ESTABLISHING THE MOST PROFITABLE BACKGROUNDING STRATEGY FOR DIFFERENT WEIGHT GROUPS OF WEANED BONSMARA CALVES BASED ON ECONOMIC MARGINS

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Abstract

Backgrounding is the period between calf weaning and feedlot placement. There is no predetermined period for how long calves of specific weight classes should be backgrounded. The primary objective of this study was to establish which backgrounding period is the most economical and risk efficient for various weight groups of weaned Bonsmara calves in the Free State province of South Africa. A trial was conducted to establish performance data for four backgrounding treatments for four weaning weight groups. The performance data obtained from the trial were incorporated into an economic simulation model to determine the economic gross margins. Economic gross margins include the opportunity cost of the backgrounding pasture as the pasture rent. Gross margins for weekly cycles in 2020 were calculated. Furthermore, the gross margins were integrated into a stochastic efficiency with respect to a function (SERF) analysis to rank the strategies based on their risk efficiency. The findings indicated that no backgrounding should be conducted; instead, animals should be placed on the feedlot immediately. Economic gross margins and risk efficiency decreased as the backgrounding periods increased. However, when excluding the opportunity cost of land and simply calculating the accounting gross margins, the recommendations differ. Longer backgrounding periods are then more profitable and risk efficient, with the immediate feedlotting strategies being the least preferable. The conclusion is thus that the backgrounding pastures are too valuable to conduct backgrounding.

Key words: Feedlot economics, cattle backgrounding, beef cattle, opportunity cost.

1. Introduction

Three types of primary beef production systems are found in South Africa, namely cow-calf production, ox production, and speculative production (Grobler, 2016). Cow-calf production is the most commonly utilised system and delivers weaned calves to primarily commercial feedlots (Maré, 2018). The feedlot sector is responsible for finishing 70% to 80% of the slaughter-ready beef cattle in South Africa (Spies, 2018). There is, however, another link between the cow-calf producers and the feedlot, which is commonly referred to as backgrounding (Fourie & Matli, 2014).

Backgrounding serves as a preconditioning period to prepare weaned calves for feedlots (Fourie & Matli, 2014). Backgrounding is a management strategy aimed primarily at aiding in the frame building of the calves and optionally improving their health status. Frame building of weaner calves is improved by animals being placed on low-energy diets (grazing pasture or forage) that slow down muscle growth and enhance bone growth (Muth et al., 2005). Backgrounding is said to improve the feedlot performance of weaner calves (Dhuyvetter et al., 2005; Waggoner et al., 2005).

Feedlots may conduct their own backgrounding in the form of either drylot backgrounding or pasture backgrounding (Mathis et al., 2007). Feedlots commonly require specific entering weights for placement in the feedlot, and when calves do not meet these requirements, the feedlot can decide to place them on backgrounding instead of immediate feedlot placement (Beck et al., 2019). The focus of this study is on feedlots that conduct their own backgrounding to improve the feedlot performance of their animals.

Regardless of the theory that backgrounding improves feedlot performance, it must be economically beneficial for a feedlot to implement backgrounding. Economic profit margins refer to the difference between all the firm's revenues or receipts and the value of all employed inputs, whether or not the firm paid for them. Economic profit margins therefore include opportunity cost, which is a measure of the value of an earning opportunity foregone by utilising a resource in its current employment (Drummond & Goodwin, 2013). In other words, opportunity cost is the highest economic value of a resource in an alternative use (Drummond & Goodwin, 2013). In this case, the opportunity cost that must be considered is that of backgrounding instead of immediate feedlotting. Some feedlots do not implement

backgrounding as they either do not perceive backgrounding as being profitable enough or simply because they do not have the necessary facilities to conduct backgrounding. The decision of feedlots that intend to implement backgrounding is influenced by two factors: the availability of pasture, and the purchase weight of the calves (Brüggemann, 2006).

Weaning age, weight, and backgrounding periods in South Africa differ from other countries, such as Australia, North and South America, and Canada, and can also differ within countries. The weaning age, among many other factors, has an impact on the weaning weight. Backgrounding periods in countries vary dramatically and range from 20 days to a year (Waggoner et al., 2005). There is thus no set ordinance for the weight, age, or duration that cattle should be backgrounded. Backgrounding strategies are therefore not consistent between or within countries. For a feedlot that is aiming to background its own cattle, there are no set guidelines on how to structure backgrounding strategies.

