Development of a management system to intensify and increase beef production in a range suckler herd in Israel - "the Amaziah project"

A. R. LEHRER[1], HAVA E. KAHN[1], J. KREITZER[2], H. GACITUA[1], Y. MIZRACHI[3] AND J. KALI[2]

Institute of Animal Science, Agricultural Research Organisation, PO Box 6, Bet Dagan, Israel.

ABSTRACT

East-Mediterranean natural pastures are characterised by extreme seasonal variation in nutritional value. High quality green standing pasture is available only during the rainy season (Dec.-May), whereas during the rest of the year the standing pasture is dry and of low quality.

The main objective of this study was to investigate the potential of increasing weaning rates and weaning weights on a commercial beef suckler herd under the above conditions. The main 3 means to achieve this were: (i) increased stocking rate, (ii) intensive trough-feeding, during the dry pasture season, of rations based on recycled wastes, and (iii) short calving periods.

Main input/output data in the 1st and 10th year of the study, respectively, were as follows: herd size: 424, 624 cows; stocking rate: 0.19, 0.29 cow/ha of pasture; trough-fed ration: 1, 2 metric tons DM/cow/year; energy in trough-fed ration: 7.5, 8.8-9.6 MJ ME/kg DM; percent cows calving in the first 2 months of the calving season (Aug. + Sept.): 35, 89; percent cows weaning (of exposed to mating bulls): 73, 86; avg. calf weaning weight 206, 259 kg LW; total weaned calf crop: 64, 138 metric ton LW/year. These data present a potential model for improving the efficiency and increasing the volume of range beef production under Mediterranean-type pasture conditions.

Studies are in progress on intensive beef production (i) by suckler herds in full confinement - fed year-round on rations composed mainly of recycled wastes, (ii) by dual-purpose cattle - in dairy herds under milk quotas, and (iii) under desert conditions based on grazing or trough-feeding forage irrigated with saline water and /or purified recycled sewage water.

Keywords: Beef production; suckler herds; feeding recycled wastes; reproductive management; grazing management; feeding management.

INTRODUCTION

Annual beef consumption in Israel is close to 60,000 metric tons of boneless carcass. About 60% of it is imported frozen and only 40% is produced domestically. About 75% of domestic production originates from the dairy herds - *ca* 110,000 high yielding Israeli-Holstein dairy cows in full confinement. The other 25% is from range herds - *ca* 45,000 suckler cows of mixed beef breeds. The overall number of range cows is limited by the relatively small area presently available for grazing - *ca* 130,000 ha of natural pastures.

The objective of saving foreign-currency on beef imports, and the need to diversify and add income sources from agriculture, led to the initiation of a comprehensive long term research and development programme to increase domestic beef production in Israel. Intensive production in range suckler herds, grazing on natural pastures, is one of the systems investigated.

The semi-arid east-Mediterranean region is characterised by strictly seasonal rainfall confined to only 5-7 autumn and winter months. The long dry season results in a long period of low quality dry standing pasture containing ≤7.2 MJ of metabolisable energy (ME) and 60g of crude protein (CP) per kg of dry matter (DM). Abundance of high quality green standing pasture (≥10.5 MJ and 140 g CP per kg DM) is available only during *ca* 4 winter and spring months (mid-January through mid-May). (Gutman, 1978; Weitz, 1981; Bruckental *et al.*, 1984; A. Perevolotzki, unpublished data).

The long season of low quality pasture impaired production of beef herds despite some protein and energy supplementation; low calving rates and weaning weights, and extended calving periods - characteristic of suboptimally fed beef herds - were common in Israel during the 1970's (Lehrer and Schindler, 1984). Adopting Wiltbank's (1971, 1972) concept under Israeli beef herd conditions, Lehrer and Schindler (1984) demonstrated the increase in pregnancy rates and weaning weights as a result of short calving periods which were attained by improved nutrition. The subsequent stage of the work was aimed at testing a further intensified management system which integrated the following 3 main components: (i) a short, late summer/early autumn calving period, (ii) increased stocking rate, (iii) trough-feeding, during the dry pasture season, of total mixed rations (TMRs) composed mainly of recycled wastes. The specific objectives of the work were: to implement the intensified reproductive management (Lehrer and Schindler, 1984) in another commercial herd, by gradual shortening of the calving period over several years; to test intensified grazing and trough-feeding management systems which would cater for the nutritional requirements of the dams, under the intensified reproductive management; and to determine the changes in production and economic variables as a result of implementing the overall intensified management system. Results obtained over a 10 year work period are presented in this report.

