Summer fire effects on plant tissue class in the Northern Great Plains

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ABSTRACT: The objectives of this study were to evaluate the effects of summer fire on plant biomass and tissue class in the Northern Great Plains one year following fire. Sites were located near Miles City, MT. Four replicated 0.75-ha plots were burned in August 2003 and four plots were burned in August 2004. Four separate replicated control plots were used for each burn year. Biomass was clipped in early April, mid-July and early September of the year following burn. Ten 0.25 m^2 quadrats were clipped to the ground within each plot and sorted by the species classes of sedge, cool-season grasses, warm-season grasses, annual grasses, and forbs. After drying and weighing for total biomass, samples were sorted into live (greater than 50% green) and dead (less than 50% green) components, re-weighed and combined within plot and live:dead component. Data were analyzed using mixed model procedures with treatment, clipping month, and plot within treatment as fixed effects and burn year as a random effect. Total biomass was decreased by burning (1031 v 616 ± 63 kg/ha for Control and Burned plots, respectively), however, the amount of live tissue was not affected by treatment (304 v 289 ± 25 kg/ha for Control and Burned plots, respectively). Differences in total biomass due to burning were the result of decreased dead tissue biomass on Burned plots (731 v 332 ± 54 kg/ha for Control and Burned plots, respectively). Treatment effects did not interact with time of sampling. We conclude that summer burning decreased plant biomass in the following year by removing standing dead tissue without affecting new growth.

OBJECTIVE: Evaluate the effects of summer fire on plant and tissue class biomass and mineral concentrations in the Northern Great Plains one year following fire

METHODS:

- Near Miles City, MT.
- Four replicated 0.75-ha plots were burned in August 2003 and four plots were burned in August 2004. Four separate replicated Control plots were used for each burn year.
- Biomass was clipped in early April, mid-July and early September of the year following burn.
- Ten 0.25 m^2 quadrats were clipped to the ground within each plot
- Biomass was sorted by the species classes of sedge, cool-season grasses, warm-season grasses, annual grasses, and forbs.
- After drying and weighing for total biomass, samples were sorted into live (greater than 50% green) and dead (less than 50% green) components, re-weighed and combined within plot and live:dead component.
- Mineral analysis was conducted on samples large enough for analysis. Only cool season grass mineral data is reported here.

Data were analyzed using mixed model procedures with treatment, clipping month, and plot within treatment as fixed effects and burn year as a random effect.

RESULTS:

TOTAL PLANT BIOMASS

- Total biomass was decreased by burning (1031 v 616 ± 63 kg/ha for Control and Burned plots, respectively).
- Amount of live tissue was not affected by treatment (304 v 289 ± 25 kg/ha for Control and Burned plots, respectively).

Differences in total biomass due to burning were the result of decreased dead tissue biomass on Burned plots (731 v 332 ± 54 kg/ha for Control and Burned plots, respectively).

COOL SEASON GRASS BIOMASS

- In April, a greater amount of dead biomass was present in the control compared to burned plots (Table 1).
- By July, biomass of live tissue had increased in both Control and Burned plots and no differences among burn treatments or live and dead biomass occurred.
- By August, dead tissue had increased in both Control and Burned plots, resulting in no differences in amount of dead tissue or in amount of live tissue between Control and Burned plots. The amount of live biomass was less than the amount of dead biomass in both Control and Burned plots.

Table 1. Cool season biomass by tissue type (live versus dead) on three dates over 2 years from Control plots or plots burned the previous summer.

	Live	Dead	TOTAL
Control	----------kg/ha----------		
April	93.8^{A}	396.4^{B}	
July	262.8	342.8	
August	129.0^{C}	460.8^{D}	
AVERAGE	161.9^{a}	400.0^{b}	280.9^{c}
Burn			
April	30.0^{B}	30.5^{B}	
July	326.5	210.3	
August	153.1^{C}	395.5^{D}	
AVERAGE	169.9^{b}	212.1^{b}	191.0^{d}

^{AB} Means from April with differing superscripts differ, P < 0.05
^{CD} Means from August with differing superscripts differ, P < 0.05
^{ab} Means from AVERAGE with differing superscripts differ, P < 0.05
^{cd} Means from TOTAL with differing superscripts differ, P < 0.05

MINERALS IN COOL SEASON GRASS COMPONENT

- Concentrations of TKN, K, Ca, Mg and Mn were greater in dead material from Burned plots than from Control plots due to the difference in age of the standing dead between treatments (Figure 1).
- Total amount of all minerals in live plant tissue did not differ between control and burned plots.
- Concentrations of P were greater in live tissue of Control than Burned plots.
- Due to the increased biomass of standing dead in the Control plots, the amounts (weight /ha) of TKN, P, Ca, Mg, and Mn in plant biomass was greatest in dead material on Control plots.

