Grain & Graze National Feedbase Project

Using simulation to improve feedbase management in the summer dominant rainfall zone

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The subtropical region of southern Queensland and northern New South Wales experiences a highly variable rainfall environment with a summer dominant rainfall pattern but with significant winter rainfall. There is a mix of temperate and (sub)-tropical pasture species and fodders available that can contribute to the 'feedbase'. Nonetheless, summer growing native or sown pastures are the dominant forage source in this region. Feed year planning can be improved by information about the variability in feed supply, the range and pattern of feed supply of pasture or fodder options that are available. Understanding the average growth curves of various feed options and typical intra-year gaps in feed supply is useful for designing feeding systems, and is needed to improve decision tools such as the MLA Feed Demand Calculator, which is currently not parameterised for northern Australia. While average growth curves are useful, variations in seasonal rainfall often experienced in sub-tropical climates can produce large inter-yearly variations in the amount and timing of forage supply. This study deals with assessing the capacity to improve the forage supply by diversifying the forage sources that can contribute to the feedbase.

Methods

Expected forage growth

To investigate the options for managing the feed supply through the range of forage options in northern NSW and southern Qld we prepared both annual average growth curves the range of pastures and forage sources commonly utilised in the growth in the Border Rivers and Maranoa-Balonne regions. This was based on best knowledge obtained from the literature and expert advice.

Table 1: Annual initialisation and management details used for simulations

Crop (cultivar)	Reset date	Sowing date	Plant numbers	Date crop removed	Fertiliser	Cutting management
Grass (buffel)	1 Aug	-	5/m^2	-	Nil	
Lablab (Highworth)	1 Oct	1 Oct	5/m^2	1 May	Nil	Cut to 10 cm at floral initiation or > 3 t DM/ha
Oats (Coolibah)	1 Apr	14 Apr	100/m^2	1 Dec	40 kg N at sowing, 20 kg N at cutting	Cut to 10 cm at floral initiation or > 2 t DM/ha
Lucerne (Trifecta)	1 Apr	-	200/m^2	-	Nil	Cut to 5 cm at flowering or > 2 t DM/ha

Simulated forage growth

The systems analysis tool APSIM (Agricultural Production Systems Simulator) was used to simulate year to year variation in seasonal pasture/fodder production for a number of forage options. Simulations of monthly growth rates were conducted using a common soil (a brigalow soil adjusted to 1 m depth with 150 mm PAWC), and 100 years of historical meteorological data for 4 sites, Warialda, Nindigully, Roma and Miles. The pasture growth model GRASP was configured to run in APSIM to simulate the growth of a sown tropical grass (buffel grass). Lablab, oats and lucerne growth was simulated in their respective modules in APSIM 5.2. Each year at the beginning of the growing season for each forage (date in Table 1), soil water, nitrogen and organic matter were reset to 120 mm PAWC (85% of full), 30 kg of soil N and 1000 kg of OM.

Results

Expected forage growth

Growth of tropical grasses slows significantly between late autumn and early spring, due to temperature and moisture limitations (Fig 1a). Thus, reliance on this as the dominant feed source results in a deficit of growth during this time. This can be reduced by carrying over excess biomass produced during the peak growing period in summer. However, the quality of these pastures also decline during this period. It is expected that the timing of growth of lucerne and summer growing forage crops match that of grass pastures but they provide higher quality forage during autumn or alternatively the opportunity to conserve hay or silage to be used in winter (Fig 1b & d). But in particular, winter growing forage crops such as oats have the capacity to improve the continuity of feed supply (Fig 1c). These growth curves are based on an average year sourced from LeyGrain for northern NSW, but simulation may provide a useful tool to better define these for each forage type.

