

Kansas Agricultural Experiment Station Research Reports

Volume 6
Issue 3 *Roundup*

Article 4

2020

Saline Experimental Range Dormant Season Wildfire: Short-Term Effect on Forage Production and Plant Composition

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Recommended Citation

Harmoney, Keith R. (2020) "Saline Experimental Range Dormant Season Wildfire: Short-Term Effect on Forage Production and Plant Composition," *Kansas Agricultural Experiment Station Research Reports: Vol. 6: Iss. 3.* <https://doi.org/10.4148/2378-5977.7901>

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Saline Experimental Range Dormant Season Wildfire: Short-Term Effect on Forage Production and Plant Composition

Abstract

Rangeland wildfires in the southern plains may occur any time of year, but the low humidity, increasing temperatures, and dry and abundant fuel load of late winter and early spring can result in greater wildfire occurrence and severity. Fires that occur before the growing season remove standing residual vegetation and greatly reduce litter cover, so the soil surface may be left bare for several weeks or months before the onset of new pasture growth. Exposure of plant buds to cold temperatures during dormancy, soil water evaporation, and soil crusting from the force of falling precipitation and puddling may lead to the eventual loss of plant density and available soil moisture for plant growth following wildfire. Information collected from a previous wildfire that occurred during mid-March at the Kansas State University Agricultural Research Center–Hays showed that forage production was significantly reduced for two years following the fire. However, timing and conditions leading up to wildfires and conditions following wildfires may allow pastures to respond to each fire differently. In the week of March 5-11, 2017, several wildfires ignited throughout central and western Kansas. One of those fires was the largest known wildfire in Kansas history, the Starbuck Fire, that consumed more than 460,000 acres of Kansas land in Clark, Meade, and Comanche counties. Another fire ignited on the Kansas State University Saline Experimental Range (SER) in northeast Ellis County on March 7, 2017.

Keywords

bunchgrass, litter cover, rhizomatous species, stoloniferous species

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Saline Experimental Range Dormant Season Wildfire: Short-Term Effect on Forage Production and Plant Composition

Keith Harmoney

Introduction

Rangeland wildfires in the southern plains may occur any time of year, but the low humidity, increasing temperatures, and dry and abundant fuel load of late winter and early spring can result in greater wildfire occurrence and severity. Fires that occur before the growing season remove standing residual vegetation and greatly reduce litter cover, so the soil surface may be left bare for several weeks or months before the onset of new pasture growth. Exposure of plant buds to cold temperatures during dormancy, soil water evaporation, and soil crusting from the force of falling precipitation and puddling may lead to the eventual loss of plant density and available soil moisture for plant growth following wildfire. Information collected from a previous wildfire that occurred during mid-March at the Kansas State University Agricultural Research Center–Hays showed that forage production was significantly reduced for two years following the fire. However, timing and conditions leading up to wildfires and conditions following wildfires may allow pastures to respond to each fire differently. In the week of March 5-11, 2017, several wildfires ignited throughout central and western Kansas. One of those fires was the largest known wildfire in Kansas history, the Starbuck Fire, that consumed more than 460,000 acres of Kansas land in Clark, Meade, and Comanche counties. Another fire ignited on the Kansas State University Saline Experimental Range (SER) in northeast Ellis County on March 7, 2017.

Experimental Procedures

The SER pasture area is native, untilled rangeland and consists mostly of blue shale, limy slopes, shallow limy, and loamy plains ecological sites. Dry, dormant grass was abundant, humidity was near 10%, and winds were gusting over 30 mph when the wildfire started. Approximately 6500 acres of rangeland was consumed by the quick spreading fire. The pasture area at the SER that was burned had permanent transects for monitoring rangeland production and plant composition. Transects were in place for two growing seasons before the wildfire occurred. A total of sixteen transects, each approximately 100 yards in length, were established on north, south, east, and west facing slopes in two 800-acre pastures. Along each transect, pasture biomass was estimated by dropping a weighted plate meter in the canopy and measuring the height of the plate to which the forage held the plate above the soil surface. Forage was clipped in a frame directly under

the plate and then dried, and a linear calibration equation of the height:forage yield relationship was created from all height and yield measurements. Extra plate height measurements were collected along each transect, and within each year and sampling period the plate height readings for a transect were averaged. The average height for a transect was inserted into the calibration linear equation derived for that particular year and period to estimate available dry matter of the transect. In alternating years, a modified step point method was used to record bare soil, litter, plant basal cover, and the nearest plant species from 100 points along each transect to estimate ground cover and plant species composition. Pastures with transects were grazed starting in May with the same stocking density all five years of data collection, although stocking was deferred until June after the wildfire in 2017.