The purpose of this study is to calculate a feedlot's economic advantage of different backgrounding periods of certain weight classes. Firstly, a trial is conducted to establish how the various backgrounding periods impact animal performance. The economic margin of different backgrounding periods for different calf weight groups is then calculated for the year 2020 to determine whether backgrounding offers an economic advantage over immediate feedlotting. Since backgrounding also influences feedlot performance, the backgrounding options must be evaluated in combination with feedlotting to determine the economic advantage of the total period.

2. Methodology

2.1 Backgrounding and feeding trial

A cattle backgrounding and feeding trial was used to generate data on how different weight groups of weaned calves perform under various backgrounding strategies. This trial was conducted from September 2020 to April 2021 on the Liebenbergstroom farm in Edenville, Free State. The total number of cattle backgrounded and fed was 400 head. Backgrounding took place during spring, from 3 September 2020 to 29 October 2020, on winter grazing as the first summer rain only occurred after the backgrounding period. The weaners were approximately seven months old when they were included in the trial. Before backgrounding, the cattle were divided into four weight groups, consisting of 100 animals each, namely G250 (250 ± 12.7 kg), G220 (220 ± 6.1 kg), G200 (200 ± 5.6 kg), and G180 (180 ± 8.7 kg). Each weight group was then further divided into different backgrounding periods/strategies,

consisting of 25 animals each, namely: BG0 (control – no backgrounding), BG4 (four weeks backgrounding), BG6 (six weeks backgrounding), and BG8 (eight weeks backgrounding).

On arrival, the weaners were placed either directly on feedlot (control group) or natural pasture for backgrounding. All animals in the respective weight groups were placed in one backgrounding camp to minimise camp effects. Weaners were monitored during this time and received supplemental feed, in the form of a concentrated feed lick, where necessary to maintain the targeted gain of 1 kg/day.

After backgrounding, the cattle were placed in feedlot pens according to their treatment. All weaners (for both the backgrounding and control treatment) went through a rumen adjustment period upon feedlot entry where they received a low-energy starter feed ration for three weeks. After adjustment, all the weaners were subjected to the same feeding protocol to reach a target live weight of 480 kg. The feeding strategy was categorised according to the various feed rations, namely Grower 1, Grower 2, and Finisher. These rations are formulated to fulfil the animals' nutritional requirements during the various growth phases. As the animals grow, the rations gradually change to include more energy. All animals were fed for one week on Grower 1. The period that Grower 2 was fed varied according to the live weight of the animal before the Finisher ration was fed for three weeks. Feed intake was determined daily for each pen to estimate the average individual feed intake. The animals were weighed individually on a monthly basis.

Standard slaughter protocol practised by Country Meat Abattoir was used for all the animals when they reached the target weight. The data generated for each group included feed intake, average daily gain, feed efficiency, slaughter weight, carcass weight, and dressing percentage.

2.2 Animal performance and carcass data analyses

All animal performance and carcass parameters were measured to establish the performance of the various backgrounding strategies of a certain weight class. Table 1 indicates the various performance measurements of each backgrounding strategy. The backgrounding data presented include the daily average supplement intake and the average daily gain. Feedlot data pertain to daily average feed intake, average daily gain, and feed conversion ratio. The total period (backgrounding and feeding) is presented along with the carcass data, which include the carcass weights and dressing percentages. The dressing percentages were calculated from the slaughter and carcass weights.

Table 1: The performance and carcass data of the various backgrounding strategies for all the weight groups

