COMPARISON OF SIX FORAGE SYSTEMS AS A SOURCE OF LATE SUMMER/AUTUMN FEED FOR DAIRY HEIFERS

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SUMMARY
A grazing study over 6 consecutive years assessed the value of 6 alternative forage systems for growing dairy heifers during late summer and autumn in a subtropical environment. The forages were Pinto peanut (*Arachis pintoi* cv. Amarillo), rhizomatous peanut (*Arachis glabrata* cv. Prine), nitrogen-fertilised pangola grass (*Digitaria eriantha* ssp. *pentzii*), lucerne (*Medicago sativa*), naturalised pasture and leucaena (*Leucaena leucocephala*). Heifers with an average weight of 210 kg were grazed on the pastures at 3.8 animals/ha in late summer and autumn of 1996 to 2001, and were supplemented with 2 kg of grain plus minerals/animal/day. Naturalised pasture was stocked at 1 animal/ha.

Feed on offer was not significantly related to rainfall. There was an average of less than 400 kg DM/ha of legume in the feed on offer in the *Arachis* paddocks. The target liveweight gain (700 g/animal/day) was achieved by all systems in 4 of the 6 years. Liveweight gain was linearly related to rainfall for each system, accounting for over 65% of the variation. Adding the following factors (feed on offer, sown component feed on offer, the amount of hay fed to compensate for the shortfall in feed as a result of drought and irrigation) did not improve the relationship. Animals on the lucerne system gained more liveweight in 3 of the 6 years than those on the Amarillo, Prine or nitrogen-fertilised pangola grass systems although animals grazing lucerne required a greater amount of hay each year. The naturalised pasture system performed as well as other systems, but at a much lower stocking rate and with more supplement. The leucaena system was superior to the other systems in 2001. This can partly be related to the management, which required leucaena to remain ungrazed from early spring while the other forages were used in the farm rotation until December each year.

Keywords: heifer growth, liveweight gain, lucerne, grazing peanut, pangola grass, *Arachis,* leucaena

INTRODUCTION
Generally, farmers in the subtropics rely on low quality naturalised pastures, which are supplemented by concentrates, to achieve the required growth rates of 700 g/day for growing heifers (Moran *et al.* 2001). Higher first lactation milk yields are produced from better-grown first calf heifers (Moss 2001), so improving the quality of forage supplied to heifers can have a substantial long term advantage. Grass-nitrogen systems are the most regularly used option for autumn feed, but it would reduce costs of production and address environmental concerns if legume-based systems could replace them. Lucerne, grazing peanut (*Arachis* spp.) and leucaena are legumes that are adapted to southeast Queensland. This project compared a number of alternative forage systems that may suit the autumn forage requirements of growing heifers in the subtropics.

MATERIALS AND METHODS
The investigation was conducted from January/February to April in 1996 to 2001, and was located at Mutdapilly Research Station (27º45'S; 152º40'E; altitude 40 m). Autumn feed for growing heifers was supplied by 6 pasture systems, where Pinto peanut (*Arachis pintoi* cv. Amarillo), rhizomatous peanut (*Arachis glabrata* cv. Prine), nitrogen-fertilised pangola grass (*Digitaria eriantha* ssp. *pentzii*), lucerne (*Medicago sativa*), leucaena (*Leucaena leucocephala* cv. Barambah) and naturalised pasture were compared. All pastures were 2 ha in area, except the naturalised pasture, which was 4 ha. Each system included a supplement of 2 kg of grain (11% crude protein) plus a mineral mix per animal daily. Amarillo peanut, lucerne and pangola grass were sown in 1991 and were grazed throughout the study. Rhodes grass (*Chloris gayana* cv. Pioneer) was the grass component in the legume pastures. The naturalised pasture, dominated by paspalum (*Paspalum dilatatum*), Rhodes grass and forest blue grass (*Bothrichloa bladhii*), was used in 1996 and 1997. Prine rhizomatous peanut was sown vegetatively in October 1996 into a mixture of Rhodes grass, paspalum and native grasses (pitted blue grass (*B. decipiens*) and rats tail (*Sporobolus* spp.)) and was used from 1998-2001. Barambah leucaena was sown into a similar pasture in 3 m rows in October 1998 and was included in 2001 only.

