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Using leafy turnip to maintain growth rates of dairy heifers during summer

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Abstract

In New Zealand, growth rates of dairy heifers can be restricted during late summer/early autumn due to inadequate pasture production and quality, which may delay puberty and compromise lactational performance, and, ultimately reduce their longevity in the herd and overall farm profits. The aim of this experiment was to determine the effect of feeding leafy turnip as an alternative summer forage to ryegrass-based pasture on the growth rate of heifers. Forty-five heifer calves aged six months were assigned to one of two treatment groups: (1) ryegrass-based pasture and (2) leafy turnip and were fed a combination of these feeds during summer/early autumn. Calves fed a greater proportion of leafy turnip were heavier (235.6 ± 3.8 kg, $P < 0.05$) and had greater average daily gain (0.74 ± 0.01 kg/day, $P < 0.05$) than calves fed a greater proportion of pasture (218 ± 3.9 kg and 0.59 ± 0.01 kg/day), primarily due to pasture supply being restricted during the latter part of the experiment. The greater liveweight advantage from feeding leafy turnip remained for two months. Leafy turnip could be considered as an option to maintain growth rates of dairy heifers when pasture supply is restricted.

Keywords: dairy heifer; growth rate; live weight; leafy turnip

Introduction

Growing good dairy heifers benefits their reproductive performance (e.g., age at puberty and first calving) and subsequent milk production; therefore, growth rates are regarded as an important component in heifer rearing (Lopdell & McNaughton 2013). Low growth rates may delay puberty and decrease days in milk (DIM) and milk production, and, ultimately reduce their longevity in the herd and overall farm profits (Lopdell & McNaughton 2013, Wathes et al. 2014).

In New Zealand's pastoral dairy-farming system, growth rates of dairy heifers can be restricted in late summer/early autumn (Handcock et al. 2015) due to inadequate pasture production which is restricted by soil water availability (Chapman et al. 2012; Waghorn & Clark 2004). The quality of pasture also declines with increasing temperature which stimulates reproductive grass growth and, thus, leads to an increase in fibre content (Litherland et al. 2002). High fibre content in the diet results in low digestibility, and limits voluntary feed intake which negatively affects growth (Litherland et al. 2002).

Leafy turnip (*Brassica campestris* × *Brassica napus*) is a hybrid multi-grazing brassica that has become popular for use during summer as a forage for grazing, providing larger quantities of feed with higher feeding value (Lindsay et al. 2007; Westwood & Mulcock 2012) than ryegrass-based pastures. Lambs grazing on leafy turnip had greater average daily gain (ADG) than lambs grazing on ryegrass and white clover pastures (220 vs 160 g/day) (Lindsay et al. 2007) or ryegrass and orchardgrass pastures (217 vs 131 g/day) (Reid et al. 1994) during summer.

There is no published information available on feeding leafy turnips to growing heifers. Therefore, the aim of this experiment was to determine the effect of feeding leafy turnip as an alternative forage to ryegrass-based pasture during summer/early autumn on the growth of heifer calves.

Method and materials

This study was approved by the Massey University Animal Ethics committee and conducted at Massey University's Keeble farm during the summer/autumn months (mid-January – May) of 2016.

Animal management and treatments

Forty-five replacement heifer calves (17 Friesian (F), 11 Jersey (J) and 17 Friesian-Jersey crossbred (FxJ)) were allocated to one of two treatment groups: (1) ryegrass-based (*Lolium perenne*) pasture (n=22) and (2) leafy turnip (cv. Hunter) pasture (n=23). Treatment groups were balanced for breed, date of birth, and weight. All heifers were transitioned to leafy turnip for two weeks prior to the study to allow rumen adaption to the change of diet. Initially, heifers grazed on leafy turnip for three hours a day with the remaining time on pasture. The time spent on leafy turnip during the transition period increased gradually every three days, so that by day 12, the heifers were grazing on leafy turnip for 24 hours per day.

The experiment consisted of three periods: Period I (day 0-32) from 18th January to 19th February when all calves were grazed on leafy turnip, Period II (day 33-56) from 19th February to 14th March when calves were grazed on pasture to allow the leafy turnip to regrow for 4 weeks, and Period III (day 57-105) from 14th March to 2nd May when calves were split into their allocated treatment groups and grazed on either ryegrass pasture or leafy turnip.

