy ecological site of all three management treatments, and stem density data was not collected during 1999 on the sandy and silty ecological sites of the long-term nongrazed treatment.

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 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 or the stem density 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 density or 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 a growing season. Density importance value ranks the forbs and shrubs and 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

White wild onion resumed growth in early spring with two rounded basal leaves arising from nodes in a whorl on top of an egg shaped bulb which has short tufted roots arising from nodes at the base of the bulb. Additional bulbs can be produced vegetatively by bulbels arising from nodes at the base. No stems develop (acaulescent). A compact umbel of 15 to 30 small flowers with white tepals form on top of a solitary erect leafless scape that arises from nodes on top of the bulb. On the fall grazed pastures of the 1955-1962 study, the earliest first flowers appeared 12 May, the mean first flowers occurred on 20 May, and the 4 week flower period extending from mid May to mid June was observed during the 1969-1971 study (table 1) (Goetz 1963, Zaczkowski 1972). The mean flower stalk height of 10.3 cm (4.1 in) with an annual variance in height from 10.0 cm (4.0 in) to 11.0 cm (4.3 in) was reached during July (table 2) (Goetz 1963). The reported normal flower stalk height in the Northern Plains ranged from 10 cm to 20 cm (4.0-8.0 in) tall. The flower stalks measured during the 1955-1961 study were within the short end of normal height in the Northern Plains.

Plant species composition in rangeland ecosystems is variable during a growing season and dynamic among growing seasons. White wild onion was found in low abundance only on the shallow ecological sites. Patterns in the changes in individual plant species abundance was followed for 30 growing seasons during the 1983-2012 study on the shallow ecological sites of the long-term nongrazed, traditional seasonlong, and twice-over rotation management treatments.

On the shallow site of the nongrazed treatment, White wild onion was present during 5.3% and 3.9% of the years that density and basal cover data were collected with a mean 0.02 stems/m^2 density and a mean 0.004% basal cover during the total 30 year period, respectively. During the early period (1983-1992), White wild onion was not present on the shallow site of the nongrazed treatment. During the middle period (1993-1997), White wild onion was present during 20.0% of the years that basal cover data were collected with a mean 0.02% basal cover. During the later period (1998-2012), White wild onion was present during 7.1% of the years that density data were collected with a mean 0.03 stems/m^2 density. White wild onion was present during 6.7% of the years, the growing seasons of 1996 and 2009, on the shallow site of the nongrazed treatment.

On the shallow site of the ungrazed seasonlong treatment, White wild onion was not present during the total 30 year period.

On the shallow site of the ungrazed twice-over treatment, White wild onion was present during 18.2% and 3.5% of the years that density and basal cover data were collected with a mean 0.09 stems/m^2 density and a mean 0.003% basal cover during the total 30 year period, respectively. During the early period (1983-1992), White wild onion was present during 14.3% of the years that density data were collected with a mean 0.06 stems/m^2 density. During the middle period (1993-1997), White wild onion was present during 20.0% of the years that basal cover data were collected with a mean 0.02% basal cover. During the later period (1998-2012), White wild onion was present during 20.0% of the years that density data were collected with a mean 0.11 stems/m^2 density. White wild onion was present during 16.7% of the years, the growing seasons of 1986, 1996, 2003, 2007, and 2009, on the shallow site of the ungrazed twice-over treatment.

On the shallow site of the grazed twice-over treatment, White wild onion was not present where basal cover data were collected and was present during 9.1% of the years that density data were collected with a mean 0.06 stems/m^2 density during the total 30 year period. During the early period (1983-1992), White wild onion was present during 14.3% of the years with a mean 0.06 stems/m^2 density. During the later period (1998-2012), White wild onion was present during 6.7% of the years with a mean 0.05 stems/m^2 density. White wild onion was present during 6.7% of the years, the growing seasons of 1987 and 2009, on the shallow site of the grazed twice-over treatment.

White wild onion was present 9 times during 6 growing seasons, 20.0% of the years. It was present on one treatment each during 1986, 1987, 2003, and 2007; present on two treatments during 1996; and present on three treatments during 2009. White wild onion is a perennial monocot that has two round and channeled leaves 10-15 cm (3.9-5.9 in) long and 2-4 mm wide, making this plant difficult to observe when the flowers are not present. During dry conditions, aerial parts can become senescent early. Conversely, when conditions are wet, senescence of aerial parts is delayed. White wild onion is a highly dynamic member of the mixed grass prairie plant community.

Discussion

White wild onion, *Allium textile*, is a native, late succession, cool season, perennial, monocot forb of the lily family that is present at low abundance on healthy mixed grass prairie plant communities. White wild onion grows best on shallow ecological sites. Annual aerial growth arises from a perennating bulb that has a whorl of nodes on the top and base. Short tufted roots arise from nodes at the base of the bulb. Vegetative secondary bulbs can develop as bulbels from nodes on the base. Two round and channeled leaves and an erect leafless scape arise from a whorl of nodes on the top of the bulb . A cluster of small flowers with white tepals form in a compact umbel at the top of the leafless scape. The mean first flower date is 20 May (1955-1962 study) with a four week flower period from mid May to mid June (1969-1971 study). Mean flower stalk height reached during July was 10.3 cm (4.1 in) (1955-1962 study). White wild onion grows best on shallow ecological sites and it has dynamic appearances in the mixed grass prairie plant communities. During the total period of 30 growing seasons, White wild onion was never present on the seasonlong treatment, it was present two times (6.7%) on the nongrazed treatment, and it was present 7 times during the 6 growing seasons (20.0%) on the twice-over treatment.

