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Productivity loss due to fire in a semi-arid rangeland of South Africa

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Key words : aboveground phytomass production , fuel load , regrowth

Introduction Accidental , runaway veld fires will not only have a short-term influence on productivity of the rangeland ecosystem , but may also have a major residual effect on the next growing season , depending on subsequent climatic conditions and post-fire management (Snyman , 2003) . It was the objective of this study to estimate the short-term impact of fire , which is a normal phenomenon in the semi-arid areas , on the sustainability of the ecosystem .

Material and methods The research was conducted in a semi-arid summer rainfall (annual average—560 mm) region of South Africa (28°50'S ; 26°15' E , altitude 1350 m) . The study area is situated in the moist , cool Highveld grassland . Soils are mostly fine , sandy loams . The research was conducted on six plots of 3 m × 10 m each , re-applied every year on a new area (on the same soil form) , over a 10-year period (1995/96—2004/05 season) . Each plot was monitored only over a two year period . The treatments randomly applied , consisted of the burning (head fire) of a plot and a control without burning . The burning treatment was applied each year at the end of August by which time the grass fuel was dry . Fuel load included the aboveground phytomass as well as the litter just before burning . Seasonal regrowth was determined at the end of the growing season (April) in each plot by clipping the plants in 10 quadrates (1 m² each , randomly placed) to a height of 30 mm . The fuel load before burning and the season's rainfall following the burning were regressed on the seasonal production loss due to burning (seasonal unburnt production minus regrowth of burnt grassland) .

Results and discussion The average aboveground phytomass production of the burnt and unburnt rangeland differed ($P \leq 0.01$) from each other over the study period and ranged between 1121 and 2614 kg/ha for unburnt rangeland and between 814 and 2110 kg/ha for burnt rangeland . Production losses due to fire , which is also a function of seasonal rainfall (between 412 and 861 mm) , varied between 238 and 444 kg/ha . The aboveground phytomass production loss due to fire (kg/DM/ha) is described for one (1) and two (2) seasons after the fire , by the following multiple linear regression equations ($P \leq 0.01$) :

$$y = -98.18 + 0.44x_1 + 0.04x_2 \quad (n=10) ; r=0.89 \quad (1)$$

$$y = 47.22 - 0.06x_1 + 0.12x_2 \quad (n=10) ; (r=0.88) \quad (2)$$

Where y is the production loss due to fire , x_1 is the seasonal rainfall (mm) and x_2 is the fuel load without burning (kg/DM/ha) . The equation clearly indicated that the higher the fuel load before burning the greater the production loss due to fire .

Conclusions These significant relationships between effects of fire , rainfall and fuel load on phytomass production , based on 10 years of observations , can serve as a simple empirical model for managers to determine short-term production losses due to fire . This information can also serve as a scientific guideline in estimating production losses in claims for damages suffered in cases of negligent rangeland fires .

Reference

Snyman , H . A . . (2003) . Short-term response in productivity following an unplanned fire in a semi-arid rangeland of South Africa . *Journal of Arid Environments* 56 , 465-485 .