GROWING OUT FEEDER STEERS AND FINISHING FEEDLOT CATTLE ON SYSTEMS INCORPORATING MAIZE SILAGE

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SUMMARY

Two grazing trials were conducted in consecutive years on an irrigated farm near Kyabram in northern Victoria. In Trial A, 192 steers grazed perennial pastures during February and March and were supplemented with maize silage and cereal grain. Pasture intakes were recorded using pre and post grazing heights to estimate pasture dry matter (DM) removed. Maize silage constituted 60% of the total DM intake while growth rates averaged 1 kg/day.

The grazing system was refined the following year in Trial B by including urea in the supplement while 214 steers strip grazed the same perennial pastures over three months in autumn. Pasture quality was considerably better in the second year. Light weight steers grew at 1 kg/day on a diet of 2.2 kg pasture DM, 5.2 kg maize silage DM, 0.6 kg barley and 145 g/day of urea. However heavy weight steers only grew at 0.7 kg/day on a similar diet and their poorer performance was attributed to their inability to graze the short pastures.

Such a grazing system, incorporating stocking rates up to 11 steers/ha and with maize silage providing at least 50% of the total DM, allowed 300 kg steers to grow at 1 kg/day.

Steers were fed maize silage-based diets in two pen feeding trials at the Kyabram Research Centre. Trial C investigated two sources of dietary nitrogen (N), urea *v* cottonseed meal, in steers previously underfed. Trial D compared two levels of wheat, nil *v* 48%, in steers slaughtered at 450 kg live weight.

Although feeding cottonseed meal stimulated feed intake, it had little effect on growth rates or feed conversion ratios in Trial C. Therefore steers could successfully be grown out in opportunity feedlots using urea as the major N source. Including wheat increased growth rates (0.9 *v* 1.3 kg/day) in Trial D and produced carcasses with higher rib fat and lower rib muscle contents. There were no other dietary effects on carcass and meat quality.

INTRODUCTION

The traditional method for growing cattle out to live weights suitable for slaughter or for feedlot entry is based on grazed pasture, together with supplements to overcome seasonality deficiencies in pasture growth and/or quality. Through feeding supplements, producers can increase farm stocking rates and hence grazing pressures. This should improve the utilisation of available pasture and hence live weight gain per hectare of grazed pasture. Hay and cereal grains usually fill these pasture feed gaps. However, maize silage could be considered as an alternative supplement, particularly if it is available at a cheaper price.

Feedlot finishing diets use up to 70% cereal grain to optimise growth rates and carcass fat deposition. As maize silage contains up to 35 or 45% of its DM as maize grain, it could replace some of this cereal grain as well as supply the required roughage in feedlot diets (Brennan et al. 1987).

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This paper reports some of the findings from a Meat Research Corporation supported project conducted at Kyabram in the irrigated zone of northern Victoria (Wales and Moran 1992). The aims of the project included the assessment of maize silage as a supplement to grazing steers destined for finishing in feedlots (Trials A and B) and the role of maize silage as a component of feedlot rations (Trials C and D).

MATERIALS AND METHODS

Grazing trials

Two grazing trials investigated a feeding system to improve the supply and quality of cattle for entry into feedlots. They were conducted in consecutive years on an irrigated beef property in the Kyabram district. The producer purchases store cattle during summer when supplies are plentiful and they graze irrigated perennial pastures. They then graze annual pastures following the autumn break. In previous years, the variation in animal performance had made it difficult to reliably meet the specifications of winter markets for feeder steers.

The producer traditionally fed hay or grain to overcome pasture deficiencies but recently commenced growing forage maize for silage to supplement the grazing animals. He chose forage maize because of its high potential DM yield and high water use efficiency. When grown correctly, the crop can yield 20 t DM/ha and it requires less water than an equivalent area of perennial pasture. At these yields, maize silage cost him $100/t DM to produce. This included the cost of growing and harvesting the crop, losses associated with ensiling and feeding out plus the opportunity cost of the irrigation water which would otherwise been used on perennial pastures. He grows up to 12 hectares of forage maize each year.

Trial A Eighteen hectares of a white clover (*Trifolium repens*)/perennial ryegrass (*Lolium perenne*) pasture was divided into 10 bays of equal area and each bay further subdivided into five equal areas each of 0.36 ha, using electric fencing. For ease of management, the purchased animals were split into two herds, 93 British breed steers in Herd 1 and 99 larger framed steers in Herd 2. They grazed the irrigated perennial pasture over 63 days in autumn 1991 at an average stocking rate of 10.7 steer/ha.