Treat-ment	Backgrounding data		Feedlot data			Total period	Carcass data	
	Average Supple-ment Intake	Average Daily Gain	Average Feed Intake	Ave-rage Daily Gain	Feed Conver-sion Ratio	Dura-tion	Car-cass weight	Dress-ing per-cen-tage
	(kg/ day)	(kg/ day)	(kg/ day)	(kg/ day)	(kg/kg)	(days)	(kg)	(%)
G250								
BG0	0.000	0.000	8.862	1.954	4.535	116	271.945	0.571
BG4	2.430	0.752	10.248	2.050	4.999	103	275.744	0.572
BG6	2.630	0.863	10.857	2.190	4.957	90	269.210	0.558
BG8	2.907	1.171	10.830	1.837	5.896	89	268.350	0.562
G220								
BG0	0.000	0.000	8.459	1.868	4.528	138	267.334	0.560
BG4	2.429	0.815	9.487	1.900	4.993	125	271.241	0.565
BG6	2.610	0.852	10.665	2.028	5.259	113	272.140	0.562
BG8	2.855	1.200	10.970	1.736	6.319	112	277.261	0.577
G200								
BG0	0.000	0.000	8.135	1.792	4.540	158	274.314	0.568
BG4	2.375	0.767	8.936	1.745	5.121	151	282.622	0.583
BG6	2.593	0.959	9.526	1.780	5.351	137	278.245	0.576
BG8	2.880	1.261	10.558	1.754	6.020	122	279.226	0.578
G180								
BG0	0.000	0.000	8.008	1.656	4.836	183	287.831	0.596
BG4	2.333	0.740	8.839	1.785	4.952	158	279.788	0.580
BG6	2.545	0.792	9.275	1.679	5.524	162	279.490	0.577
BG8	2.806	1.074	9.914	1.630	6.082	151	281.970	0.581

Source: Own construction

Table 1 shows a tendency that longer backgrounding periods within a weight group resulted in a higher average supplement intake during backgrounding and a higher average feed intake on the feedlot. A higher feed intake as backgrounding periods increased was expected, as animals grow bigger during the longer backgrounding period and therefore develop larger rumens compared to their counterparts, which result in a greater feed intake capacity. The same tendency, higher average supplement intake and average feed intake, for the heavier weight groups compared to lighter weight groups can be seen and were also expected because heavier, bigger animals have greater rumen capacity.

Most of the groups obtained relatively acceptable average daily gains during the backgrounding period, as the target was 1 kg/day, with only four groups (G250 BG4, G220 BG8, G200 BG8, and G180 BG8) exceeding the target. The feedlot average daily gains varied between 1.6 kg/day and 2.2 kg/day, with the highest average daily gain on feedlot realised by the heaviest weight group and the lowest average daily gain by the lightest weight group. The average daily gains in the feedlot for the same weight group also increased with the backgrounding period. In terms of feed conversion ratio during the feedlot period, the trend was that the groups that received longer backgrounding had higher feed conversion ratios, which means that they were less efficient than those placed on feedlot earlier. The relationship between weight and feed conversion ratio was also positive.

The total period indicates how long the combined backgrounding and feedlot period was for each strategy. It is evident that the total period decreased as animals were backgrounded for longer and increased as the weaning weights decreased. Slaughter weights were targeted at 480 kg. All groups were close to the target, with the weights varying between 477 kg and 485 kg at slaughter. The carcass weights and dressing percentages were determined at slaughter. The carcass weights ranged between 268 and 288 kg. All the dressing percentages were very similar; ranging between 56% and 60%, which is within the South African benchmark range (Spies, 2018).

2.3. Economic profit simulation model

The trial data were used and simulated with economic variables for the year 2020 to compare the gross margins of the various strategies of each weight group and determine the most economically beneficial strategy. By increasing the scope beyond the trial period, the various strategies can be compared over different seasons to include the effect of varying costs and revenues and backgrounding supplement intakes within a year.

A feedlot is not restricted to buying its animals during a certain time of the year (e.g., the trial period), but buys and sells animals weekly to ensure that the business continues to operate. A scenario of weekly intakes of animals must therefore be simulated to consider the price variations that may affect which strategy should be adopted by the feedlot. Weekly data for the period 2020 were either used for the feeding costs (FCs), the total value of the product (TVP), the total variable costs (TVCs) and the gross margins.

Feed prices for the various phases (backgrounding, starter, grower 1, grower 2, and finisher) were available for the 2020 period. The weekly weaned calve price (Agricultural Market

Trends, 2021) and carcass price (Red Meat Abattoir Association, 2021) were available for the year of the analysis.

Each week was regarded as the beginning of a new intake to determine the gross margins each group would have obtained if they were fed from that week onwards. Table 2 depicts the placement of the various cycles throughout a year. For illustration purposes, only three cycles of G250 BG0 is described.

Table 2: The placement of weekly intake cycles of G250 BG0

Weight group			G250		
Backgrounding strategy			BG0		
Year	Week	Cycle 1	Cycle 2	…	Cycle 52
2020	1				
2020	2				
…	…				
2020	18				
2020	19				
…	…			…	
2020	52				
…	…				
2021	17				

Source: Own construction

Table 2 shows that the placement cycles are packed in such a way that each week represents the onset of a new cycle. A total of 832 gross margins for the 16 groups were calculated based on the weekly data for one year. This resulted in 52 gross margin observations for each group which is used to characterise the gross margin risk associated with each weight class and backgrounding strategy. The 52 gross margins were used in the cumulative distribution functions to compare the profitability of each strategy in each group.

