ISSN 1562-5192

Spotlight on Agriculture

Ministry of Agriculture, Water and Forestry, Directorate of Agricultural Research and Training, Private Bag 13184, Windhoek

No 110 August 2008

NUTRIENT HOTSPOTS FROM PATCH BURNING OF RANGELAND

INTRODUCTION

Fires have shaped savanna rangelands for millennia, occurring after exceptional rains when grass growth exceeded offtake by herbivores to provide sufficient fuel for burning (Bond 1997). However, most farmers have controlled lightning-induced fires on their farms in past decades, with resultant changes in rangeland condition (De Klerk, 2004). A few farmers have applied prescribed burning to portions of their farms, mainly in attempts to control bushes that have encroached on the land, but very few apply patch burning for biodiversity, such as promoted by Fuhlendorf & Engle (2001). Vermeire, Mitchell, Fuhlendorf & Gillen (2004) concluded that patch burning can act as an effective, inexpensive grazing distribution tool, after they found that the standing grass crop decreased predictably according to its proximity to burned plots. The significance of nutrient hotspots to savanna dynamics has been highlighted by Scholes & Walker (1993). This study, which falls under the Biodiversity Transect Analysis in Africa (BIOTA) programme, funded by the German Ministry of Education and Research (BMBF), gleans knowledge from a farmer who applies patch burning to attract animals and create nutrient hotspots.

METHODS

Patch burning of Namibian thornbush savanna was applied at Farm Otjekongo, with a mean annual rainfall of 400 mm. A firebreak of 30–40 m in width was heavily grazed by cattle within moveable electric fencing, around the patch to be burnt (Figure 1). The patch of roughly 10 ha was burnt by means of a head-fire towards the end of the dry season (Figure 2). Different variables were measured along permanently delineated transects of 50 m. These included the intercepted dung (measured in units of length) which served as an index of herbivore pressure (Landsberg & Stol, 1996). Soil was collected at three burnt patches (Figure 3). At the patch burnt two years previously, soil was collected only from the burnt zone and nearby unburnt control, since the firebreak was no longer visible. At the patch burnt one year earlier, soil was also collected from the firebreak zone, while at the patch burnt in the year of sampling, soil was furthermore collected before and immediately after the fire (Figure 4). Soil samples, augured to 15 cm at 10 points spaced 10 m apart on both sides of a transect, were mixed into the same bag for later distribution amongst 10 pots for radish bioassay (Olsvig-Whittaker & Morris, 1982) to determine overall fertility (Figure 5). Five transects per zone were sampled this way. One radish was grown per pot and harvested after five weeks to measure diameter of the radish (Figure 6), length of the longest leaf,

Figure 1. Electric fencing is removed after cattle have grazed part of the firebreak.

Figure 2. A head-fire was applied to the patch of about 9 ha.

Figure 3. Soil samples were augured from previously burnt patches.

Figure 4. Soil was also sampled before and after the application of patch burning.

Figure 5. Radishes were grown in soil from different patches to indicate overall fertility.

Figure 6. Radish diameter was one of the measurements included in the bioassay.

Figure 7. A drop of radish sap was squeezed onto a refractometer to measure the sugar and mineral concentration in brix.

Figure 8. Grass in a patch burnt two years previously has been grazed short, while ungrazed grass further away now grows where there was insufficient fuel to sustain burning two years earlier.

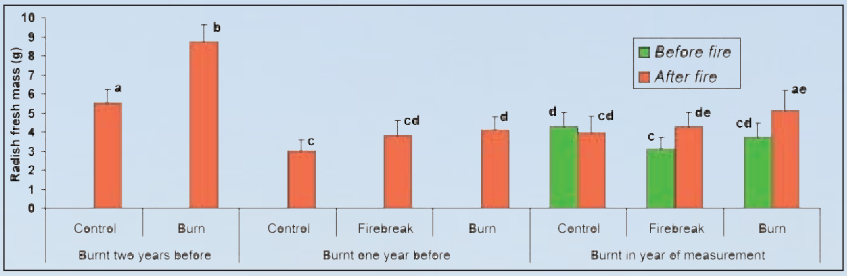

Figure 9. Fresh mass per radish grown on soils from three patches (each burnt in a different year), grazed firebreaks around two of those patches, and unburnt controls nearby (Error bars show 95 % confidence limits; bars do not differ significantly at $P < 0.05$ if they share any letter above them, by Tukey post-hoc test).

fresh mass (including leaves) and brix of sap squeezed from the radish onto a refractometer (Figure 7). Fuel load, by clipping in 34 randomly placed quadrats of 1 m^2 at the last of the three patches to be burnt, was 1,74 ± 0,29 t/ha of dry grass.

RESULTS

Patches that were burnt two years previously continued to attract more large herbivores for at least two years after burning. Dung covered 1,29 ± 0,46 % of the firebreak after grazing compared with 0,08 ± 0,04 % in the control. Within burnt patches the sub-patches that had failed to burn due to lack of grass now supported a lot of grass while the grass in burnt sub-patches was grazed preferentially and kept very short (Figure 8). Differences in soil fertility from the fresh mass bioassay are shown in Figure 9. Similar, but less significant trends emerged from the measurements of radish diameter, followed by leaf length, while brix showed a slightly opposite trend, with sap of thinner radishes generally more concentrated.

CONCLUSIONS

The soil was more fertile where a patch had been burnt two years earlier, as was expected from the shallow calcrete layer evident there. Burning increased patch fertility two years after burning, compared with the unburnt control, presumably because of higher concentrations of urine and dung dropped by cattle and game attracted to the patch. The higher fertilities of firebreaks and more recently burnt patches on deeper sandy loam are not significant at $P < 0{,}05$, but may become more pronounced over time.

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