Both herds were offered a mixture of maize silage and cereal grain (oats:barley in the ratio of 95:5) once daily for 63 days. Supplement intakes were monitored each day using portable load cells to weigh the feedout cart. Pasture DM intakes was measured five times during the two month trial by calculating the difference between pre and post-grazed pasture availabilities. Pasture height was measured using a rising plate metre (Earle and McGowan 1979) with regressions developed to relate pasture height to DM yield.

The offered pasture and the supplements were analysed for DM, crude protein and *in vitro* DM digestibility or IVDMD, the latter using the two stage method of Tilley and Terry (1963). Metabolisable energy (ME) concentrations were calculated from IVDMD (Standing Committee of Agriculture 1990).

Trial B In February 1992, 21.6 ha of white clover/perennial ryegrass pasture was divided by electric fence into 12 bays then into five equal areas each of 0.36 hectare. The purchased 214 steers of mixed breeds were again split into two herds. The 139 steers in Herd 1, initially weighing 295 kg, grazed 10.8 ha of pasture. After 37 days, 24 of them were removed and this reduced stocking rates from 12.9 to 10.7 steers/ha. The 75 heavier steers in Herd 2, initially weighing 528 kg, grazed the remaining 10.8 ha for the entire 93 day trial at 6.9 steers/ha.

Pasture intake was measured using the same techniques employed the previous year. Steers were supplemented with maize silage, rolled barley and urea. The pasture and supplements were analysed for DM, protein and IVDMD.

Feedlot trials

Diets Two trials undertaken at the Kyabram Research Centre evaluated the potential of maize silage as a base for feedlot rations. Diets were offered once daily as Ruiz and Mowat (1987) showed that twice daily feeding of high forage diets at *ad libitum* levels had no beneficial effects on intake, digestibility or steer performance.

Trial C compared the growth rate of steers over 63 days when offered isocaloric and isonitrogenous diets containing either urea or cottonseed meal as the major N source. Two pens, each of six Angus steers, were fed one of the following diets:

MS/Wh 83% maize silage, 15% rolled wheat, 2% urea plus vitamins and minerals (on a DM basis)

MS/CSM 83% maize silage, 17% cottonseed meal plus vitamins and minerals.

Trial D compared two levels of cereal grain, nil *v* 48%, in maize silage-based finishing rations when fed for up to 120 days. Two pens, each of four Angus steers, were fed one of the following diets:

MS/Ur 96.8% maize silage, 1.7% urea, 0.7% cottonseed meal plus 0.81% vitamins and minerals

MS/Wh/CSM 46.9% maize silage, 48.1% rolled wheat, 1.7% cottonseed meal, 0.85% urea, 1.6% bentonite and 0.85% vitamins and minerals.

Dietary constituents in both trials were analysed for DM, protein and IVDMD.

Animal and carcass measurements Growth rates were calculated from initial and final fasted live weights. The steers in Trial D were slaughtered at an estimated hot carcass weight of 260 kg. After 48 h at 4°C, fat thickness at the P8 site, fat distribution, meat colour and fat colour were assessed on each carcass by a trained operator using methods based on AUSMEAT standards. Each carcass was then quartered at the 12/13 rib where fat thickness and rib eye area were measured. The 9-10-11 rib sets (Hankins and Howe 1946) were physically dissected into bone, muscle and fatty tissues. A 10 cm long section of *Longissimus dorsi* was frozen for later assessment of meat quality. The parameters measured were ultimate pH, sarcomere length, and following cooking at 80°C for 1 h, Warner-Bratzler shear force and cooking loss (Bouton et al. 1975). The meat was also analysed for intramuscular fat and water contents.

Growth rates and carcass and meat quality data were analysed using two-way analysis of variance with diet and replicate pen as factors.

RESULTS

Grazing trials

Feed quality Chemical analyses of pasture and supplements are presented in Table 1. The DM content of maize silage averaged 31.6% in 1991 and 33.4% in 1992. The quality of the maize silage and grain was similar in both years however the protein and energy contents of the pasture were considerably higher in Trial B.