The aim was to have a growth rate over summer of 0.7 kg per day, which was used for calculating feed requirements over the experimental period. This growth rate will ensure heifers meet liveweight targets over this period (McNaughton & Lopdell 2013). Area for allocation of feed was 3 ha of leafy turnip and 8 ha of ryegrass-based pasture, with 1 ha leafy turnip and 2 ha of pasture available if extra feed was required. Heifers in both treatments were shifted to a new grazing break weekly based on pre-

grazing herbage mass (kg dry matter (DM) per ha), heifer feed requirements to meet target growth rates, and a target post-grazing residual of 1800 kg DM/ha; or earlier if post-grazing herbage mass was too low. During the experiment, heifers had free access to fresh water at all times. All heifers were drenched to individual live weights at 1 ml per 10 kg for parasite control every three weeks beginning at the start of the transition period with Coopers Alliance® triple combination drench.

Animal measurements

Individual heifer live weight was measured every two weeks during the experimental period. Calves were weighed before they were moved to the new break to minimise the effects of gutfill. After the experimental period, all heifers were sent to a commercial grazing property as one herd and live weight was measured monthly until 22-months of age.

Herbage Measurements

The herbage mass of leafy turnip were measured by quadrat (0.1 m²) cutting before and after grazing. Six random quadrat cuts were cut five days before grazing and within 24 hours after removal of heifers (Handcock et al., 2015) to determine the pre- and post-grazing herbage dry matter (DM). Samples were washed, and weighed after being dried in an oven at 75°C for 48 and the mean of the six samples was calculated for determination of herbage mass available on a DM per ha basis. For ryegrass-based pasture, a Filip's Folding Plate Pasture Meter (Jenquip, New Zealand) and summer calibration equations were used to determine pre- and post-grazing masses (kg DM/ha).

Statistical Analysis

Data was analysed using SAS (Version 9.4, SAS Institute Inc, Carey, North Carolina, USA, 2016). Live weight of each heifer was analysed using mixed models allowing for repeated measures. The models included the fixed effects of breed, treatment, day, and the interaction of breed and day with treatment, with heifer included as a random effect. Average daily gain (for each period and overall) was analysed by using a general linear model, which included the fixed effect of breed and treatment and their interaction. Initial live weight at each period was considered as a covariate.

Results

Mean live weights during each experimental period for heifers on both diets are shown in Table 1. Both treatment groups had similar live weights ($P>0.05$) before they were allocated to either leafy turnip or pasture in Period III. On the first weigh day after heifers were split (D73), heifers fed leafy turnip tended to be heavier ($P=0.06$) than heifers grazed on pasture. Leafy turnip-fed heifers were heavier ($P<0.05$) than pasture-fed heifers by D84 and on subsequent weigh days. Mean live weight of heifers grazed on leafy turnip was 17.1 kg greater than those grazed on pasture by the end of experimental period (D105).

There was no interaction between treatment and breed on ADG. Heifers fed leafy turnip had greater ADG than did

Table 1 Mean live weight (kg) and average daily gain (kg/day) \pm SEM of heifers grazed as one mob during a transition period and Period I on Leafy Turnip (*brassica campestris* \times *brassica napus*), followed by Period II on Ryegrass-based (*lolium perenne*) pasture, and then allocated to either leafy turnip or pasture during Period III.

	Leafy Turnip (n=23)	Pasture (n=22)
Live weight (kg)		
Pre-trial weight and transition period on leafy turnip (6th Jan)		
D-12	160.1 \pm 2.8	157.9 \pm 2.9
D0	158.4 \pm 3.1	156.7 \pm 3.2
Period I grazing leafy turnip (3rd Feb)		
D16	170.8 \pm 3.4	167.5 \pm 3.6
D32	182.3 \pm 4.0	180.0 \pm 4.2
Period II grazing pasture (2nd Mar)		
D44	191.5 \pm 3.8	189.4 \pm 4.0
D56	203.9 \pm 3.7	201.8 \pm 3.9
Period III grazing either leafy turnip or pasture (31st Mar)		
D73	208.9 \pm 3.6	198.9 \pm 3.8
D84	217.5 \pm 3.6 ^a	202.8 \pm 3.7 ^b
D94	225.5 \pm 3.6 ^a	210.4 \pm 3.8 ^b
D105	235.6 \pm 3.8 ^a	218.8 \pm 3.9 ^b
Average daily gain (kg/day)		
Period I	0.75 \pm 0.03	0.74 \pm 0.03
Period II	0.90 \pm 0.04	0.90 \pm 0.04
Period III	0.66 \pm 0.03 ^a	0.33 \pm 0.03 ^b
Overall	0.74 \pm 0.01 ^a	0.59 \pm 0.01 ^b

