Beef Production on Rotationally Grazed F1 *Pennisetum* Hybrid and Elephant Grass *(Pennisetum Purpureum* Schum.) Pastures

by

M. E. Aken'ova and H. R. Chheda
Department of Agronomy,
University of Ibadan
Ibadan, Nigeria.

SUMMARY

COMPARATIVE studies of elephant grass and the F1 hybrids between the 'maiwa' cultivar of millet (*Pennisetum americanum*) and elephant grass (*P. purpureum*) indicated a superiority in quality of the hybrids. To ascertain this potential superiority animal performance was measured by estimating beef production on F1 *Pennisetum* hybrid and elephant grass pastures consisting of random mixtures of genotypes which were grazed from July 28 to December 6, 1972 (132 days) by 18 to 24 months old White Fulani (Bunaji) Zebu heifers. Each pasture was divided into six 0.07-ha paddocks which were grazed in rotation by two heifers for 5 to 7 days with intervening rest periods of 30 to 35 days.

Total liveweight gains per hectare, of animals grazing F1 *Pennisetum* hybrid and elephant grass pastures were 246.71 and 171.77 kg respetively. Mean daily liveweight gain per 100 kg body weight of animals on the F1 *Pennisetum* hybrid pasture was 0.18 kg which was significantly higher than the 0.13 kg of animals grazing elephant grass. Dry matter (DM) utilisation and average daily intake of the F1 hybrids and elephant grass were respectively, 46 and 35% and 2.2 and 2.0% of body weight while 11.71 kg and 15.85 kg of F1 *Pennisetum* hybrids and elephant grass, respectively, were consumed per kg of liveweight gain. The superior performance of animals grazing F1 *Pennisetum* hybrids was attributed to the higher intake and more efficient conversion of the hybrids.

Stand mortality of F1 *Pennisetum* hybrids and elephant grass at the end of the study were 25 and 15%, respectively. Greater animal output can be expected from F1 *Pennisetum* hybrids selected for improved DM production quality and plant persistence.

INTRODUCTION

Investigations of the forage potential of the F1 hybrids between the 'maiwa' cultivar of millet (*Pennisetum americanum* and elephant grass *(P. purpureum)* revealed that in addition to possessing dry matter production potential and crude protein and crude fibre content which were comparable to those of the most promising elephant grass selections, several hybrid genotypes were also characterised by a greater proportion of leaves in the herbage higher in-vitro organic matter digestibility values and superior acceptability resulting in significantly higher utilisation of herbage on offer (Aken'Ova, Chheda and Crowder, 1976; Chheda, Aken'Ova and Crowder, 1973a). In order to verify the superiority thus indicated, of the F1 *Pennisetum* hybrids over elephant grass, the study reported here was conducted in 1972 to measure cattle performance by estimating beef production on rotationally grazed F1 *Pennisetum* hybrid and elephant grass pastures. The effects of this form of grazing management on the productivity and persistence of the pastures were also determined.

MATERIALS AND METHODS

The experiment was conducted on the University of Ibadan Teaching and Research Farm. The experimental area was topdressed with 5t/ha of farmyard manure, ploughed, harrowed and divided into 12 paddocks each measuring 29·89 x 12·96 m. F1 *Pennisetum* hybrids and elephant grass were each established in alternate paddocks to provide six paired units.

Crown splits of unselected random genotypes of F1 *Pennisetum* hybrids and elephant grass were set every 61 cm in rows 91 cm apart in June 1971 and allowed

1. Study supported in part by grants from the Rockefeller Foundation.

to grow uninterrupted during the rainy season for satisfactory establishment of the pastures. In mid-October, prior to the onset of the dry season, plants were cut back to a 30 cm height and herbage removed.

On June 9, 1972 and at weekly intervals thereafter for five successive weeks, plants in the paired paddock units were cut in succession 30 cm above ground level to provide herbage of the same age at the beginning of each grazing period when the animals were moved from one paddock to another. The paddocks were rotationally grazed from July 14 to December 6, 1972. During the first grazing cycle, each paddock was grazed for one week followed by a resting period of five weeks. Owing to insufficiency of herbage available for grazing during the subsequent two cycles, the paddocks were grazed for six days with a resting period of 30 days and in the fourth and final cycle, which coincided with the early part of the dry season, each paddock was grazed for five or six days. The pastures were fertilised at the rate of 1121 kg/ha of 'totalfert' (15% N; 15% P_2O_5; 15% K_2O) applied in two equal instalments prior to the first and third grazing cycles.

Four White Fulani (Bunaji) Zebu heifers, 18 to 24 months old and weighing between 172 and 195 kg were selected from the University herd. These were divided into two groups, which were closely identical in total liveweight, of two animals each and allowed to graze the F1 *Pennisetum* hybrid and elephant grass pastures. At the end of the grazing period in each paddock, animals were taken out in the evening, penned overnight without access to food or water, weighed the following morning, and then moved into the next paddock. Salt licks and water were provided in all paddocks.