2.3.1 Gross margin

A gross margin is an indication of the profitability of an activity before interest and tax. The gross margins of the different backgrounding strategies indicate how profitable it will be to implement it as a standard management practice in a commercial feedlot. The gross margin is

calculated as the difference between the total value of the product (TVP) and the total variable cost (TVC).

The daily gross margin for a given weight group subject to a specific backgrounding strategy can be calculated as:

$$DG\pi_{bs,wg} = \frac{G\pi_{wg,bs}}{TP_{wg,bs}} \quad [1]$$

Where:

DGπ Daily gross margin (R/head/day) for weaning weight *wg* and backgrounding strategy *bs*

Gπ Gross margin per cycle (R/head/cycle) for weaning weight *wg* and backgrounding strategy *bs*

TP Total period per cycle (days/head/cycle)

The daily gross margin is a standardised way of comparing the various strategies as the strategies have different cycle lengths. In other words, some strategies require a longer time between buying the weaners and selling them for slaughter. It is therefore necessary to compare the daily gross margins. The daily gross margin is simply derived from the strategy's gross margins. The gross margins for a weaning weight group subjected to a specific backgrounding strategy can be calculated as:

$$G\pi_{wg,bs} = TVP_{wg,bs} - TVC_{wg,bs} \quad [2]$$

Where:

TVP Total value of the product (R/head/cycle) for weaning weight *wg* and backgrounding strategy *bs*

TVC Total variable cost (R/head/cycle) for weaning weight *wg* and backgrounding strategy *bs*

Based on the $G\pi_{wg,bs}$, the profit-maximising backgrounding strategy for a specific weight class can be determined. The backgrounding period with the highest $G\pi_{wg,bs}$ indicates the most profitable duration for weaned calves of a certain weight to be placed on backgrounding.

2.3.2 Total value of the product (TVP) for different weight classes in various backgrounding strategies

The total value of the product is a function of the weight gain, the dressing percentage, and the carcass price. The total value of the product of each backgrounding strategy ($TVP_{wg,bs}$) can be calculated as:

$$TVP_{wg,bs} = SW_{wg,bs} \times cp \times DP_{wg,bs} \quad [3]$$

Where:

SW Average slaughter weight of group (kg/head) for weaning weight *wg* and backgrounding strategy *bs*

cp Carcass price per cycle (R/kg/head/cycle)

DP Dressing percentage (%/head) for weaning weight *wg* and backgrounding strategy *bs*

The total value of the product shows how the value of the animal changes when weight groups are allotted to different backgrounding strategies. Carcass prices used for each weekly intake were the reigning carcass price during the week when the respective groups were sold for the market.

2.3.3 Total variable cost (TVC) for different weight classes in various backgrounding strategies

The total variable costs is a function of the weaning weight, weaner price, feed intake, feeding period, feeding cost, period on backgrounding, rental cost of backgrounding pasture, morbidity rate, and health costs. The total variable costs for a backgrounding strategy for a weight class ($TVC_{wg,bs}$) can be calculated as:

$$TVC_{wg,bs} = (WW_{wg,bs} \times wp) + FC_{wg,bs} + (MOB_{wg,bs} \times hc) + (BP_{wg,bs} \times r) \quad [4]$$

Where:

WW Average weaning weight of group (kg/head) for weaning weight *wg* and backgrounding strategy *bs*

wp Weaner price per cycle (R/kg/head /cycle)

FC Feeding costs of the group (R/head) for weaning weight *wg* and backgrounding strategy *bs*

MOB Average morbidity rate of the group (amount of hospital visits/head) for weaning weight *wg* and backgrounding strategy *bs*

hc Health costs (R/head)

BP Average backgrounding period of the group (weeks) for weaning weight *wg* and backgrounding strategy *bs*

r Rent of backgrounding pasture (R/head/week)

Various backgrounding durations for various weight groups each have unique total variable costs. The total variable costs will ultimately affect the gross margins and the total value of the product. A higher total variable cost will not necessarily result in a lower gross margin as total value of the product can also be proportionately greater.