Table 1 Nutritive value of pasture and supplements fed in Trials A and B

	Maize silage	Oats	Barley	Grain mix	Pasture
		Trial A			
Protein (%)	7.6	8.0	14.5	8.4	14.5
IVDMD (%)	64.6	72.4	92.4	73.5	55.8
ME content (MJ/kg DM)	9.0	10.3	13.7	10.5	7.5
		Trial B			
Protein (%)	7.1	-	13.0	-	16.0
IVDMD (%)	65.9	-	89.4	-	70.6
ME content (MJ/kg DM)	9.2	-	13.2	-	10.0

Animal Performance in Trial A The 192 steers were each allocated on average 6.4 kg pasture DM/day. Their initial and final live weights, feed intakes and growth rates are presented in Table 2. Maize silage DM intakes increased with time from 4.8 to 6.5 kg DM/steer/day, as steer live weight and hence appetite increased, pasture intake declined and the level of grain fed was reduced.

Maize silage constituted about 60% of the total DM intake. Each steer consumed on average 84 MJ/day of ME with a dietary protein level of 9.7%. There was little difference in the growth rates of the two herds which averaged 1.07 kg/day.

Table 2 Feed intakes and growth rates of steers in Trial A

	Herd 1	Herd 2
Initial live weight (kg)	303	313
Final live weight (kg)	366	379
DM intake (kg/day)		
Pasture	2.9	2.9
Maize silage	5.7	5.7
Grain	0.9	1.2
Total	9.4	9.8
Growth rate (kg/day)	0.99	1.15

Animal Performance in Trial B The smaller Herd 1 steers could graze the pasture down to a height of 3.4 cm as against 4.4 cm by the heavier Herd 2 steers. Herd 1 steers then utilised 45% of the available pasture compared to only 23% by Herd 2 steers. Steer live weights, feed intakes and growth rates are presented in Table 3. Maize silage comprised 64% of the total DM in Herd 1 and 56% in Herd 2.

Herd 1 consumed 8.1 kg DM/day, equivalent to 2.4% of live weight as DM, which supplied 78 MJ of ME/day with a dietary protein content of 14.4%. Herd 2 consumed 9.2 kg DM/day, equivalent to 1.6% of their live weight as DM, which supplied 95 MJ of ME/day with a dietary protein content of 13.2%.

The lighter Herd 1 steers grew faster than the heavier Herd 2 steers (0.98 *v* 0.68 kg/day) and their performance was comparable to that recorded the previous year in steers of similar weight during Trial A.

Table 3 Feed intakes and growth rates of steers in Trial B

	Herd 1	Herd 2
Initial live weight (kg)	295	528
Final live weight (kg)	383	590
DM intake (kg/day)		
Pasture	2.2	1.7
Maize silage	5.2	5.2
Barley	0.6	2.3
Urea	0.14	0.11
Total	81	92
Growth rate (kg/day)	0.98	0.68

The heavier Herd 2 steers were slaughtered for an export trade following 93 days grazing and their carcass quality was measured by an AUSMEAT accredited operator. Hot carcass weights averaged 324 kg for steers with a mean 2.7 permanent teeth, while P8 fat depths averaged 15.2 mm, ranging from 12.8 mm to 17.0 mm.

<u>Feedlot trials</u>

The nutritive value of the dietary constituents and the mixed rations in the two feedlot trials are presented in Table 4. The two rations in Trial C had similar ME and protein contents while the MS/Wh/CSM diet had the higher ME content of the two feedlot diets in Trial D.

Table 4 Nutritive value of dietary constituents and rations in Trials C and D

	Trial C					Trial D				
	MS	Wh	CSM	MS / Wh	MS/ CSM	MS	Wh	CSM	MS/ Ur	MS/ Wh/CSM
Protein (%)	6.7	12.8	45.2	12.5	13.2	8.8	13.7	45.1	13.1	13.4
IVDMD (%)	64.4	89.1	74.4		- -	73.1	88.4	74.7		- -
ME content (MJ/kg DM)	8.9	13.1	10.6	9.4	9.2	10.4	13.0	10.7	10.1	11.3

Animal performance is presented in Table 5. In Trial C, steers fed the MS/CSM diet had the higher ($P<0.05$) DM intake (in g/kg$^{0.75}$/day) but there were no significant treatment differences in growth rates, which averaged 1.27 kg/day. In Trial D, steers fed the MS/Wh/CSM diet grew faster ($P<0.05$), 1.33 v 0.93 kg/day, but had similar DM intakes and feed conversion ratios to the steers fed the MS/Ur diet.