Heifers were introduced onto the pastures in late January or early February, and averaged 242, 200, 190, 204, 228 and 209 kg in liveweight in 1996 to 2001, respectively. The stocking rate was 3.8 animals/ha on all systems except the naturalised pasture (1.0 animals/ha).

Pastures were managed to optimise performance in each forage system, based on current recommendations (Anon. 1995). Lucerne was rotationally grazed on a 2-paddock system. The leucaena area remained ungrazed from spring until mid summer. All other species were grazed in normal rotations until a month before the experimental grazing commenced. Pangola grass received 200 kg N/ha as urea in 2 applications. All pastures received CK 88 (15:4.3:11.3:13.6: - N:P:K:S) at 200 kg/ha annually in spring. All paddocks were to receive supplementary irrigation to maintain growth during dry periods. However, irrigation availability was restricted from 1996-1999 and was unavailable in 2000 and 2001 (Table 1). As a result, a system of providing extra feed (as lucerne hay) was instigated when available feed on offer dropped below 1000 kg/ha. Rather than supplement the animals in the Prine area with hay, an extra 2 ha of Prine was offered, reducing the stocking rate to 1.9 heifers/ha for the last 60 days in 1998 and 2000.

Feed on offer was measured fortnightly by cutting 20 quadrats (0.5 x 0.5 m) from all paddocks, sorting into components and drying at 80ºC. Leucaena leaf and small stems (<0.5 mm in diameter) were stripped from plants in 20 strips, 0.5 m long, randomly selected from within the rows. Animals were weighed fortnightly. Feed on offer, liveweight gain, hay fed and irrigation applied were regressed against rainfall received during the growing season using a Generalised Linear Model (Genstat 5).

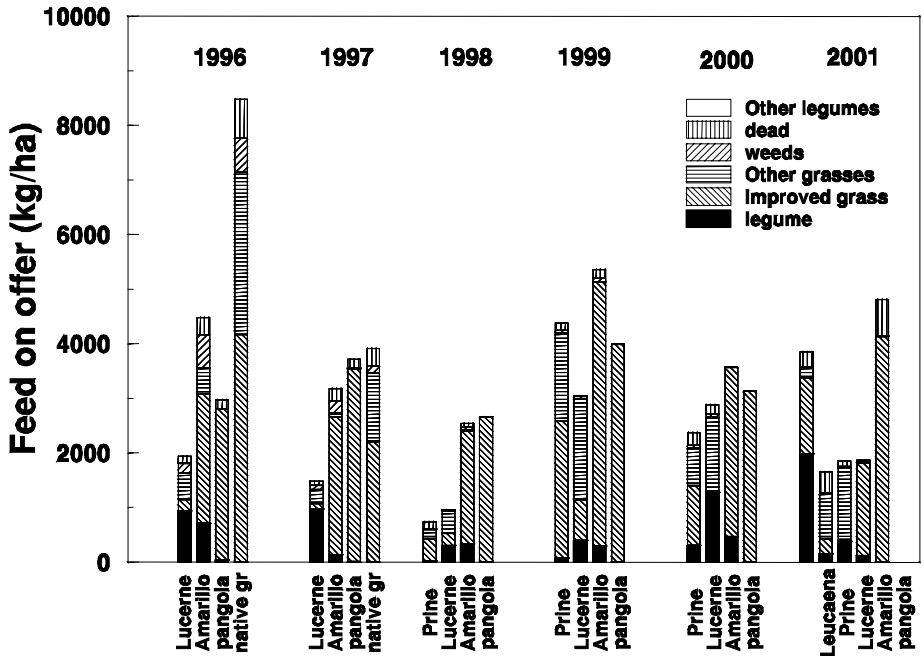

Figure 1. Total feed on offer from the 6 pastures over the grazing period (January/February to April) from 1996 to 2001.

RESULTS

Feed on offer

Feed on offer of the improved species was greatest in 1999 and least in 1998 (Figure 1). Leucaena produced substantially more than the other 3 legumes in 2001, but its growth was accumulated over a longer period. Lucerne production varied considerably and the stand required replanting on 2 occasions. Waterlogging in 2001 resulted in almost complete stand death caused by violet root rot (Rhizoctonia sp.). However, the invading grasses responded to the release of nitrogen after the death of lucerne plants. Feed on offer in the naturalised grass area in 1996 was greater than all other swards because it had remained ungrazed for 2 years prior to the commencement of the investigation. Neither Arachis cultivar produced large quantities of forage under the conditions, with feed on offer generally averaging around 400 kg/ha. There was no apparent relationship between feed on offer and rainfall or total water (rainfall plus irrigation).