2.3.4 Feeding costs

Feeding costs is a factor of the ration (backgrounding, starter, grower 1 and grower 2, and finisher) price and how much feed was consumed during the relevant feeding period. The total amount of feed consumed is a factor of the average feed intake of the respective ration and the number of days the animals were subjected to the feeding phase. The feeding costs for a backgrounding strategy for a weight class ($FC_{wg,bs}$) can be calculated as:

$$FC_{wg,bs} = FI_{wg,bs,r} \times FP_{wg,bs,r} \quad [5]$$

Where:

r Ration number

FI Average feed intake (kg/head/day) for weaning weight *wg* and backgrounding strategy *bs* for ration number *r*

FP Feeding period (days/head) for weaning weight *wg* and backgrounding strategy *bs* for ration number *r*

There will be a difference in each group's feeding costs as the animals will most likely have different feed intakes as influenced by the strategy they are subjected to. Feeding costs is the biggest component of total variable costs, which will ultimately affect the gross margins of the

group. The average supplement intake of the animals during the backgrounding period was changed depending on the season for which the gross margins were simulated. In practice, the backgrounding supplement intake changes as the nutritional value of the pasture changes during seasons (Swiegers, 2021). Table 3 indicates the average supplement intake during backgrounding depending on the season. The backgrounding supplement intakes during the various seasons are also shown in Table 3.

Table 3: The placement of weekly intake cycles of G250 BG0

Season	Months	Duration (months)	Average supplement intake (kg/day)
Summer	Nov. to Feb.	4	0.5
Transition	Mar. to Apr.	2	1.5
Winter	May to Aug.	4	3
Transition	Sept. to Oct.	2	1.5

Source: Swiegers (2021)

The average supplement intakes were changed for the numerous simulated gross margins with the values indicated in Table 3. To retain the variance between the strategies, each strategy's backgrounding feed intake was proportionally adjusted to the seasonal average. The average feed intake between all strategies in a season was therefore the same as the values expressed in Table 3.

3. Results

The results of the study include the gross margin simulations for weekly intakes of each weaning weight group and backgrounding strategy for the year 2020. The cumulative distribution functions (CDFs) of the gross margins for weekly intakes of each weight groups various backgrounding strategies are illustrated in Figures 1 – 4. The gross margins are expressed on a R/head/day basis to account for the variation in the lengths of the cycles of each backgrounding strategy in each weight group.

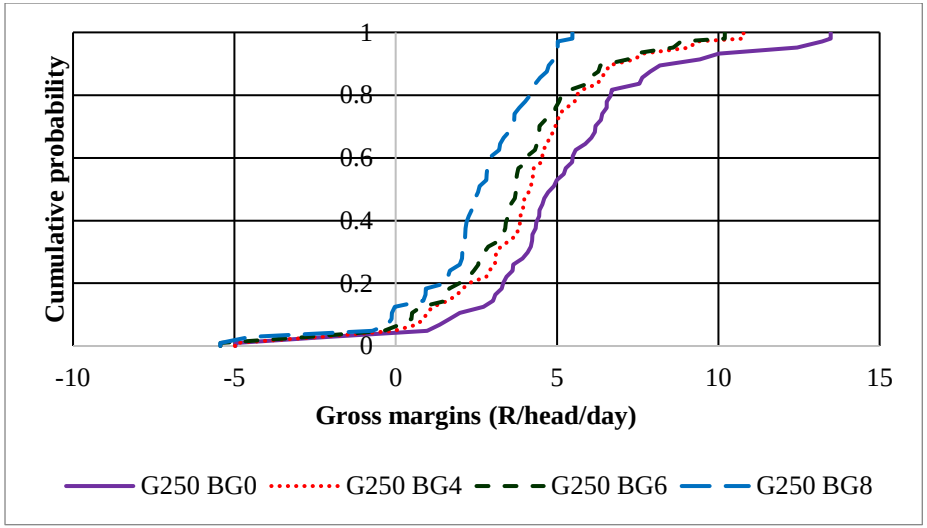


Figure 1: Cumulative distribution function (CDF) for gross margins for weekly intakes for G250