Table 5 Performance of steers fed maize silage-based diets in Trial C and D

Diet	Trial C MS/Wh	Trial C MS/CSM	SE	Trial D MS/Ur	Trial D MS/Wh/CSM	SE
Initial weight (kg)	245	244	5.4	348	349	2.1
Mid weight (kg)	302	305	4.3	398	410*	2.5
DM intake (kg/day)	7.65	8.18	-	9.34	9.94	-
DM intake (g/kg$^{0.75}$/day)	105.9	112.2*	1.2	104.8	108.9	-
Growth rate (kg/day)	1.22	1.33	0.07	0.93	1.33*	0.06
Feed conversion ratio	6.3	6.2	-	10.0	7.5	-

SE, standard error; *, P<0.05

Carcass and meat quality data from steers slaughtered in Trial D are presented in Tables 6 and 7. Although the MS/Wh-fed steers had the higher slaughter live weight, diet differences in hot carcass weights were not significant. Carcasses from MS/Wh-fed steers had higher (P<0.05) rib fat and lower (P<0.05) rib muscle contents. Dietary treatments had no influence on other carcass or meat quality measurements. Muscle colour scores averaged 3.7 out of 9, fat colour scores 3.2 out of 9 and marbling scores 2.1 out of 12 points.

Table 6 Carcass quality in steers offered maize silage-based diets in Trial D

	MS/Ur	MS/Wh/CSM	SE
Slaughter live weight (kg)	448	470*	12.3
Hot carcass weight (kg)	247.7	257.9	3.5
Dressing percentage	55.3	54.9	0.3
P8 fat cover (mm)	12.5	10.8	0.9
Eye muscle area (cm^2)	69.3	70.9	3.4
Carcass length (cm)	177.1	179	1.5
Rib fat %	38.5	42.9*	1.1
Rib muscle %	46.5	43.2*	0.9
Rib bone %	14.6	14.1	0.5

Table 7 Meat quality in steers offered maize silage-based diets in Trial D

	MS/Ur	MS/Wh/CSM	SE
Meat water content (%)	68.7	68.5	0.4
Meat fat content (%)	5.2	5.7	0.7
Meat pH	5.59	5.58	0.01
Sarcomere length (um)	1.78	1.87	0.06
Meat tenderness (kg)	4.48	3.86	0.29
Cooking losses (%)	33.3	33.0	0.7

DISCUSSION

Nutritive value of maize silage

Over the past ten years there has been a significant expansion in the cultivation of forage maize in Australia. The increase has occurred due to the advances in crop husbandry and breeding, leading to the production of a high yielding, medium energy content, roughage source. The low protein content in maize silage necessitates the formulation of diets incorporating additional sources of dietary protein to ensure acceptable animal performance.

With grazing dairy cattle, the optimum level of maize silage fed and the subsequent animal response depends primarily on the quality of the basal pasture (Moran et al. 1990). Pasture protein and energy levels in Trial A were both low for irrigated perennial pastures during autumn and the protein content of the total diet DM was marginal at only 9.7% protein. As a precaution against low pasture protein levels, urea was also fed with the cereal grain in the following year. Dietary protein levels were much improved in Trial B averaging 14.4% for the light weight and 13.2% for the heavier steers. Despite this trial difference in pasture quality, growth rates of 300 kg steers were similar in the two years. The major reason for the poorer growth of heavier steers in Trial B was their inability to graze the short pastures.

Growing out steers at Pasture for entrv in feedlots

There is potential to supply pre-conditioned cattle to feedlots during autumn and winter using maize silage as the major forage supplement. These trials have demonstrated that large numbers of feeder steers can readily adapt to a grazing/feedlot feeding strategy and grow at 1 kg/day for 60 to 100 days during a period when growth rates of cattle are traditionally variable and generally low.

By employing high stocking rates, pasture utilisation was shown to be high. However, a supplementary feeding strategy was needed to fully feed the steers leading to improved per steer production. This was achieved by using a mixture of maize silage, cereal grain and in the second trial, urea. In both trials, maize silage contributed over 50% of the total feed intake.

One advantage to a feedlot operator is the potential for a greater throughput as the steers would more quickly adapt to the high grain feedlot diets and would be more used to being handled in pen feeding situations.