Total amounts of plant TKN, P, Ca Mg, and Mn were greater in Control than Burned plots. Total amounts of K were not affected by burning even though concentration in dead tissue was greater in Burned than Control plots.

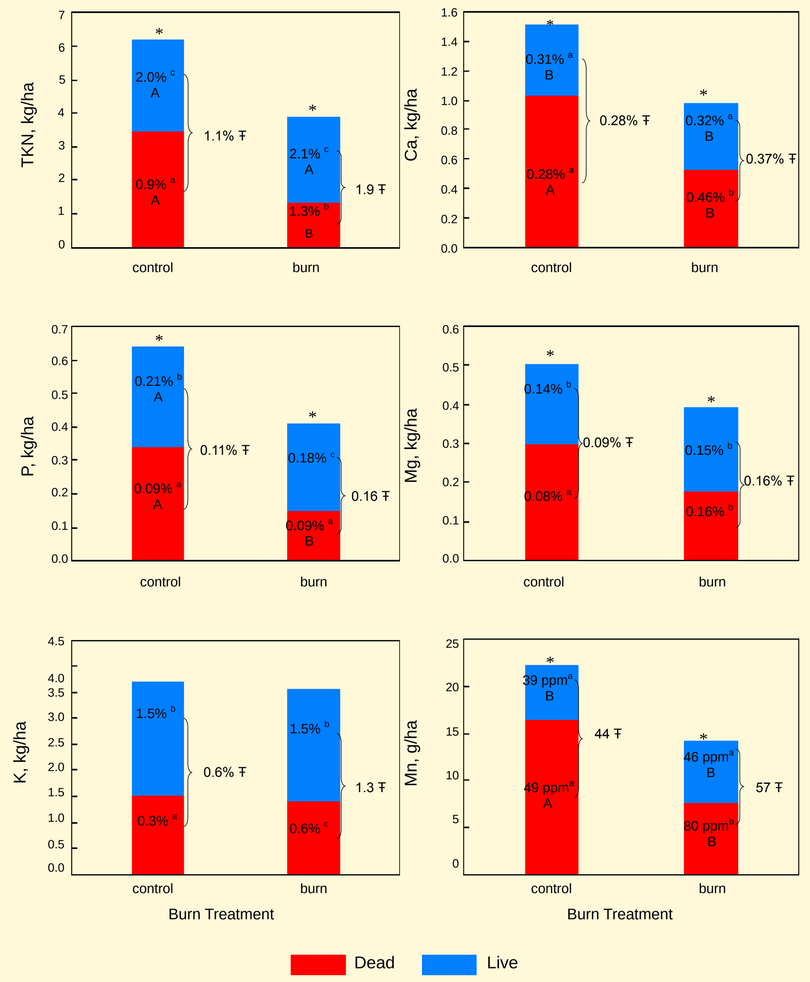

FIGURE 1. Minerals in cool season plant biomass from live and dead tissue on Control and Burned plots averaged across three clipping dates and 2 years for plots burned the previous summer. Boxes represent the amount (kg/ha) of each mineral in live or dead tissue for each burning treatment. Differing upper case letters within each box signify significant differences. Asterisks represent significant differences in total plant (live + dead) mineral amounts as affected by burning. Numbers within each box are the concentration of mineral (% or ppm) present in each tissue component as affected by burning. Lower case letters signify significant differences in mineral concentrations. The number next to the bracket outside of each box indicates total plant mineral concentrations. Symbol indicates significant differences in total plant mineral concentration.

Take home message:

- Summer reduced plant biomass by removing standing dead
- Productivity was not affected
- TKN, Ca, Mg, and Mn concentrations were lower in standing dead of non-burned plots
- Total amounts of plant TKN, P, Ca, Mg and Mn were greater in non-burned plots even though burning increased mineral concentrations in cool season grasses.
- Increased concentrations of total plant TKN, P, K, and Mg following fire suggest potential differences in meeting nutrient requirements of grazing livestock.