^{ab} Means within rows with differing superscripts are significantly different ($P<0.05$)

heifers fed pasture in Period III (Table 1). Over the whole experiment, heifers fed leafy turnip during Period III had a greater ADG ($P<0.05$) of 0.74 kg/day compared to pasture-fed heifers that gained 0.59 kg/day.

The mean pre- and post-grazing mass of leafy turnip and pasture during each period is presented in Table 2. Average pre-grazing cover of leafy turnip was above 5,000 kg DM/ha in Period I (January – mid February) and first two weeks in Period III (early March), and then declined to approximately 3,500 kg DM/ha in April. During Period III, the average pasture pre-grazing mass (approximately 2,100 kg DM/ha) was consistently lower than that of leafy turnip. The post-grazing herbage masses were only measured in Period II and Period III. The mean post-grazing herbage mass during Period III was 2,583 kg DM/ha and 1,852 kg DM/ha for leafy turnip and pasture, respectively. The pasture post-grazing masses in late March (23rd – 30th), were below 1,500 kg DM/ha.

Heifers grazed on leafy turnip were heavier ($P<0.05$) than heifers grazed on pasture during Period III and this advantage was sustained for approximately two months after the experimental period ended (Figure 1). Leafy turnip-fed heifers were 12 kg heavier ($P<0.05$) and 10 kg heavier ($P=0.09$) than pasture-fed heifers by 10 months and 11 months of age, respectively. By 12 months of age (three months after the experiment), however, heifers in

Table 2 Means of the pre- and post-grazing herbage masses (kg DM/ha) of leafy turnip (*brassica campestris* × *brassica napus*) and ryegrass-based (*lolium perenne*) pasture during transition period and Period I, Period II, and Period III.

Day	Herbage masses			
<i>Transition period and Period I on leafy turnip</i>				
Day -12 to Day 32 (6th Jan to 16th Feb)	Pre-grazing 6921		Post-grazing -	
<i>Period II on pasture</i>				
Day 35 to Day 56 (16th Feb to 14th Mar)	Pre-grazing 3308		Post-grazing 2112	
<i>Period III either on leafy turnip or pasture</i>				
	Leafy turnip		Pasture	
Day 57 to Day 105	Pre-grazing	Post-grazing	Pre-grazing	Post-grazing
(14th to 31st Mar)	5636	2898	1928	1771
(1st to 14th Apr)	4271	2647	2411	2074
(14th to 2nd May)	3088	1824	1958	1509
Mean	4580	2583	2113	1852

(Dates in parenthesis indicate when masses were determined)

the pasture-treatment group reached the same live weights as heifers in the leafy turnip group, and there were no differences between the two groups in subsequent live weight till 22 months of age.