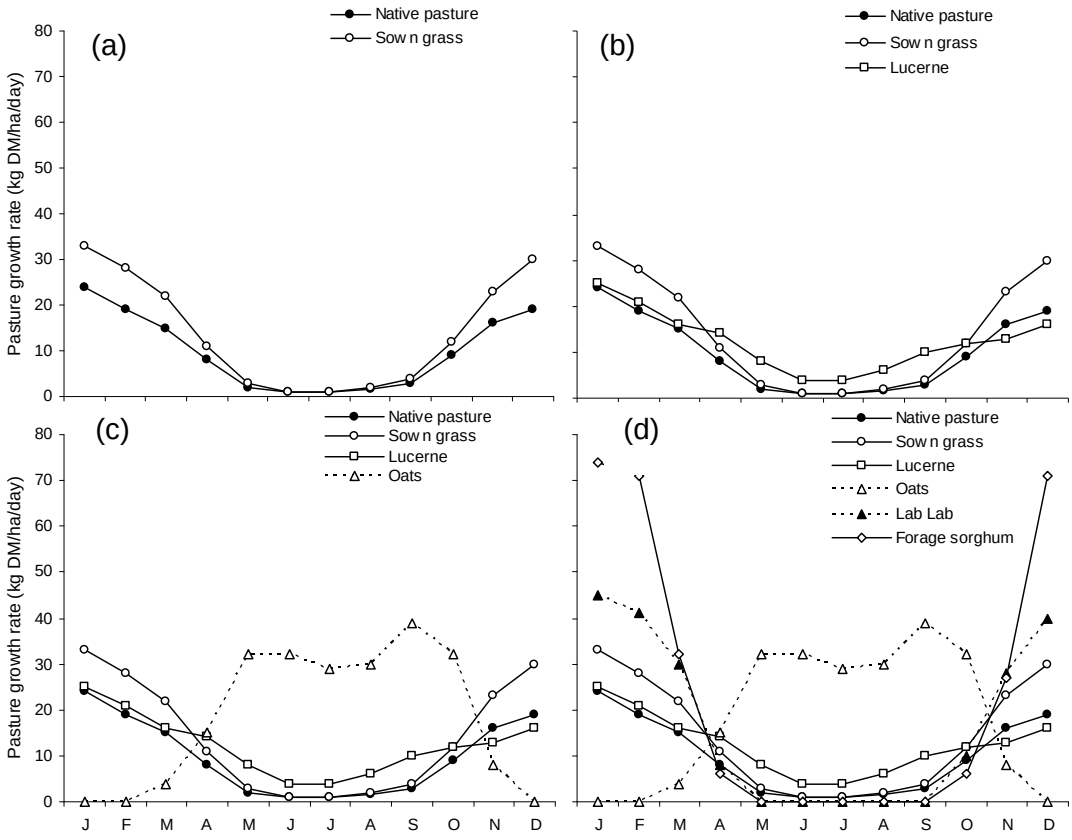

Figure 1: Estimated average growth rates for 'feedbase' varying in complexity, (a) summer-growing grass pastures (SG) only, (b) SG + lucerne, (c) SG + lucerne + oats, and (d) SG + lucerne + oats + summer forage crops.

Simulated forage growth

APSIM simulations were used to demonstrate the variability in pasture and forage growth rates that could be expected. Figure 2 displays the median and the inter-quartile variation in grass pasture at locations throughout the Border Rivers and Maranoa/Balonne regions. This demonstrates that a large amount of between year variability in grass productivity during summer, and that between year variations in forage supply need to be managed equally to within year fluctuations. Also in the lower rainfall environments (Nindigully and Roma) this variability is larger, and the 25th percentile of monthly growth rates demonstrating very little growth.