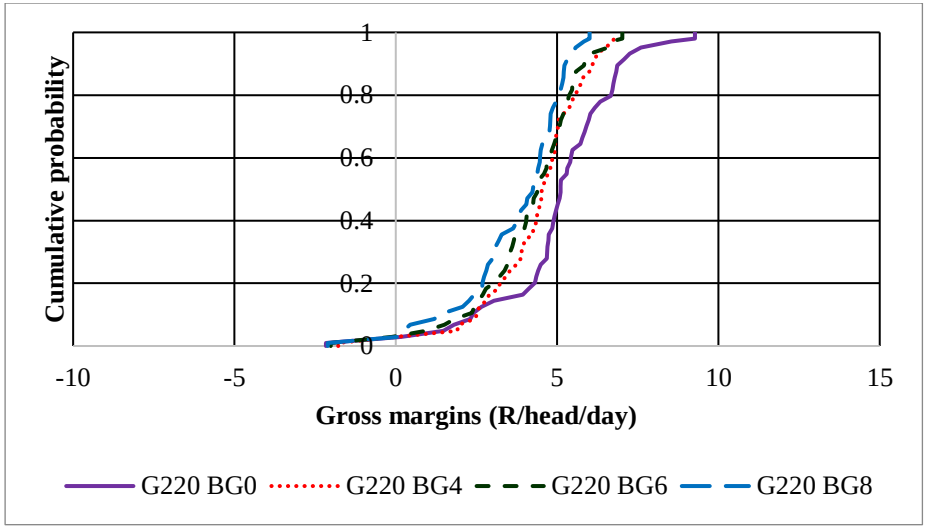
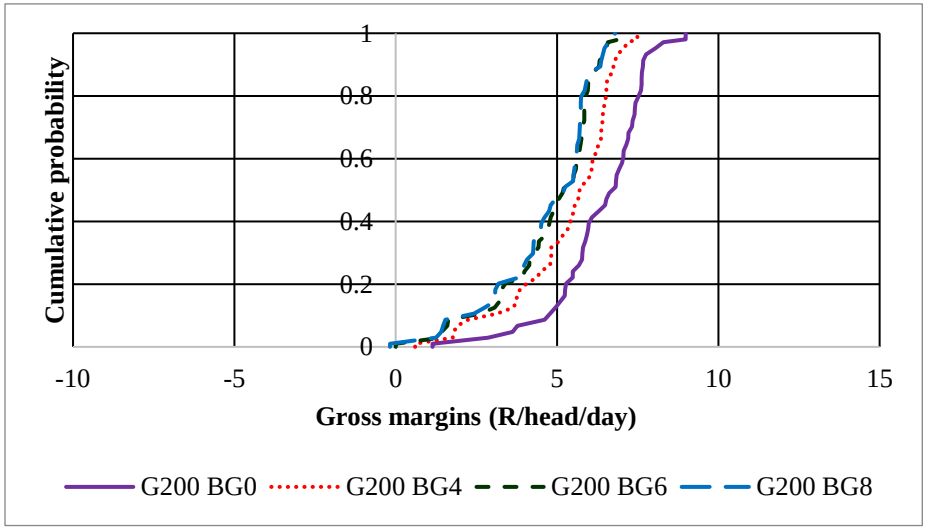