MATERIALS AND METHODS

Most of the work was conducted on a commercial beef herd at Moshav Amaziah, a co-operative village about 40 km

[1]On Sabbatical at AgResearch, Ruakura Research Centre, Private Bag 3123, Hamilton, New Zealand.
[2]The Extension Service, Ministry of Agriculture, Israel.
[3]Moshav Amaziah, Israel..

south-west of Jerusalem. The herd of *ca* 400-600 head, subdivided in to groups of *ca* 150-250 head/group were rotationally grazed on *ca* 2,200 ha of natural pastures, mainly hill slopes at elevations ranging from *ca* 200-350 m above sea level.

During the dry pasture season - when dams were in last trimester of pregnancy through to mating - trough-fed TMRs were provided ad lib. Examples of TMRs, for late pregnant non-lactating and for nursing cows, are presented in Table 1. Freshly prepared TMRs were provided either daily or once in 2 days. No trough feeding took place during the green pasture season.

Dams were of mixed breeds, predominantly varying ratios of Simmental X Hereford crosses. Maiden heifers and first calvers were mated naturally with Simmental X Hereford bulls; Heifers born to these matings were used as replacements. Second and subsequent calvers were mated naturally with pure-bred or cross-bred Charolais bulls to produce terminal offspring.

Weaning of 6-10 month old calves was timed to coincide with withering of the green pasture. Weaning date varied among years (between the end of April through the beginning of June) depending mainly on pasture quality.

Data were collected and analysed on amounts, composition, and the nutritional value of TMRs in the daily fed groups, calving dates, cow/calf filliations, and weaning liveweights (LW). In addition, one of the herd subgroups was used for determining the annual pattern of LW changes of the cows and calf crop, cow body-condition score (BCS in a scale of 1-5), and luteal ovarian cyclicity of the suckling dams at start of the mating period (based on plasma progesterone concentrations in 3 consecutive once weekly plasma samples). All details of costs, expenses and income were collected and analysed.

Additional subjects investigated, beyond the scope of this report, were post-weaning management of replacement heifers to first calving at *ca* 2 years of age, feed lotting of the weaned calf-crop to slaughter LW of 400-450 kg at 14-16 months of age, and seasonal changes in pasture quantity, nutritional value and estimated intake.

The multidisciplinary approach, professional involvement, data collection and analysis methods, and procedures of team decision making, were similar to those practised by the "Farm Monitor Groups" in New Zealand (Webby and Sheath, 1991).

RESULTS AND DISCUSSION

Annual profiles of dam net maternal LW and BCS relative to pasture condition, and to weaning, calving, and subsequent mating periods, are presented in Figure 1. Net maternal LW and BCS declined simultaneously with the decline in pasture quality, throughout the last trimester of pregnancy and the subsequent postpartum and mating periods, not withstanding the trough-feeding of TMRs. Liveweight and BCS were gained during the green pasture season, reaching their annual peaks at the end of this season (Kahn *et al.*, 1987 and unpublished data).

Despite the LW and BCS losses, post-partum ovarian cyclicity by the start of the mating period was resumed in >80% of the suckling cows, and pregnancy rates after 90-100 d mating periods were >90%. These high rates of ovarian activity and pregnancy were achieved provided that, on average, LW at the beginning of the mating period was ≥85%

FIGURE 1: Annual profiles of mean liveweight and body condition score of beef cows, relative to pasture condition, and to weaning, calving and subsequent mating periods at Moshav Amaziah beef herd, Israel.

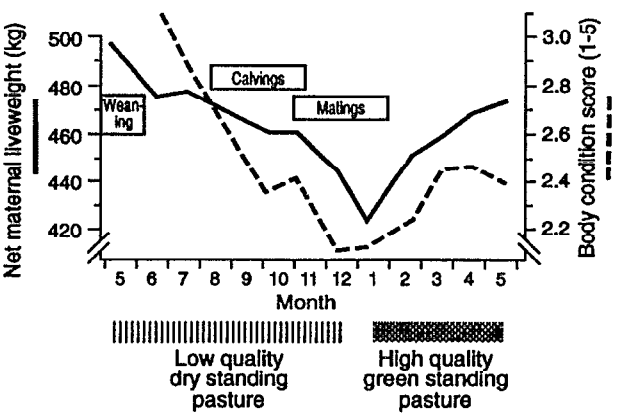

TABLE 1: Examples of daily TMRs for a late pregnant, non-lactating (A), and a suckling (B) beef cow.

