Influence of pen area and trough space on feedlot performance of beef cattle

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Two experiments were conducted to measure the influence of trough space (170 mm, 350 mm and 700 mm/animal) and pen area (5,5 m², 11 m² and 22 m²/animal) on feedlot performance. There was no advantage in allowing more than 170 mm trough space or more than 5,5 m² floor area per animal with the conditions and climate under which these trials were conducted.

Twee proewe is uitgevoer om die invloed van kripspasie (170 mm, 350 mm en 700 mm/bees) en kraaloppervlakte (5,5 m², 11 m² en 22 m²/bees) op voerkraalprestasie te meet. Daar was geen voordeel om meer as 170 mm kripspasie of meer as 5,5 m² kraaloppervlakte per bees toe te laat onder die omstandighede en klimaat waarby hierdie proewe uitgevoer is nie.

Keywords: Trough space, pen area, feedlot cattle

Commercial feedlot cattle are fed in groups and are normally given free access to feed but for economic reasons both pen area and trough space are restricted. A reduction in space allowance is known to increase agonistic behaviour in various animal species (Craig, Bisvas & Guhl, 1969; Alexander & Roth, 1971), including cattle (Donaldson, Albright & Ross, 1972). Under such conditions, social dominance within a group of animals can be expected to initiate stress responses and to lower productivity. In outdoor, unpaved feedlots a further source of stress is the accumulation of mud and excreta, particularly in high rainfall areas or during wet and cold seasons with cold winds.

For these reasons it is important to establish the minimum trough space and pen area which would be compatible with good animal performance. Although practical guidelines for both feed trough space (± 200 mm) and pen area (10 – 15 m²) are available, we could find little reliable experimental evidence in support of these recommendations and no such work has been done in this country. Therefore two experiments were conducted to examine the effect of varying trough space and pen area on feed intake and feedlot performance.

A total of 196 dehorned British crossbred weaner oxen were used in these experiments. In order to measure not only livemass gain but also carcass mass gain a representative group of 12 animals was selected under conditions of restrictive randomization and slaughtered at the beginning of the trial. A regression equation, based on the slaughter data, was used to estimate the initial carcass mass of the experimental animals. The cattle were fattened in a conventional open, unpaved feedlot situated on a well-drained sloping site. The roofed trough was provided with a 3,5 m concrete apron. The feedlot facility is situated on the Natal north coast and the rainfall experienced during the 4-month feeding period from February to June 1983 totalled only 133 mm. The climate in the area is subtropical. The average minimum and maximum temperature during the experimental period was 16°C and 26°C, respectively.

In Experiment 1, animals were given free access to a highly concentrated diet consisting, in the first replicate, of *ad libitum* whole maize grain and free access to a pelleted protein, roughage, additives, and mineral mixture. The feeding system, in the second replicate, was as above except that hominy chop was substituted for whole maize grain. In Experiment 2, both replicates were fed as in replicate 1 above. In both experiments the animals voluntarily consumed about 85% whole maize grain or hominy chop, respectively, and about 15% of the pelleted concentrate. The two experiments were designed to determine the effect of trough and pen space on animal performance without any one of these two variables being confounded by the other. In Experiment 1, trough space per animal (700 mm, 350 mm and 170 mm) was varied while keeping floor space per animal constant (11 m²). In Experiment 2, floor area was varied (5,5 m², 11 m² and 22 m²) while trough space was held constant at 350 mm per head. To achieve this with the available facilities, the cattle numbers in certain groups were double those of others. Because cattle in the hominy chop and maize groups were expected to gain at different rates it was decided to feed animals in the various groups to the same final livemass in order to minimize differences in degree of finish and thus grading.

The results of these experiments are summarized in Tables 1 and 2. It can be noted from Table 1 that increasing the available trough space from 170 mm to as much as 700 mm per animal had no advantage measured in terms of feed intake, mass gain, or feed efficiency. If the results of the two replicates are pooled, the data show a tendency for performance to improve with reduced trough space but this effect was not statistically significant ($P > 0,05$). Friend, Polan & McGilliard (1977), working with dairy cows fed under free stall conditions, found that time spent eating at the feed bunk was not reduced until feed trough space was reduced to 100 mm per cow. Average daily feed intake also appeared to drop when feed trough space was reduced to 100 mm. They concluded that 200 mm of feed bunk space is adequate for

Table 1 Effect of trough space on gain and efficiency of feed conversion in feedlot oxen fed a highly concentrated diet