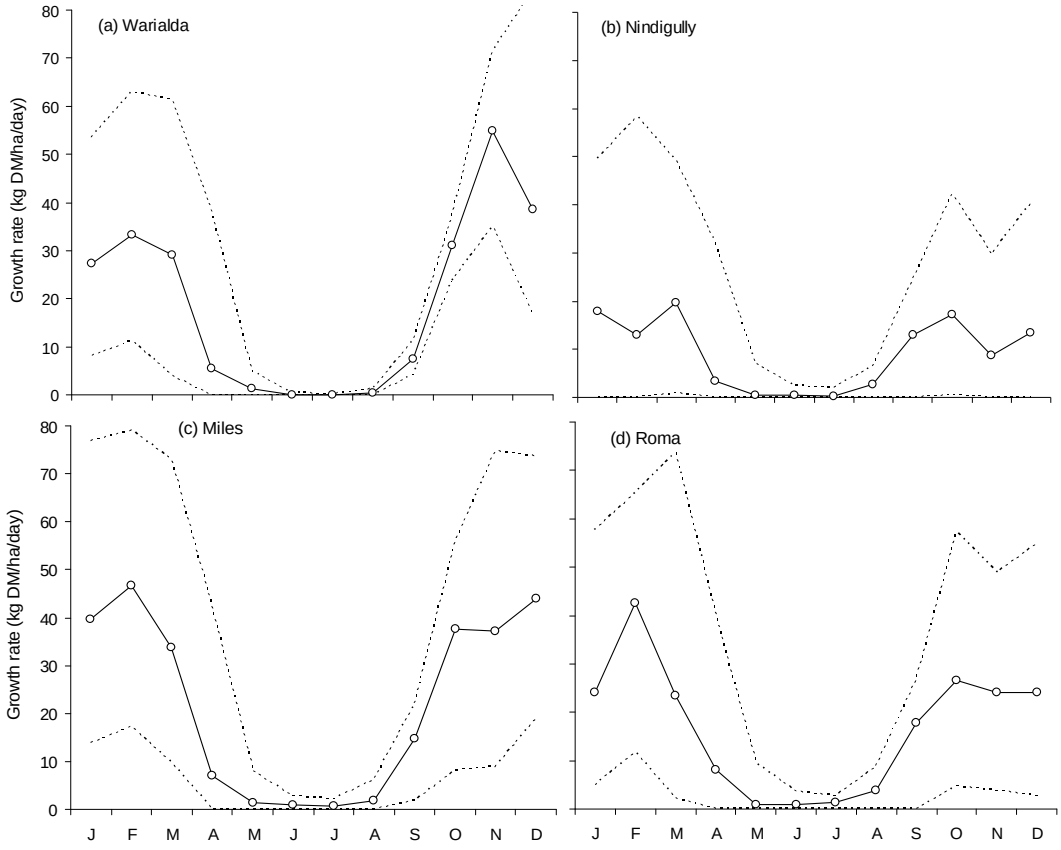

Figure 2: Simulated growth rates of a summer-growing grass pasture simulated at (a) Warialda, (b) Nindigully, (c) Miles and (d) Roma. Solid lines represent median and dotted lines upper and lower quartiles from 100 years of growth simulated using GRASP in APSIM.

Figure 3 compares the variability of production from various forage sources at Warialda in northern NSW. The forage crops, oats and lablab, when sown onto good stored soil moisture, showed reliable amounts of early growth. Oats productivity was typically reduced as soil water and soil N declined. Lablab growth during late summer to autumn was variable depending on the occurrence of rainfall during this time. Permanent lucerne pasture demonstrated some variability in growth rates, but production appears to be reasonably reliable.