Figure 2: CDF for gross margins for weekly intakes for G220



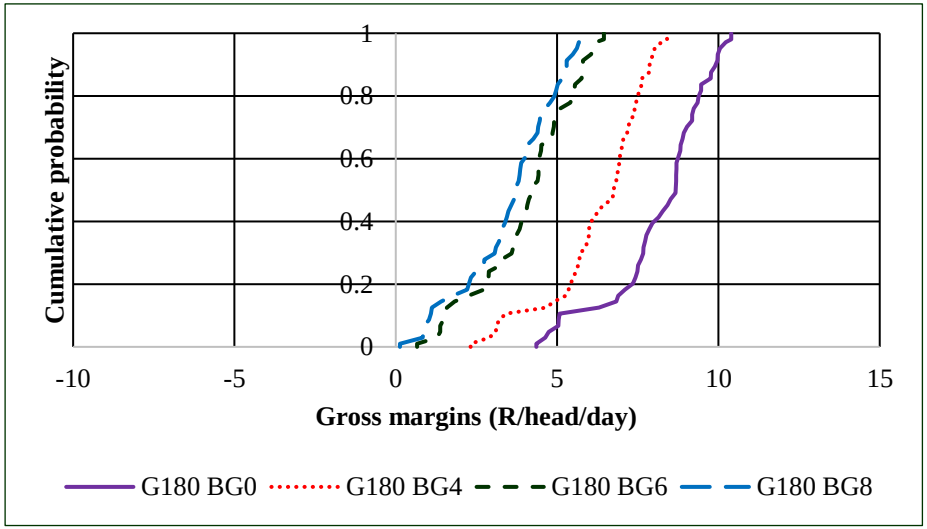


Figure 3: CDF for gross margins for weekly intakes for G200

Figure 4: CDF for gross margins for weekly intakes for G180

Figures 1 – 4 show that the economic gross margins, for all the weight groups, decreased as the backgrounding period increased. All weight groups, except G180, realised a certain degree of negative gross margins. The lowest gross margin of -R5.43/head/day was obtained by G250 BG8 with the highest minimum gross margin of R4.36/head/day being obtained by G180 BG0. In terms of maximum gross margins, G250 BG0 indicated the highest gross margin of R13.48/head/day with G250 BG8 obtaining the lowest maximum of R5.48/head/day. G250 BG0 revealed the greatest fluctuation of R18.45/head/day in the gross margins obtained meaning that this weight group and backgrounding strategy combination is the riskiest to feed. When considering the averages, the average gross margin increased as the weaning weights were lighter. The highest average gross margin was realised by G180 BG0 of R8.15/head/day and the lowest by G250 BG8 of R2.43/head/day. The results in general showed that it was on average more profitable to background and feed lighter weaner calves than it was to feed heavier calves. This is in line with the findings of Adams, Klopfenstein, Erickson, Griffin et al. (2010) and Arikan and Gökhan (2018).

If the accounting gross margins were considered with the exclusion of the opportunity cost of land, such as in the studies of Kumar (2010) and Cox-O'Neill et al. (2017), the recommendations differ. Kumar (2010) concluded that backgrounding was more profitable and Cox O'Neill et al. (2017) found that there is not a certain strategy that is more profitable than the other with certain strategies being more profitable during certain years. Figures A1 - A4 in Addendum A show the accounting gross margins for weekly intakes of the various strategies for the various weight groups. Immediate feellotting is not the most profitable when opportunity cost is excluded, but the most profitable based on accounting margins are: G250 BG8, G220 BG8, G200 BG8 and G180 BG4.

4. Discussion

The economic margins during the 2020 period illustrated that the profitability of the numerous weight groups decreased as the backgrounding periods increased. Economic profitability was calculated in this study as the opportunity cost of backgrounding was incorporated in the form of backgrounding rent. The results from Kumar (2010) and Cox-O'Neill et al.'s (2017) studies, which proposed that longer backgrounding periods are more profitable, differ as these studies failed to account for opportunity cost.

5. Conclusion and recommendations

There is a common perception that backgrounding is more profitable or as profitable as immediate feedlot placement because the opportunity cost is not accounted for. The opportunity cost of the backgrounding pasture is the value of the land rent where the animals are backgrounded. When basing the optimal strategy on an accounting profit, feedlots are advised on strategies that will not optimise their direct and indirect (opportunity) profits, but simply on what is directly paid by the feedlot. Based on Kumar (2010), the recommendation is to background all animals. Cox O'Neill et al. (2017), however, states that all strategies are very similar in terms of profitability.

The optimal backgrounding strategy in this study based on the economic, and not accounting, profits, is immediate feedlotting. Backgrounding is not economically profitable in this study. All animals should be placed on feedlot immediately after weaning. Based on the findings, the recommendations in this study are to decrease the cost of the backgrounding supplement, to conduct backgrounding during seasons when the pasture can sustain the animals, to conduct backgrounding on cheaper land parcels, to conduct another enterprise on the backgrounding pasture that has greater economic gross margins, or to rent the land out to a tenant.