The perennating bulb with active nodes on the top and base help White wild onion to persist through the harsh conditions of the Northern Mixed Grass Prairie.

Acknowledgment

I am grateful to Sheri Schneider for assistance in the production of this manuscript and for development of the tables.

Table 1. First flower and flower period of Allium textile, White wild onion.

	Apr	May	Jun	Jul	Aug	Sep
First Flower						
1955-1962						
Earliest		12				
Mean		20				
Flower Period						
1969-1971		XX	XX			

First Flower data from Goetz 1963.
Flower Period Data from Zaczkowski 1972.

Table 2. Autecology of Allium textile, White wild onion, with growing season changes in mature height.

				Percent of Mature Height Attained					
Data Period	Minimum Annual Mature Height cm	Maximum Annual Mature Height cm	Mean Mature Height cm	Apr %	May %	Jun %	Jul %	Aug %	Sep %
1955-1962	10.0	11.0	10.3	65.6	85.7	93.9	100.0		

Data from Goetz 1963.

Table 3. Autecology of Allium textile, White wild onion, with growing season changes in density importance value, 1983-2012.					
Ecological Site Year Period	Nongrazed	Seasonlong		Twice-over	
		Ungrazed	Grazed	Ungrazed	Grazed
Sandy					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					
Shallow					
1983-1987	0.00	0.00	0.00	0.48	2.97
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.00	0.00	0.00	0.00	0.00
1999-2003	0.00	0.00	0.00	0.66	0.00
2004-2009	0.54	0.00	0.00	0.67	0.48
2010-2012	0.00	0.00	0.00	0.00	0.00
Silty					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					

Table 4. Autecology of Allium textile, White wild onion, with growing season changes in basal cover importance value, 1983-2012.					
Ecological Site Ten Year Period	Nongrazed	Seasonlong		Twice-over	
		Ungrazed	Grazed	Ungrazed	Grazed
Sandy					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					
Shallow					
1983-1987	0.00	0.00	0.00	0.00	0.00
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.18	0.00	0.00	0.15	0.00
1999-2003	0.00	0.00	0.00	0.00	0.00
2004-2009	0.00	0.00	0.00	0.00	0.00
2010-2012	0.00	0.00	0.00	0.00	0.00
Silty					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					

Table 5. Autecology of Allium textile, White wild onion, with growing season changes in density, 1983-2012.					
Ecological Site Year Period	Nongrazed	Seasonlong		Twice-over	
		Ungrazed	Grazed	Ungrazed	Grazed
Sandy					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					
Shallow					
1983-1987	0.00	0.00	0.00	0.01	0.01
1988-1992	0.00	0.00	0.00	0.00	0.00
1993-1998	0.00	0.00	0.00	0.00	0.00
1999-2003	0.00	0.00	0.00	0.01	0.00
2004-2009	0.01	0.00	0.00	0.02	0.01
2010-2012	0.00	0.00	0.00	0.00	0.00
Silty					
1983-1987	Few Plants Present				
1988-1992					
1993-1998					
1999-2003					
2004-2009					
2010-2012					

Literature Cited

Cook, C.W., and J. Stubbendieck. 1986. Range research: basic problems and techniques. Society for Range Management, Denver, CO. 317p.

Goetz, H. 1963. Growth and development of native range plants in the mixed prairie of western North Dakota. M. S. Thesis, North Dakota State University, Fargo, ND. 165p.

Great Plains Flora Association. 1986. Flora of the Great Plains. University of Kansas, Lawrence, KS.

Johnson, J.R., and G.E. Larson. 2007. Grassland plants of South Dakota and the Northern Great Plains. South Dakota University. B 566 (rev.). Brookings, SD.

Manske, L.L. 2016. Autecology of prairie plants on the Northern Mixed Grass Prairie. NDSU Dickinson Research Extension Center. Range Research Report DREC 16-1093. Dickinson, ND.

Stevens, O.A. 1963. Handbook of North Dakota plants. North Dakota Institute for Regional Studies. Fargo, ND.

Stubbendieck, J., M.J. Coffin, and L.M. Landholt. 2003. Weeds of the Great Plains. Nebraska Department of Agriculture. Lincoln, NE.

Weaver, J.E. 1954. North American Prairie. Johnson Publishing Co. Lincoln, NE.

Weaver, J.E., and T.J. Fitzpatrick. 1934. The Prairie. Ecological Monographs 4(2):109-295.

Zaczkowski, N.K. 1972. Vascular flora of Billings, Bowman, Golden Valley, and Slope Counties, North Dakota. PhD. Thesis. North Dakota State University, Fargo, ND. 219 p.