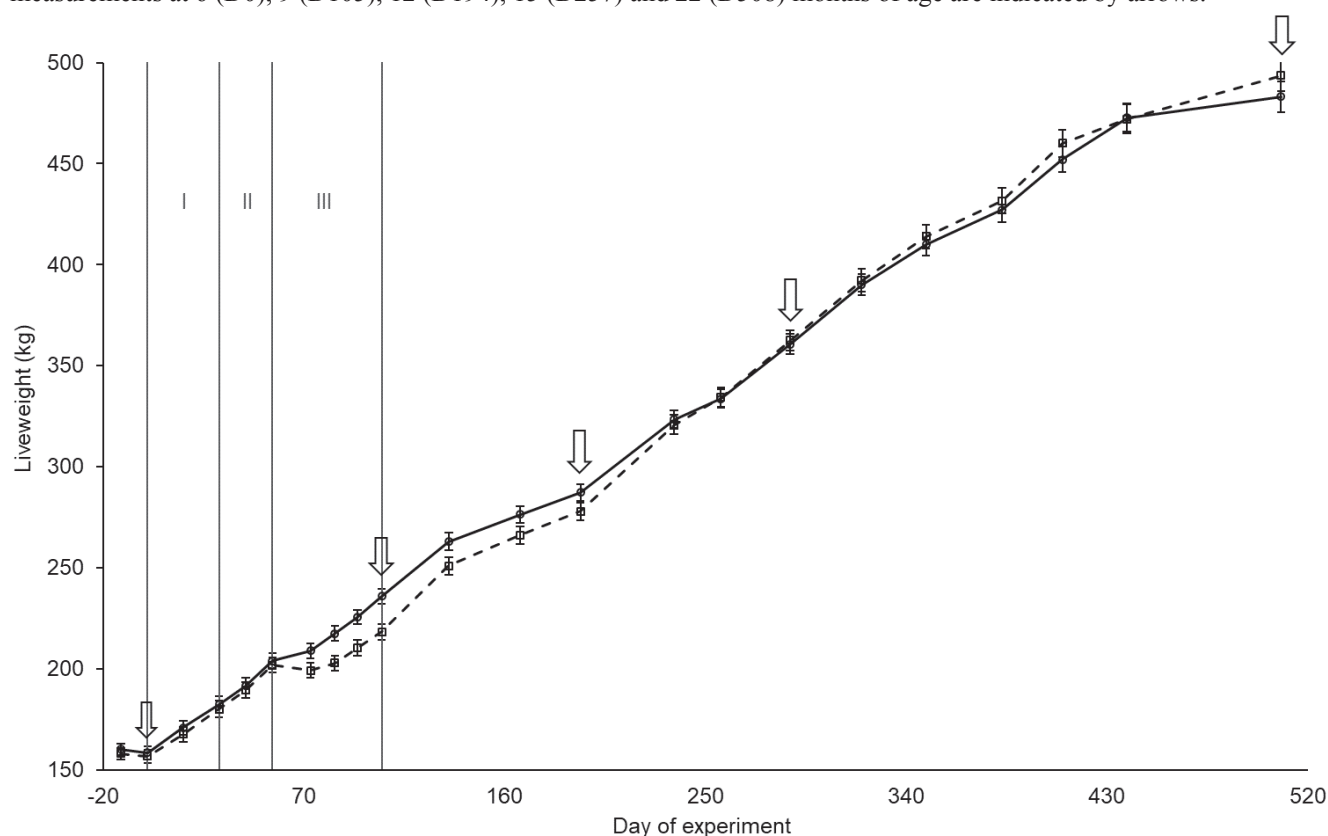
Discussion

Incorporating leafy turnip into heifer grazing during summer/early autumn resulted in the ability to maintain

growth rates of 0.7 kg/day during a period that pasture feeding can often not support due to low ryegrass-based pasture growth rates. As shown in Table 2, the leafy turnip sward provided greater pre-grazing DM than pasture over the experimental period. Heifers fed leafy turnip during late summer/early autumn (Period III) were 17 kg (7.7%) heavier and had 0.15 kg/d greater overall growth rate than those fed pasture. During this period, pasture availability was insufficient, despite having extra paddocks made available; this restricted the growth of pasture-fed heifers so that they failed to meet the target growth rate, and the experimental period was ended earlier than planned. The growth rate in Period III of heifers in both treatment groups was lower than in Period I and Period II (Table 1), with lower herbage availability in late March and April compared to January and February (Table 2).

Low ADG may not be solely influenced by herbage quantity but also quality. Poor growth rates for heifers fed ryegrass-based pasture during late summer/early autumn have been reported by Handcock et al. (2015), who concluded that the poor ADG of pasture-fed heifers (0.53 ± 0.02 kg/day, which is similar to Period III in the study reported here), was caused by intakes with lower ME and higher fibre compared with Lucerne and herb-clover mixed pasture. Herbage quality was unable to be determined in the current study due to the breakdown of the freezer where samples for analysis were stored, however, the nutritional analysis of leafy turnip (Lindsay et al. 2007,

Figure 1 Mean live weight of heifers grazed on leafy turnip (○, solid line) or ryegrass-based pasture (□, dashed line) from day -12 to 508. Experimental periods I (D0-32), II (D33-56), and III (D57-105), are illustrated by vertical lines. The measurements at 6 (D0), 9 (D105), 12 (D194), 15 (D257) and 22 (D508) months of age are indicated by arrows.