Since the animals were not used to long periods in confinement and were on different feeding regime prior to their use in this study, two weeks were allowed to adjust them to grazing in enclosed paddocks as well as provide adequate time for any physiological adjustments. The experimental results reported here, therefore, cover a 132-day period from July 28 to December 6, 1972.

In every paddock during each grazing cycle, herbage on offer and residual herbage after grazing were estimated by weighing herbage clipped 30 cm above ground level, from three 1·83 x 1·22 m quadrats on the first (pre-grazing sample) and last day (post-grazing sample) of each grazing period, respectively. Dry matter (DM) content of herbage on offer as well as of residual herbage were then determined by drying about 0·5 kg samples of cut herbage to constant weight at 95°C in a forced-air oven. Consumption of DM by the grazing animals was calculated as the difference between pre-and post-grazing DM yields, and percent utilisation of herbage calculated from the following formula: (DM consumed/DM offered) 100. Intake was calculated as DM production x percent utilisation. *In - vitro* organic matter digestibility (IVOMD) of herbage on offer was estimated from pre-grazing samples taken in two paddocks of each treatment during the second grazing cycle and Tilley and Terry's (1963) two-stage technique as modified by Alexander (1969) was employed for the purpose. Samples for IVOMD estimation were oven-dried at 70°C.

At the end of the study counts of surviving stands were made within areas of 4·88 x 21·96 m size in each paddock to estimate stand mortality in the two treatments.

For uniformity of comparison average daily liveweight gains were also expressed as gains per 100 kg of body weight and on this basis, a test for significance of the difference between the two treatments was conducted according to the *t*-test for paired observations as described by Guenther (1973).

RESULTS AND DISCUSSION

Animal performance on F1 *Pennisetum* hybrid and elephant grass pastures as measured by total liveweight gains as well as average daily gain of the experimental animals is presented in Table 1 along with

the production and utilisation of herbage in the two pastures. Data also show average liveweight gains per grazing cycle.

Total liveweight gains for the period of study and daily liveweight gains per animal were 44% higher, respectively, among animals grazing the F1 *Pennisetum* hybrids. The average daily liveweight gains per animal recorded on either pasture compare favourably with those obtained on other pastures in Southern Nigeria (Crowder and Chheda, 1974). As this study was conducted during the late rainy season and early dry season, higher liveweight gains can be expected during the early and middle parts of the rainy season as has been reported by Oyenuga and Olubajo (1966) and Chheda (1973). Coefficient of variation values for mean liveweight gain per grazing cycle which were 21·86 and 44·12% for F1 *Pennisetum* hybrid and elephant grass pastures, respectively showed that variation in liveweight gains among grazing cycles was less among animals grazing the F1 *Pennisetum* hybrids as compared to elephant grass, an indication that the hybrids maintained more uniform levels of nutritional quality during the study.

Daily liveweight gain per 100 kg of body weight was significantly higher among animals grazing F1 *Pennisetum* hybrid than those grazing elephant grass. This result suggests a greater potential of the F1 hybrids for grazing and beef production

Percent herbage utilisation though low, was 31% higher on the F1 *Pennisetum* hybrid pasture. With the onset of flowering and the approach of the dry season the increasingly higher DM content of residual herbage as well as its increased stemminess were largely responsible for the low utilisation values in this study.

Morrison (1949) recommended daily DM consumption of about 2·5% of body weight for satisfactory animal performance. In the present investigation, average DM consumption was 2·2 and 2·0% of body weight by animals grazing F1 *Pennisetum* hybrids and elephant grass, respectively (Table 1). Low intake is characteristic of many West African forages (Crowder and Chheda, 1974) and is an important contributory factor to their poor nutritive value (Ademosun, 1970). However, the steadily diminishing quantities of herbage on offer in the course of this study could account in part for the low intake values. Chheda, Aken'Ova and Crowder (1973 b) reported that DM intake of F1 *Pennisetum* hybrids and elephant grass were 3·1 and 2·3% of body weight, respectively. These

TABLE 1

Performance of White Fulani Zebu heifers and dry matter production, utilisation and intake on rotationally grazed F1 *Pennisetum* hybrid and elephant grass pastures.

	F1 Pennisetum hybrids	*Elephant grass*
Liveweight gain in kg		
Total	97·16	67·65
Total/ha	246·71	171·77
Per grazing cycle	24·29 ± 5·31b	16·91 ± 7·46b
Daily/head	0·36	0·25
Daily/100 kg body wt*	0·18	0·13
Dry matter		
Production (t/ha)	6·28	7·78
Utilisation (%)	46·0	35·0
Daily intake (% of body wt)	2·2	2·0
Consumption/kg liveweight gain (kg)	11·71	15·85

a Experimental period: July 28–December 6, 1972; 132 days
b Standard deviation
* Significant difference between treatments at the 5% level

values apply to the first grazing cycle when more herbage was available.