A. Late pregnant non-lactating cow

Component[1]	kg as fed	kg DM	ME (MJ) per kg DM	ME (MJ) Total	CP %	CP (g)	cost (1993 US $)
Artichoke foliage silage	12	3.6	8.4	30.2	5.0	180	0.18
Poultry litter + citrus peels silage	8	3.6	8.4	30.2	21.9	790	0.21
Dry standing pasture (estimated intake) or wheat straw	2	1.8	6.7	12.1	1.9	35	0.10
Total/cow/day	-	9.0	8.1	72.5	11.2	1,005	0.49
NRC (1984) recommendations	-	9.5	7.3	69.4	7.0	661	

B. Suckling cow

Artichoke foliage silage	20	6.0	8.4	50.4	5.0	300	0.30
Poultry litter + citrus peels silage	8	3.6	8.4	30.2	21.9	790	0.21
wheat hay	3	2.7	9.1	24.6	10.0	270	0.24
Total/cow/day		12.3	8.6	105.2	11.1	1,360	0.75
NRC (1984) recommendations		10.8	9.6	104.2	11.1	1,194	

[1] Other commonly used components are: various vegetable foliage, cobless green maize-stalks, fresh citrus peels.

of the preceding annual peak LW, and BCS at the beginning of the mating period was ≥2.5. (Kahn and Lehrer, 1984 and unpublished data).

The changes in input, output, and economic variables over the 10 year report period are presented in Table 2.

It can be seen that about 50% increase in stocking rate (as a result of about a 50% increase in the number of cows on about the same pasture area) was accompanied by about a

TABLE 2: The changes in input (A), output (B) and economic (C) variables during multi-annual implementation of integrated grazing, trough-feeding, and reproductive managerial means at Moshav Amaziah beef herd, Israel (from Lehrer and Kali, 1990).

	Year of report period		
	1st	5th	10th
A. Input			
No. of cows in the herd	424	544	624
Stocking rate (cow/ha)	0.19	0.25	0.29
Trough feeding/cow/year			
DM (metric tons)	1.1	1.3	2.0
ME (1000 MJ)	8.0	12.3	17.4
B. Output			
% Calving in first 2 months of the calving period (Aug. + Sept.)	35	61	89
Annual weaning rate (% of cows exposed to bulls at mating)	73	79	86
Avg. weaning weight (kg LW)			
per weaned calf (males & females)	206	231	260
per cow in the herd	151	182	221
Total weaned calf crop (metric tons LW/year)	64	99	138
C. Economic variables (Kreitzer and Bar-Yosef, 1975-1988)			
	US$ adjusted for 1988		
Trough-feeding cost/cow/year	65	129	152
Production cost/kg LW weaned	3.2	2.6	2.3
Net profit/cow/year (non-producing cows included)	-72 (net loss)	32	114

100% increase in trough fed DM and energy.

The changes in grazing and trough-feeding managements were associated with about 2.5 fold increase in the percentage of the calf crop born during the first 2 months of the calving period, and about a 20% increase in annual weaning rate (as a composite expression of calving rate and calf mortalities from birth through weaning).

Average LW weaned per cow in the herd was increased by about 50% and the overall weaned calf-crop LW in the herd more than doubled.

The 2 fold increase in trough-feeding/cow resulted in more than a 2 fold increase in annual cost of trough-feeding/cow, because of the higher energy content, and therefore the higher cost of kg DM fed. Nevertheless, due to the overall increase of production, production cost/kg LW weaned was reduced by about 30% and net annual profit/cow in the herd was increased from -72 (net loss) to 114 US$.

The results show that integrated implementation of the 3 planned managerial components - ie higher stocking rate, intensified trough-feeding and shorter calving period - was biologically feasible and cost effective under Israeli conditions.

Under the system tested, the nutritional requirements of late gestation, suckling, and rebreeding are supplied by trough-feeding, although these high requirements could be fully met, at a lower cost, by timing calvings to the green pasture season. Nevertheless, calvings are timed to the dry pasture season because in that way the offspring reach the subsequent green pasture season at an age when they are capable of exploiting the forage efficiently. This permits an extended preweaning period on high quality green pasture, which result in high weaning weights and, consequently, a shorter postweaning-to-slaughter feed-lotting. The economic rationale of the system is, thus, in trading off imported and expensive grain used for feed-lotting postweaned offspring, by low cost recycled wastes for trough-feeding the dams.

