Can we really understand our grasslands with short-term experiments ?

V Allen[1] ,D .Kemp[2] ,D .Michalk[3]
[1] Department of Plant and Soil Science ,Texas Tech University ,Lubbock ,TX ,79409-2122 ,USA ; [2] School of Agriculture and Wine Science ,Charles Sturt University ,Orange ,NSW ,Australia 2800 ; [3] Orange Agricultural Institute ,NSW Department of Primary Industries ,Orange ,NSW Australia 2800 . E-mail : vivien .allen@ttu .edu

Key words : grazing research ,grazing systems ,long-term experiments

Introduction Grasslands are complex ecosystems comprising natural ,exotic and imposed elements over many scales .The behaviour of these components can appear chaotic but when investigated in detail ,a deeper order often emerges with time along with a clearer understanding of the mechanisms driving production and ecosystem outcomes *e .g* . the Park Grass Experiment at Rothamsted .Too often interpretations from grassland studies are based on guessing likely longer-term trends derived from only a few years of observation as funders are reluctant to make long-term commitments .This often leads to erroneous conclusions because the behavior of the system has not had time to express itself .Grasslands research ,of necessity large scale and expensive in terms of land ,labour and capital ,is faced with a dilemma .Yet the longer better designed and resourced experiments are monitored the greater the return in information gained .

USA example A 10-year (1997-2007) ,3-paddock ,field-scale integrated cotton/forage/grazing system for stocker steers was compared with a cotton (*Gossypium hirsutum* L .) monoculture on the Southern High Plains ,Lubbock ,Texas .Both systems (3 replications) were subsurface drip irrigated .The grazing system included the perennial C_4 grass ,*Bothriochloa bladhii* (Retz) S . T .Blake while cotton was grown in a 2-paddock rotation with grazed wheat (*Triticum aestivum* L .) and rye (*Secale cereale* L .) .In years 1 to 5 ,the grazing system consistently required 23% less irrigation water ,40% less nitrogen (N) fertilizer ,and was 90% more profitable than the cotton monoculture (Allen et al . ,2005) .However ,from year 6 ,weather patterns changed . Profitability of cotton increased as new cotton technologies increased yields ,though water and N fertilizer use remained lower for the grazing system .Wheat became non-viable in the rotation due to suppression by allelopathic chemicals .Herbicide-tolerant weeds increased ,especially in the cotton monoculture .Both systems had shifts in soil microbial populations and in soil organic carbon relating to both current and past vegetation cover and to grazing effects .Results obtained during years 1 to 5 would not have predicted results obtained in subsequent years .

Australian examples Over a 24-year period ,the grazing management of native perennial grassland at Trangie in western New South Wales was investigated (Michalk and Robards ,1993) .After 5 years (1967-71) perennial basal area declined from ~2 . 8% to 0 ,suggesting that even the lowest stocking rate (2 .5 sheep/ha) was unsustainable .By year 8 ,basal area was >8% at the lowest stocking rate and ~4% at the highest rate (4 .9 sheep/ha) .After 24 years (1990) basal cover at the high stocking rate was ~2% ,the same as the starting value in 1967 .The study concluded that effects of weather patterns which had a significant effect on vegetal change ,could not be predicted by a 4-5 year grazing study .

A small paddock ,sheep grazing experiment using four pasture systems : natural grassland (C_3 and C_4 species) ; natural grassland plus phosphate fertiliser ; sown fertilized perennial temperate pasture species ; chicory forage system) and two grazing treatments (continuous grazing and a tactical grazing / reduced stocking rate designed to increase the content of perennial grass species when required) was done over 7 years at Carcoar in central New South Wales (Michalk et al .2003) .It took the first three years from the start of the study (the normal time for funding projects) for each treatment to function in some consistent way .Pressure was exerted by funding bodies (resisted by the researchers) to impose grazing on some treatments before plants were adequately established which would have only produced results that reflected early system behaviour .The next three years were reasonably consistent behaviour ,but then a drought and the effects of grazing treatments had important effects on species composition ; *Dactylis glomerata* was replaced in the sown pasture by *Phalaris aquatica* ,while *Themeda australis* (native grass) and *Echium plantagineum* (weed) became more dominant spatially in native pasture paddocks .The treatment and replicate layout was initially based on botanical and soil surveys across the whole site to ensure that there were no major initial differences between treatments and replicates . However , by year 7 landscape effects were emerging that could not be investigated further as funds had finished .Current recommendations to farmers are then limited in how best to use these variable resources .

References

Allen ,V .G . ,C .P .Brown ,R .Kellison ,E .Segarra ,T .Wheeler ,P .A .Dotray ,J .C .Conkwright ,C .J .Green ,and V .Acosta-Martinez . 2005 .Integrating cotton and beef production to reduce water withdrawal from the Ogallala Aquifer in the Southern High Plains .*Agron .J* . 97 :556-567 .

Michalk ,D .L . ,Dowling ,P .M . ,Kemp ,D .R . ,King ,W .McG . ,Packer ,I .J .Holst ,P .J .Priest ,S .J .Millar ,G .D .Brisbane ,S . , and Stanley ,D .F .(2003) .Sustainable grazing systems for the Central Tablelands of New South Wales .*Australian J .Exper . Agric* . 43 ,861-874 .

Michalk D .L . ,and Robards ,G .E .(1993) .Stability of windmill grass pastures by sheep for 24 years in semi-arid south-eastern Australia .Proceed .*XVII Internat .Grassl .Cong* . , 320-321 .