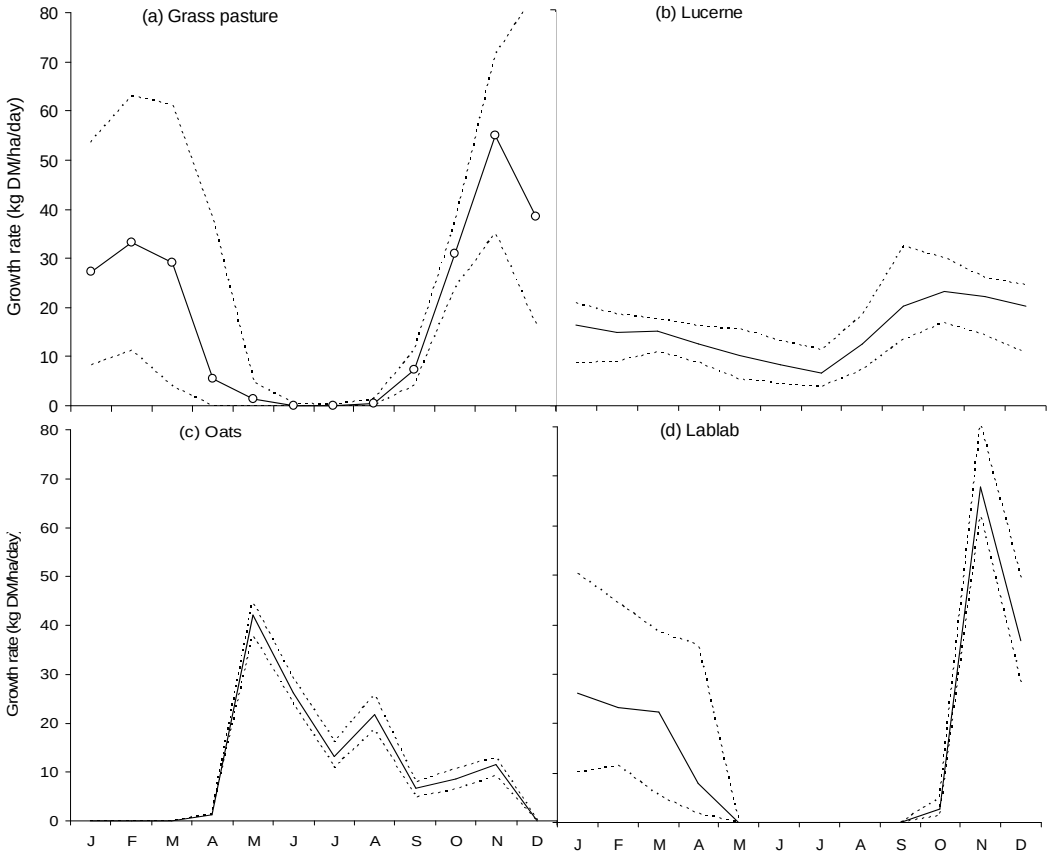

Figure 3: Simulated growth rates of (a) a sown grass pasture, (b) lucerne, (c) oats and (d) lablab at Warialda. Solid lines represent median and dotted lines upper and lower quartiles from 100 years of growth simulated using APSIM.

Figure 4 provides an example of how a variety of forage sources could be used to provide a reliable feedbase through a series of years. Obviously the whole farm forage availability is dependent on the relative proportion of the farm allocated to each forage source. Nonetheless, it is clear that the use of forage crops can supplement the pasture in poor years and during winter. For example in late summer and autumn of 1992/3 or spring of 1994 oats could be used to supplement the reduced grass growth during these periods. Under good seasonal conditions (e.g. summer 1995/96) lablab produces a large amount of biomass that could be conserved for future periods of forage deficit.

Conclusions

Feedbase management is about matching feed demand and feed supply. This can be strategically based on annual cycles in pasture growth, but must also consider yearly variations in the amount and timing of forage production. This analysis demonstrates that there is significant capacity to improve the reliability of feed supply in the subtropics through diversification of forage sources that make use of rainfall at any time of the year.

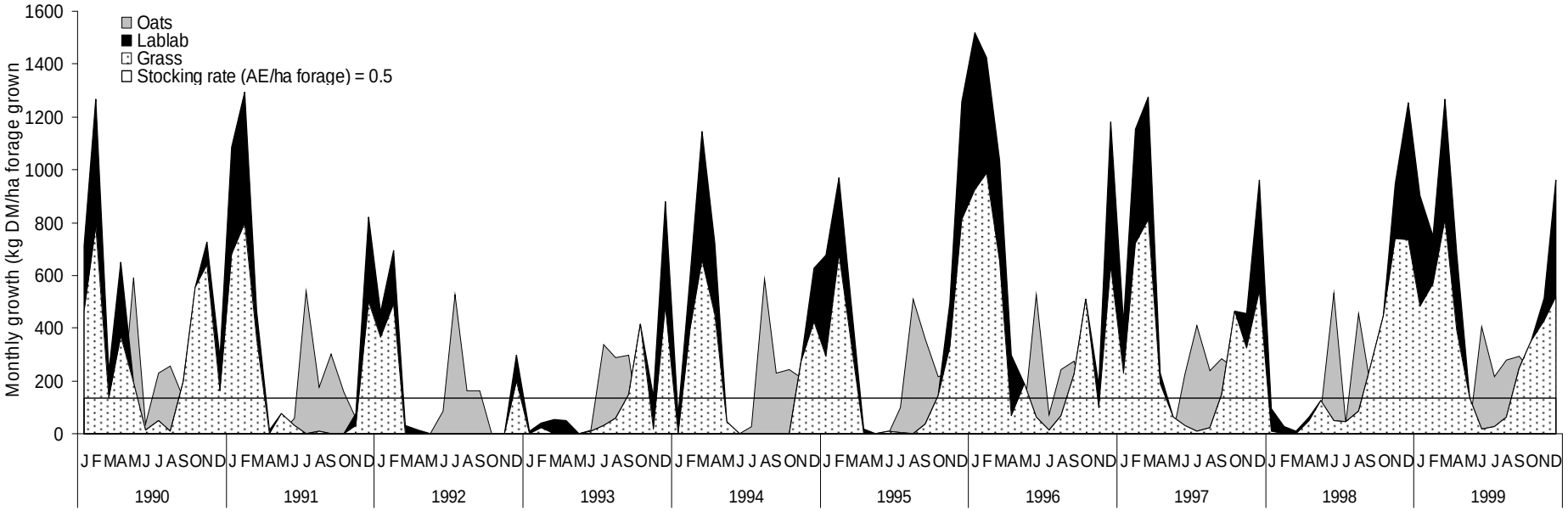

Figure 4. Simulated monthly forage production from a feedbase comprised of 60% grass pasture, 20% oats and 20% lablab at Goondiwindi over a 10 years period from 1990-1999.