Table 1. Amount of hay (kg per animal) fed to treatment groups to balance forage shortfalls from drought and lack of irrigation, and irrigation applied (mm).

Year	Amarillo		Lucerne		Pangola		Native pasture		Prine		Leucaena	
	Hay	Irrig'n	Hay	Irrig'n	Hay	Irrig'n	Hay	Irrig'n	Hay	Irrig'n	Hay	Irrig'n
1996	60	50	140	50	80	50	140[A]	0	-[B]	-	-	-
1997	N/A[C]	0	N/A	25	N/A	0	N/A	0	-	-	-	-
1998	118	0	124	50	110	50	-	-	99[D]	0	-	-
1999	25	25	0	50	0	25	-	-	27	25	-	-
2000	0	0	113	0	0	0	-	-	0[D]	0	-	-
2001	0	0	0	0	0	0	-	-	0	0	0	0

[A] Animals on native pasture received a standard heifer TMR ration, including silage, grain and hay. [B] Treatment not included in that year. [C] Data lost for the 1997 season. [D] Animals grazing Prine were allocated double the area instead of extra supplement for the last 60 days.

Level of hay required to manage forage shortfalls

As a result of ongoing drought and irrigation restrictions, it became necessary to differentially provide extra forage to the animals in order to maintain a minimum level of feed on offer. Animals grazing the lucerne pastures were fed around twice as much hay in 1996 as the animals grazing Amarillo or pangola grass (Table 1). In 1998, the deficit feeding differential was not as great, but still favoured the lucerne treatment. Lucerne had been resown prior to the 1999 season and no deficit feeding was necessary. Lucerne was the only pasture requiring hay in 2000. In 1998 and 2000, the stocking rate on Prine was reduced late in the growing season, rather than feed hay.

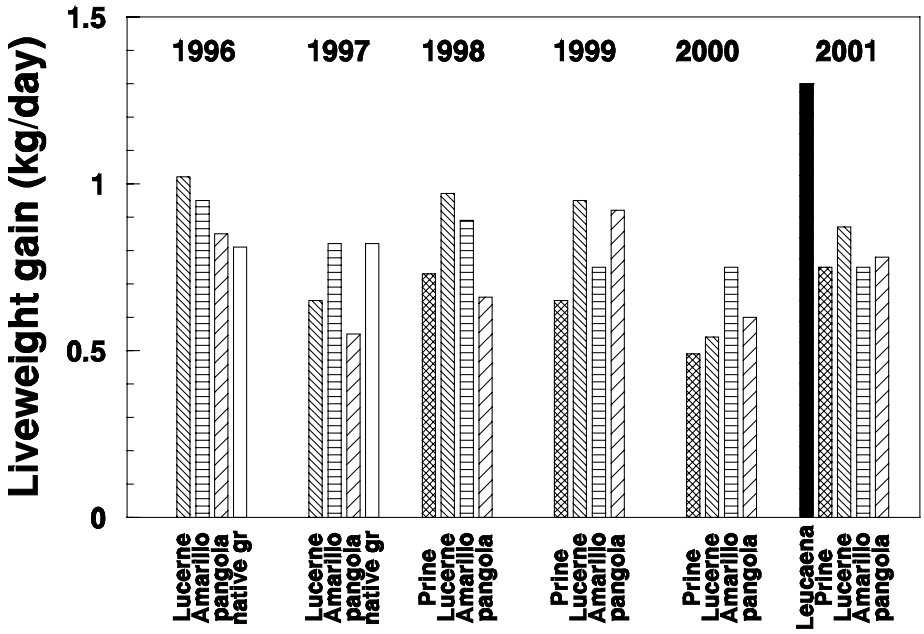

Figure 2: Average heifer growth rates for the summer/autumn period from 1996 to 2001.

Heifer growth rates

Heifer growth rates on the lucerne system were highest in 3 of the 6 years (Figure 2); the exceptions were in 1997, 2000 and 2001, when the Amarillo and native grass, the Amarillo, and leucaena systems, respectively, achieved superior liveweight gains. Growth rates of all systems were lowest in 2000, when autumn growing conditions were poorest.

