# Factors Causing Hollow-Crown or Ring Grass Patterns

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Weaver and Albertson (1956 p. 218) describe ring grass as having a mat-like growth that frequently had dead centers. This pattern is similar to ones reported by Strickland (1983) for a number of species and by Jansen (1988) for semidesert needlegrasses in Libya. In semiarid areas of western South Dakota, ring patterns or hollow-crowns have been observed for blue grama and little bluestem where plant densities were low. The following are some factors which seemed to explain ring-growth patterns in South Dakota. Possibly, these factors are applicable to other areas.

## Observations and Discussion

All ring growth patterns have been observed in South Dakota where plants were surrounded by bare ground. Light, air, soil water, and soil nutrients are more available to the expanding edges of the crown than to the older center of the crown. Hollow centers tend to form more as the crown diameter increases (Pechanec et al. 1937). Blue grama grown in the greenhouse for several years develops a crown that is pedestalled on roots that extend one to two centimeters above the soil. The roots are exposed to parasites and disease, and the plant looses vigor. Similar crown pedestaling occurs in unutilized bunches of blue grama and little bluestem in range. Blue grama with ring growth has been observed on exposed ridges where plant densities probably were low because of low water availability.

A plant surrounded by bare soil uses soil water first near the crown, then gradually in an expanding hemisphere away from the crown. As the water is removed from between mineral grains, the soil contracts toward the crown, and eventually a vertically oriented subsoil crack develops below the outer edge of the crown. Although the

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*Subsoil cracks, which could disrupt ring-growth patterns, frequently collect dark-colored surface soil.*

crack may not be open at the surface, water tends to moisten soil along the crack more rapidly than in the adjacent soil (Blake et al. 1973). This subsoil water is used by the peripheral portion of the crown to enhance its growth.

Water added to the subsoil causes it to swell and close the crack. In the next cycle of drying, the location of the crack may move slightly outward from the former crack to the next boundary between prism structural units in the soil. These prisms are small near the soil surface. With depth, several are joined at their bases into a larger prism. As the larger prism below dries, the small prisms attached to it are moved closer to each other and the crack that was between them is at least partially closed except for the crack that lies along the edge of the larger subsoil prism. This crack becomes wider and commonly extends to the soil surface during droughts. Cracks rarely form through dense crown mats, possibly because cracking is very detrimental to root systems such as those of blue grama (Hubbard 1950). The width of large prisms may limit the distance between large cracks and the maximum size of the ring patterns. In South Dakota, the maximum ring size has been about 10 to 20 inches (White 1986), which would correspond to prism sizes at a depth of 20 inches. As the ring enlarges, water becomes equally as available on either side of the ring and ring enlargement should stop.

Worrall (1959) reported that grass patterns developed on the contour in Africa. Water runoff collected in cracks, and grass downslope from the crack grew more rapidly than grass at other locations. The crack and accompanying strip of grass moved upslope each year. Although this has not been observed in South Dakota, in more arid areas the upslope side of ring growth may enlarge more rapidly than the downslope side. Wickens and Collier (1971) describe a number of vegetation patterns, some observable only from airplanes or aerial photographs. They concluded that vegetational patterns were formed because of moisture availability. Plants with wide crowns probably form in South Dakota where low soil water and/or fertility cause plant densities to be low. Eventually ring or hollow-crown patterns form as a result of drought, old age, or overgrazing (Pechanec et al. 1937; Chamrad and Box 1965; Cole and Wilkins 1958).

Heavy grazing decreases top and root growth while ungrazed plants have more top and root growth. Plants in either situation eventually can not absorb sufficient soil water and nutrients to maintain an enlarging crown. Some of it dies. Ring growth allows a plant to divide into several plants where plants from seed might fail or be genetically less suited to the site. Ring growth probably is a natural adaptation a plant has to maintain itself under unfavorable conditions either created by its own crown enlargement or by environmental conditions. Grazing practices probably should not be altered to encourage or discourage ring or hollow-crown growth.

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