Item	Replicate					
	1			2		
Trough space (mm/animal)	700	350	170	700	350	170
Days fed	120	120	120	106	106	106
Number of cattle	11	11	22	11	11	22
Initial livemass (kg)	202,4	198,2	200,8	207,5	204,9	201,6
Livemass gain (kg)	147,1	156,6	160,7	149,5	147,7	138,0
Daily livemass gain (kg)	1,23	1,31	1,34	1,41	1,39	1,30
± Standard deviation (kg)	0,19	0,18	0,19	0,15	0,18	0,16
Feed intake (kg)	8,17	7,38	8,11	8,67	8,75	8,12
Live gain/kg feed (kg)	6,66	5,66	6,06	6,15	6,28	6,23
Initial carcass mass (kg)	98,0	96,1	97,3	100,4	99,2	97,6
Carcass mass gain (kg)	96,6	93,3	104,4	95,7	93,6	89,5
Daily carcass gain (kg)	0,81	0,78	0,87	0,90	0,88	0,84
Carcass dressing (%)	55,7	53,4	55,8	56,9	54,7	55,1
Carcass gain/kg feed (kg)	10,12	9,49	9,32	9,60	9,91	9,62

Table 2 Effect of pen area on gain and efficiency of feed conversion in feedlot oxen fed over a 113-day period

Item	Replicate					
	1			2		
Pen area (m^2/head)	5,5	11	22	5,5	11	22
Number of cattle	24	12	12	24	12	12
Initial livemass (kg)	203,3	211,4	210,8	208,1	209,9	206,8
Livemass gain (kg)	131,7	143,6	155,2	145,9	140,6	137,2
Daily livemass gain (kg)	1,17	1,27	1,37	1,29	1,24	1,21
± Standard deviation (kg)	0,27	0,20	0,16	0,17	0,28	0,20
Feed intake (kg)	6,91	7,43	7,84	7,55	7,59	7,50
Live gain/kg feed (kg)	5,93	5,84	5,71	5,85	6,10	6,18
Initial carcass mass (kg)	103,7	107,3	107,0	105,8	106,6	105,2
Carcass mass gain (kg)	82,0	91,1	96,2	93,7	88,5	88,5
Daily carcass gain (kg)	0,73	0,81	0,85	0,83	0,78	0,78
Carcass dressing (%)	55,4	55,9	55,5	56,4	55,7	56,3
Carcass gain/kg feed (kg)	9,52	9,21	9,22	9,11	9,70	9,58

animals with access to the feed for 21 h per day. Keys, Pearson & Thompson (1978) working with yearling dairy heifers compared the effect of 810, 410, 270 and 200 mm of trough space on mass gains and behaviour. They reported a marked improvement in growth rates when trough space was increased from 200 to 810 mm per animal. The adverse effect on gain and eating time per day was most marked when feed trough space was reduced from 270 to 200 mm. They concluded that a minimum feed bunk space of 270 mm is required to ensure adequate daily gains in yearling Holstein heifers under conditions of restricted feed intake. The fact that feed was restricted in their experiments may explain the difference with the findings reported here. It is also important to point out that these workers made no attempt to eliminate pen space as a variable. Animals given additional trough space (200 mm – 810 mm) automatically gained more pen space (4,4 m^2 – 17,5 m^2). The improvement measured could be due partly to the increase in pen space rather than the additional feeding space given per animal.

The results in Table 2 show that increasing pen space from 5,5 to 22 m^2 per animal had no consistent effect on any of the parameters under investigation. There was a tendency for animal performance to improve in replicate 1 whereas the opposite was true in the second replicate. The pooled results show a non-significant ($P > 0,05$) tendency for feed intake and mass gains to improve as the space allowance was increased from 5,5 m^2 to 22 m^2. Efficiency of feed conversion was, however, not improved by allowing more floor space. Although these results suggest that 5,5 m^2 per animal is quite adequate to ensure optimum space in dehorned animals given free access to a highly concentrated feedlot ration, it is important to point out that relatively little rainfall was experienced during the trial. The results might have been quite different if wetter or wet and cold conditions had been experienced.

From these experiments it is possible to conclude that a feed trough space allotment of 170 mm per animal does not impose any limit on feedlot performance of dehorned animals under *ad libitum* feeding conditions. It can also be concluded that 5,5 m^2 appears to be sufficient pen area for optimum efficiency of feed conversion under the conditions prevailing in this experiment. This conclusion will not necessarily be valid in open feedlots in areas or seasons with high rainfall where the animals will be in excessive mud for long periods.

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