Westwood & Mulcock 2012) and pasture (Handcock et al. 2015; Litherland et al. 2002) has been reported in previous studies. The nutritive value of leafy turnip reported by Westwood & Mulcock (2012) was higher than that of ryegrass and white clover mixed pasture in the same region (Litherland et al. 2002). Lindsay et al. (2007) concluded that the higher liveweight gain in lambs grazing leafy turnip was as a result of greater ME and lower fibre content. Therefore it is likely that the greater growth in heifers fed leafy turnip than those fed pasture was also contributed to by the greater nutritional value of the leafy turnip.

While feeding leafy turnip during late summer/early autumn (Period III) increased live weight by 17 kg more than heifers grazing on pasture during this time, this advantage only remained for approximately two months after the experimental period, after which there were no more differences in subsequent live weight. Compensatory growth may occur wherein heifers that previously received a restricted feeding regime display greater growth in a later re-alimentation period (Roche et al. 2015). In the current study, live weight of pasture-fed heifers was similar to heifers fed leafy turnip by September (spring) which indicated that compensatory growth occurred when pasture availability was sufficient for increased growth as shown in previous studies (Back et al. 2017; Macdonald et al. 2005). With the heifers then grazed as one herd post the experimental period, resulting in similar live weights between treatments, no detrimental effects of grazing leafy turnip on growth rates were seen.

Conclusion

Overall, this study demonstrated it is possible to feed leafy turnip to growing heifers to achieve good growth rates during the summer period when pasture availability can be restricted. Further work is required to evaluate how leafy turnip could be incorporated into heifer grazing in an economically feasible manner.

References

- Back PJ, Hickson RE, Sneddon NW, Coleman LW, Laven RA 2017. Brief Communication: Managing liveweight gain of Holstein-Friesian, Jersey and Holstein-Friesian-Jersey crossbred heifer calves. *Proceedings of the New Zealand Society of Animal Production* 77: 69-71.
- Chapman D, Wayne N, Stevens D, Lee J, Minnee E 2012. Combating summer dry conditions by integrating alternative pasture and crop species into the farming system. *Proceedings of the South Island Dairy Event Conference* 14: 268-289.
- Cosgrove GP, Clark DA, Lambert MG 2003. High production dairy-beef cattle grazing systems: a review of research in the Manawatu. *Proceedings of the New Zealand Grassland Association* 65: 21-28.
- Handcock RC, Hickson RE, Back PJ 2015. The use of herb mix and lucerne to increase growth rates of dairy heifers. *Proceedings of the New Zealand Society of Animal Production* 75: 132-135.
- Lindsay CL, Kemp PD, Kenyon PR, Morris ST 2007. Summer lamb finishing on forage crops. *Proceedings of the New Zealand Society of Animal Production* 67: 121-125.
- Litherland AJ, Woodward SJR, Stevens DR, McDougal DB, Boom CJ, Knight TL, Lambert MG 2002. Seasonal variations in pasture quality on New Zealand sheep and beef farms. *Proceedings of the New Zealand Society of Animal Production* 62: 138-142.
- Lopdell T, McNaughton LR 2013. Effect of heifer live weight on calving pattern and milk production. *Proceedings of the New Zealand Society of Animal Production* 73: 103-107.
- Macdonald KA, Penno JW, Bryant AM, Roche JR 2005. Effect of feeding level pre-and post-puberty and body weight at first calving on growth, milk production, and fertility in grazing dairy cows. *Journal of Dairy Science* 88: 3363-3375.
- Reid RL, Puoli JR, Jung GA, Cox-Ganser JM, McCoy A 1994. Evaluation of Brassicas in grazing systems for sheep: I. Quality of forage and animal performance. *Journal of Animal Science* 72: 1823-1831.
- Roche JR, Dennis NA, Macdonald KA, Phyn CVC, Amer PR, White RR, Drackley JK 2015. Growth targets and rearing strategies for replacement heifers in pasture-based systems: a review. *Animal Production Science* 55: 902-915.
- Waghorn GC, Clark DA 2004. Feeding value of pastures for ruminants. *New Zealand Veterinary Journal* 52: 320-331.
- Wathes DC, Pollott GE, Johnson KF, Richardson H, Cooke JS 2014. Heifer fertility and carry over consequences for life time production in dairy and beef cattle. *Journal of Animal Science* 8: 91-104.
- Westwood CT, Mulcock H 2012. Nutritional evaluation of five species of forage brassica. *Proceedings of the New Zealand Grassland Association* 74: 31-38.