Live weight gains per hectare averaged 11.4 kg/day in Trial A. When compared to typical farm stocking rates of 2.5 steers/ha and unsupplemented growth rates of 1 kg/steer/day, this intensive grazing system produced over four times more live weight gain per ha. This level of performance was repeated the following year with the smaller steers in Herd 1.

Pasture intake and pasture utilisation (61% of available pasture) peaked when pre grazed pastures were 7.4 cm high. Thereafter, pre grazed pasture height decreased substantially, reaching a minimum of 3.5 cm. Even light weight steers did not graze below a pasture height of3 cm.

Finishing steers on high maize silage-based rations

Little research has been conducted in Australia on feeding maize silage to beef cattle. In South Australia, Hawthorne (1978) recorded growth rates of only 0.6 to 0.7 kg/day in 270 kg steers fed maize silage plus urea and this increased to 1.0 kg/day with the inclusion of 45% barley in the ration DM. The forage maize was ensiled at the soft dough stage with only 23% DM being recorded in the silage. Poor fermentation and possible effluent losses may have contributed to the low animal performance. It is normal practice to harvest forage maize at the hard dent stage, with a DM content of 30 to 35%.

Kaiser and Piltz (1991) reported on a series of trials in which 19 maize silages were fed to weaner steers, together with 2% urea plus supplementary minerals. *In* vivo digestibilities ranged from 65 to 72% (averaging 69.1%) while growth rates varied from 0.81 to 1.17 (averaging 1.01 kg/day). Heavier steers in Trial D fed a comparable diet grew at 0.93 kg/day. These findings demonstrate the potential for maize silage in promoting high growth rates in growing and finishing steers.

Commercial feedlot operators generally use maize silage in high proportions in introductory rations but then only as a roughage component in the high cereal grain finishing rations. Recent Australian data suggests that maize silage, when it is cheaper on an equivalent energy basis to cereal grain, can replace much of the grain in feedlot rations without compromising cattle growth rates or carcass characteristics. For example, Kaiser and Simmul (1991) reported steer growth rates of 1.03, 0.98, 1.14 and 1.00 kg/day from maize silage-based diets with the inclusion of 0, 27, 54 and 80% grain, respectively. It is likely that a degree of subclinical acidosis may have reduced animal performance on the very high grain ration. After including the maize grain in the silage, total grain content on this ration would have approached 90%.

Other reports also indicate minimal responses to increasing grain content above certain levels when maize silage is fed as a basal roughage. For example, Brennan et al. (1987) found that steer growth rates were similar when maize silage contributed up to 40% of a maize grain ration, fed ad *libitum.* A protein supplement was fed to all groups. Jesse et al. (1976) reported 30% maize silage/70% grain to be the optimum ratio when protein and minerals deficiencies were addressed.

Effect of maize silage based diets on carcass quality

Maize silage had no apparent detrimental effect • on the economically important carcass characteristics. Results from Trial D showed little differences in carcass quality from steers fed either a high maize silage content ration (MS/Ur) or a higher energy content ration (MS/Wh/CSM). However, carcasses from MS/Ur fed steers were lighter and had lower contents of rib fat. Carcass characteristics from the feedlot trial were not different to those in grazing steers offered maize silage in a concurrent experiment (Wales et al. 1991).

The level of maize silage in a ration can be altered to manipulate growth rate or fat deposition of steers. The MS/Ur type ration (Trial D) is a suitable introductory or growing ration, whereas the MS/Wh/CSM ration is more appropriate for finishing steers.

Meat quality analyses showed no differences between feedlot rations fed in Trial D or in carcasses from steers fed in the concurrent grazing experiment (Wales et al. 1991). Young and Kauffman (1978) showed that steers fed maize silage-based rations had fat distribution, meat colour, fat colour and meat quality equivalent to steers fed grain-based rations. Kaiser and Auldist (1991), reporting on the carcasses produced by steers in their feedlot trial (Kaiser and Simmul 1991), also noted little effect of level of maize silage feeding on carcass quality.

Other studies have shown little difference in meat quality between concentrate and maize silage-based diets. Berry et al. (1988) described results from a trial that ranked maize silage second behind maize grain in terms of tenderness and beef flavour intensity. Other diets in this study included lucerne silage and orchard grass silage. Of interest however is the inability of the taste panel to separate steaks from the maize silage and concentrate diets in terms of sensory properties.