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7. Addendum A

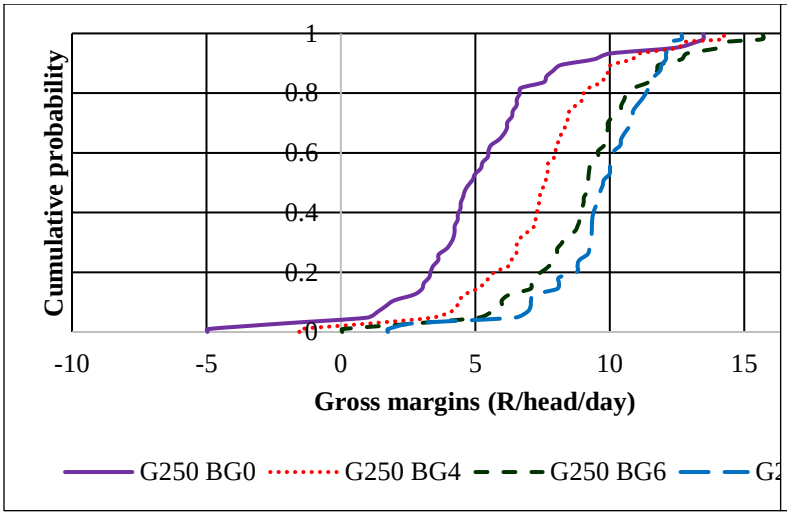

Figure A1: Cumulative distribution function (CDF) for accounting gross margins for weekly intakes for G250

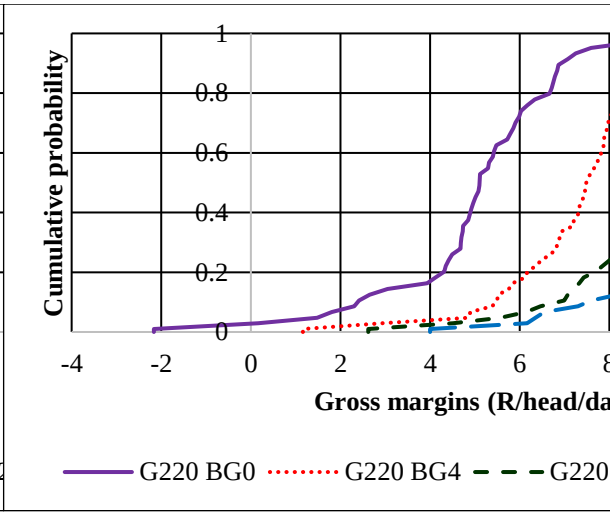

Figure A2: CDF for accounting gross margins G220

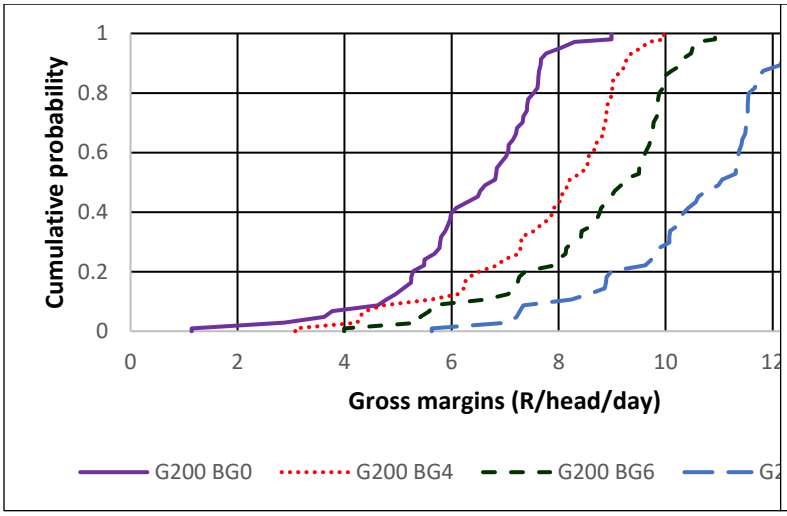

Figure A3: CDF for accounting gross margins for weekly intakes for G200

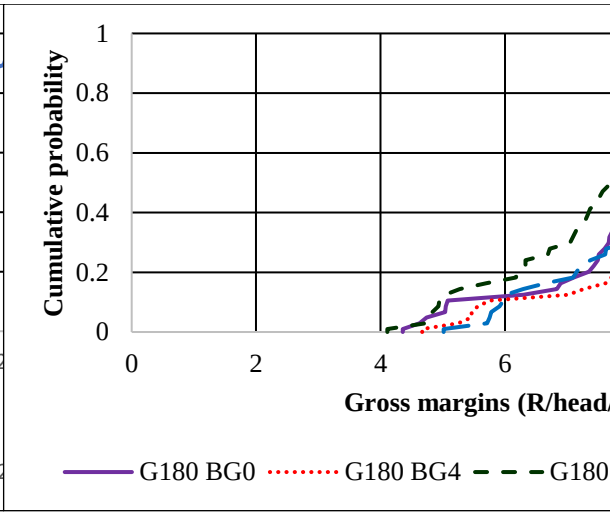

Figure A4: CDF for accounting gross margins G180