Results and Discussion

In the two years prior to the fire, growing season precipitation was just below average in 2015 and well above average in 2016. Available standing forage in late July averaged across both years was 1770 lb/acre. In 2017, the year of the wildfire, available dry matter was just over 1330 lb/acre in late July. Dry matter was reduced about 25% compared to the average of 2015 and 2016, even though similar precipitation occurred in the spring of 2017. In 2018, available dry matter once again was near 1770 lb/acre, even though precipitation in April, May, and June was less than 65% of 2016 and 2017 during the same months. In 2019, available dry matter production by the end of July nearly reached 1670 lb/acre with precipitation in April, May, and June similar to 2018 (Table 1).

In 2015, litter covered 59% of the soil surface, but following the wildfire litter cover was reduced to 23% of the soil surface. Reductions in litter cover are usually expected following both wildfire and prescribed fire. Plant basal cover was reduced by just under 1%, from 7% to near 6% of the soil surface. Big bluestem (*Andropogon gerardii*), western wheatgrass (*Pascopyrum smithii*), and buffalograss (*Bouteloua dactyloides*) all increased their plant composition in the stand. Little bluestem (*Schizachyrium scoparium*), blue grama (*Bouteloua gracilis*), and western ragweed (*Ambrosia psilostachya*) all slightly declined in plant composition. Therefore, rhizomatous and stoloniferous grass species slightly increased in composition following the wildfire, while bunchgrass species slightly declined following the wildfire.

In 2019, the third growing season after the fire, litter cover greatly increased 47% and bare soil was greatly reduced. Litter cover was fully restored within two complete growing seasons after the wildfire. Rhizomatous species such as western wheatgrass and big bluestem that increased directly following the fire in 2017 had slight reductions in 2019. The bunchgrass little bluestem and short rhizome species sideoats grama (*Bouteloua curtipendula*) had small increases in basal composition from 2017 to 2019. Western ragweed composition declined in 2017 after the fire and had another small decline from 2017 to 2019. By the end of the third full growing season following the wildfire, composition of most grass species returned close to pre-wildfire levels (Table 2).

Implications

Even though timely precipitation occurred in the spring directly following the wildfire, forage production was reduced that season, although not to the extent of previous wildfires. The substantial loss of litter cover and consequential loss of water from runoff and evaporation prior to the onset of new growth is a likely reason that forage production was reduced in the first year following dormant season wildfire. Negative effects on forage production will be lessened with shorter time frames between burning and new growth emergence and with greater precipitation following the fire. Forage production may not be affected past the first growing season. Bunchgrass species, such as little bluestem and blue grama, are most susceptible to stand reductions following dormant season wildfires, while rhizomatous and stoloniferous grass species are most likely to be unaffected and may increase following wildfire. Over time, plant composition will likely return to pre-fire proportions if stocking management is not significantly altered.

Table 1. Available dry matter in July of each year prior to the wildfire, during 2017 in the year of the wildfire, and the two years after the wildfire

| Year | Yield (lb/acre) | |
|------|-----------------|--------------|
| 2015 | 1583 | Average 1773 |
| 2016 | 1963 | |
| 2017 | 1335 | |
| 2018 | 1772 | Average 1721 |
| 2019 | 1669 | |

Table 2. Soil cover traits and plant species composition prefire in 2015, the year of the fire in 2017, and postfire in 2019

| | 2015 | 2017 | 2019 | 2015–2017 Change | 2017–2019 Change |
|--------------------|---------------|------|------|---------------------|---------------------|
| Soil cover trait | ----- % ----- | | | | |
| Basal cover | 0.07 | 0.06 | 0.05 | -0.01 | -0.01 |
| Litter cover | 0.59 | 0.23 | 0.70 | -0.37 | 0.47 |
| Bare soil | 0.34 | 0.71 | 0.25 | 0.37 | -0.46 |
| Plant species | | | | | |
| Western wheatgrass | 0.02 | 0.04 | 0.02 | 0.02 | -0.01 |
| Big bluestem | 0.14 | 0.19 | 0.16 | 0.05 | -0.03 |
| Little bluestem | 0.28 | 0.24 | 0.26 | -0.04 | 0.02 |
| Sideoats grama | 0.27 | 0.27 | 0.29 | 0.00 | 0.02 |
| Blue grama | 0.04 | 0.02 | 0.03 | -0.02 | 0.00 |
| Buffalograss | 0.07 | 0.08 | 0.07 | 0.02 | -0.01 |
| Western ragweed | 0.06 | 0.03 | 0.01 | -0.03 | -0.02 |



Figure 1. A Saline Experimental Range pasture site one month following the wildfire on March 7, 2017.



Figure 2. The same Saline Experimental Range pasture site two months following the wildfire on March 7, 2017.



Figure 3. Bunchgrass species such as these little bluestem plants are most susceptible to stand reductions following dormant season wildfires. Notice the lack of new tillers in the little bluestem crown on the left compared to the right.