Fat colour measurements tend to place steers finished on maize silage diets intermediate between concentrate and pasture finishing diets. Forrest (1982) scored fat colour of steers finished on pasture (4.7) higher than in steers finished on concentrates (3.0 to 3.6) while steers finished on maize silage had fat colour rating of 3.4 and those on grass silage, 3.7.

Comparison of different N sources in maize silage-based rations

There was no effect on growth rates by providing 40% of the total N in the form of the non-protein N source urea. This is in agreement with Thomas et al. (1975) who compared urea with dried lucerne as N sources for maize silage, finding similar growth rates in 250 kg steers. They found that cattle older than 6 months of age could achieve growth rates of 1 kg/day on maize silage supplemented solely with urea.

Despite similar DM intakes (on the basis of $g/kg^{0.75}/day$), steer growth rates in Trial C on the MS/Wh diet were 30% higher than those on the MS/Ur ration in Trial D. Although the MS/Wh diet contained additional wheat, its ME content was lower than diet MS/Ur (9.4 v 10.1 MJ/kg DM), this being due to differences in the energy content of the maize silage in the two trials. Prior to Trial C, the steers had experienced severe weight losses averaging 0.3 kg/day for the previous 48 days. Therefore their previous severe nutritional stress could have been a contributory factor to their high growth rates. The quality of the realimentation diet has a major influence on subsequent compensatory growth in steers (Moran and Holmes 1975), and it is evident that the 15% wheat/83% maize silage diet contained sufficient energy to allow for adequate compensation.

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REFERENCES

BERRY, B.W., LEDDY, K.F., BOND, J., RUMSEY, T.S. and HAMMOND, A.C. (1988). J. Anim. Sci., 66: 892.

BOUTON, P.E., HARRIS, P.V. and SHORTHOSE, W.R. (1975). J. Food Sci., 40: 1122.

BRENNAN, R.W., HOFFMAN, M.P., PARRISH, F.C., EPPLIN, F., BHIDE, S. and HEADY, E.O. (1987). J. Anim. Sci., 64: 23.

EARLE, D.E. and McGOWAN, A.A. (1979). Aust. J. Exp. Agric. Anim. Husb., 19:337.

FORREST, R. J. (1982). Can. J. Anim. Sci., 62: 1079.

HANKINS, O.G. and HOWE, P.E. (1946). USDA Tech. Bull. 926.
HAWTHORNE, W.A. (1987). Proc. Aust. Soc. Anim. Prod., **12**: 171.
JESSE, G.W., THOMPSON, G.B., CLARK, J.L., WEINER,K.G. and HUTCHESON, D.P.(1976). J. Anim. Sci., 43: 1049.
KAISER, A.G. and AULDIST, M.J. (1991). Proc. First Aust. Maize Conf., 126.
KAISER, A. and SIMMUL, L. (1991). Proc. Silage Seminar, Wagga Wagga, July 1991.
KAISER, A. and PILTZ, J. (1991). Proc. Silage Seminar, Wagga Wagga, July 1991.
MORAN, J.B. and HOLMES, W. (1978). Wld. Rev. Anim. Prod., XIV, 2.
MORAN, J.B., KAISER, A.G. and STOCKDALE, C.R. (1990). Outlook on Agric., **19:** 371.
RUIZ, A. and MOWAT, D.N. (1987). Can. J. Anim. Sci., 67: 1067
STANDING COMMITTEE OF AGRICULTURE (1990). “Feeding Standards for Australian Livestock. Ruminants”. p. 8-9. (CSIRO Publications, East Melbourne)
THOMAS, C., WILKINSON, J.M. and TAYLER, J.C. (1975). J. Agric. Sci., Camb., 84: 353.
TILLEY, J.M.A. and TERRY, R.A. (1963). J. Brit. Grassl. Soc., 18: 104.
WALES, W.J. and MORAN, J.B. (1992). “Integrating Forage Maize into Pasture Based Beef Finishing Systems”. Final Report to MRC, September 1992.
WALES, W.J., MORAN, J.B.and HARRIS, R.W.(1991). Proc. First Aust. Maize Conf., 141.
YOUNG, A.W. and KAUFFMAN, R.G. (1978). J. Anim. Sci., 46: 41.