The main guideline of the tested management system was to maximize pasture utilization while constantly controlling the nutritional status, and thus the reproductive performance of the dams, independently of pasture availability and quality. This was achieved by the trough-feeding, as required, of relatively low cost TMRs. The results showed that this approach was feasibile and cost effective when trough-feeding provided about 50% of the annual feed requirements. Ongoing work is aimed at testing the feasibility and cost effectiveness of further intensification by higher stocking rates - mainly during the green pasture season, and provision of yet higher proportions of the annual ration by trough-feeding.

It was estimated (Aharoni and Gutman, 1993; Holzer *et al.*, 1993) that self-sufficiency of beef in Israel is potentially attainable by maximal utilization of natural pastures during the green pasture season, and by grazing (following proper agrotechnical development) within presently ungrazeable afforested and natural scrub areas. In our opinion, alternative potential sources should be investigated, for example intensive beef production (i) by suckler herds in full confinement - fed year-round on TMRs composed mainly of recycled wastes, (ii) by dual-purpose cattle - in the dairy herds all of which in Israel are under milk quotas, and (iii) under desert conditions based on grazing or trough-feeding of forage irrigated with saline water and /or recycled purified sewage water. Studies in all directions mentioned above are currently in progress.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the economic analyses by Y.Bar-Yosef (Lakhish Extension Chamber), the veterinary medical care by Dr U. Gross ("Ha`Khaklait"), the invaluable co-operatopm of G. Darchi, A. Moran, and S. Rozen (Moshav Amaziah), and the comments on the manuscript by Drs D. McCall (AgResearch, Whatawhata) and W.H. McMillan (AgResearch, Ruakura).

REFERENCES

Aharoni, Y. and Gutman, M. 1993. The potential size of the national beef herd (in Israel) based on maximal utilization of green pasture. *Yediot Labokrim* 79: 40 (In Hebrew).

Bar-Yosef, Y. and Kreitzer, J. 1975-1988. Annual reports on Amaziah beef herd, issued by Lakhish Extension Chamber, Israel (in Hebrew).

Bruckental, I.; Lehrer, A.R.; Weitz, M.; Bernard, J.; Kennit, H. and Neumark, H. 1987. Faecal output and estimated voluntary dry-matter intake of grazing beef cows, relative to their live weight and to the digestibility of the pasture. *Animal Production* **45:** 23-28.

Gutman, M. 1978. Primary production of transitional Mediterranean steppe. Proceeding 1st Int. Rangeland Congress (Denver, CO), pp. 225-228.

Holzer, Z.; Gutman, M.; Aharoni, Y. and Brosh, A. 1993. Early weaning as a means to increase stocking rate of grazing beef herds. *Yediot Labokrim* **79:** 27 (In Hebrew).

Kahn, H.E. and Lehrer, A.R. 1984. A dynamic model for the simulation of cattle herd production systems: Part 3 (Reproductive performance of beef cows. *Agricultural Systems* **13:** 143-159.

Kahn, H.E.; Lehrer, A.R. and Weller J. 1987. The relationship between calf weaning weight and the live-weight of its dam in a beef herd in Israel. *Ha`Sadeh* **67:** 1644-1647 (in Hebrew with summary in English).

Lehrer, A.R. and Schindler, H. 1984. Adjustment of the breeding cycle of beef herds to the vegetational cycle of the range in Israel. pp. 339-351 *in:* "The reproductive potential of cattle and sheep (Ortavant R. And Schindler H., Editors)". Les Colloques de l'INRA, No. 27, Paris, France.

Lehrer, A.R. and Kali, J. 1990. Beef cattle R&D (a model of interdisciplinary and interinstitutional co-operation. Workshop on: "Problems of Israel agriculture and its economy (R&D as an agricultural input." The Faculty of Agriculture, Rehovot, Israel. *Ha`Sadeh* **70:** 497-502 (in Hebrew).

NRC. 1984. Nutrient Requirements of Beef Cattle (6th, revised Ed.). National Academy Press, Washington, DC.

Webby, R.W. and Sheath, G.W. 1991. Group monitoring, a basis for decision making and technology transfer on sheep and beef farm. *Proceedings of the NZ Grasslands Association.* **53:** 13-16.

Weitz, H. 1981. Energy value of natural pastures. *Ha`Sadeh.* **61:** 2053-2056 (in Hebrew).

Wiltbank J.N. 1971. How to increase beef A.I. *in:* the 1970's. Proc. Silver Anniversary Convention, N.A.A.B. (Columbus, OH), pp. 206-213.

Wiltbank J.N. 1972. Management steps to an ideal A.I. project. Proceedings of the 6th Conference, A.I. of Beef Cattle (Denver, CO), pp. 45-50.