There was a significant linear relationship between average liveweight gain and rainfall for each forage system, accounting for 65.6% of the variation (s.e. of observations 0.088, $P<0.001$) (Figure 3). The addition of other factors (feed on offer, hay fed and irrigation applied) did not significantly improve the prediction of liveweight gain. Forage systems showed parallel responses, with lucerne having the highest, and Prine the lowest, intercept. Animals on the native pasture system received a standard TMR supplement which included silage, grain and hay and achieved similar liveweight gains to those on the other systems, but at a much lower stocking rate. The leucaena system produced the best liveweight gain in 2001. Leucaena's deep root system allowed better utilisation of the available rainfall and it had a longer growing period.

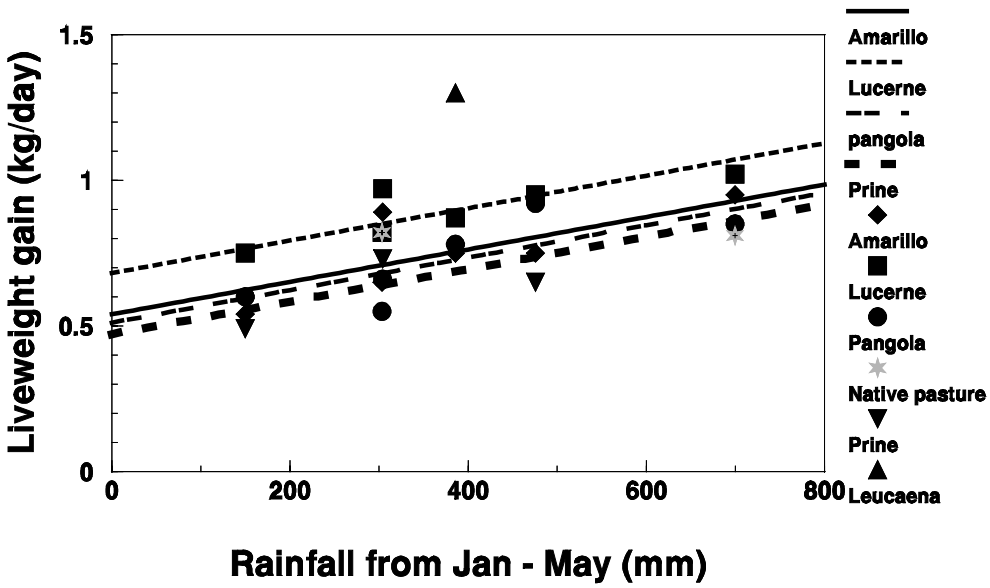

Figure 3. Relationship between average liveweight gain per day and rainfall for the forage systems over 6 years.

DISCUSSION

Improved pasture systems were able to achieve the desired growth rate for growing heifers in all but 2 of the 6 years. To achieve this, a daily supplement of 2 kg of a grain and mineral mix/animal was fed. Because of the continuing problems of drought and irrigation shortages, a small amount of lucerne hay was required during periods of low pasture growth. This typifies the problems experienced in all dairying regions of Australasia where variation in rainfall can affect the ability of farm pastures to adequately grow replacement heifers (Moran *et al.* 2001). Liveweight gain was influenced by the rainfall received over the grazing period, and by the species used in the system.

The very low feed on offer exhibited by the legume component in the 2 grazing peanut systems is related to the lower than average rainfall and humidity received during the experiment at Mutdapilly. Despite this, they were capable of producing similar liveweight gains to nitrogen-fertilised pangola grass, which is likely to be related to the higher quality of the peanut cultivars (Lowe *et al.* 1994). Irrigation was not often applied, but even when it was, growth of the grazing peanuts, and Amarillo in particular, did not respond well to the extra water. Amarillo only grew well in rainy periods when there was a build up in humidity (Lowe and Cook 2001). The leucaena system did not fit the pattern exhibited by the other systems, providing a much higher response from rainfall compared with the other systems. However, the liveweight gain was achieved from growth commencing in early September, rather than in December for the other species. Even if the rainfall received during this extended period is factored in, the leucaena response is still greater than that demonstrated by the other species. Further research is needed to confirm that this can be repeated consistently.

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