The greater consumption of F1 *Pennisetum* hybrids may be related to their improved acceptability to cattle as previous studies had revealed (Aken'Ova *et al*, 1976). Thus, though the DM production of 7·78 t/ha by elephant grass was 24% more than the 6·28 t/ha produced by F1 *Pennisetum* hybrids (Table 1), the actual utilisation by grazing animals of 2·89 t/ha of DM in the case of the F1 *Pennisetum* hybrids was 6% greater than the 2·72 t/ha of elephant grass DM utilised.

Consumption of elephant grass for each kg of liveweight gain was 35% more than that of the F1 *Pennisetum* hybrids (Table 1) indicating that the hybrids were more efficiently converted, while IVOMD values were 59·7 and 58·1% for F1 *Pennisetum* hybrids and elephant grass, respectively. Since the IVOMD of the F1 *Pennisetum* hybrids was only 3% more then that of elephant grass, the greater output of animals grazing the F1 hybrids can be largely attributed to the more efficient conversion of the hybrids, in addition to their higher intake.

The quantity of herbage on offer declined rapidly towards the end of the experimental period because of slower growth under conditions of moisture stress with the oncoming dry season, depletion of energy reserves for regrowth as a consequence of more frequent grazing, finally leading to a considerable decline in plant density as a result of decreased tillering and increased mortality of stands. Stand mortality of F1 *Pennisetum* hybrids and elephant grass were 23 and 15%, respectively. The higher mortality of F1 *Pennisetum* hybrids was partly due to the occurrence within any group of unselected hybrid genotypes, of weak subnormal plants which do not survive a full season under frequent cutting or grazing management (Aken'Ova and Chheda, 1973).

The superior performance of animals grazing the F1 *Pennisetum* hybrids was obtained by utilising a variable mixture of genotypes. Further improvement in animal output can therefore be expected if F1 *Pennisetum* hybrid genotypes selected for superior quality, high DM production and increased plant persistence are utilised. Carrying capacity would also improve.

ACKNOWLEDGEMENTS

The authors thank Professor L. V. Crowder formerly Visiting Professor in the Department of Agronomy for valuable suggestions regarding the conduct of the experiment and gratefully note the assistance of Messrs Eweme and Pius Yesifu of the Teaching and Research Farm, University of Ibadan, in the weighing of the experimental animals and their overall care. Mr. Akanji of the Department of Agronomy, University of Ibadan painstakingly typed the manuscript.

REFERENCES

ADEMOSUN, A. A. (1970.) Nutritive evaluation of Nigerian forages. 1. Digestibility of *Pennisetum purpureum* by sheep and goats. Niger. Agric. J. **7**: 19-26.

AKEN'OVA, M. E. and CHHEDA, H. R. (1973.) Interspecific hybrids of *Pennisetum typhoides* S & H x *P. purpureum* Schum. for forage in the hot humid lowland tropics of West Africa. 1. Seedling studies and preliminary evaluation. Niger. Agric. J. **10**: 82–90.

AKEN'OVA, M. E. CHHEDA, H. R. and CROWDER L. V. (1976.) Interspecific hybrids of *Pennisetum typhoides* S & H x *P. purpureum* Schum. for forage in the hot humid lowland tropics o West Africa. 2. Evaluation of selected hybrids Niger. Agric. J. 13 (in press).

ALEXANDER, R. H. (1969.) The establishment of laboratory procedure for the in-vitro determination of digestibility. West Scotland Agr. Coll. Res. Bull. 42.

CHHEDA, H. R. (1973.) Forage crops research at Ibadan. I *Cynodon* spp. *In* J. K. Loosli, V. A. Oyenuga and G. M. Babatunde (Eds.) Animal Production in the Tropics. Heinemann Educational Books (Nigeria) Ltd., Ibadan 79–94.

CHHEDA, H. R., AKEN'OVA, M. E. and CROWDER, L. V. (1973a.) *Pennisetum typhoides* S & H x *P purpureum* Schum. hybrids for forage in the low-altitude humid tropics. Crop Sci. **13**: 122–123.

CHHEDA, H. R. AKEN'OVA, M. E. and CROWDER, L. V. (1973b.) Forage cropsresearch at Ibadan. 2. *Pennisetum purpureum*. *In* J. K. Loosli, V. A. Oyenuga and G. M. Babatunde (Eds.) Ani-

mal Production in the Tropics. Heinemann Educational Books (Nigeria) Ltd., Ibadan, pp. 95–101.

CROWDER, L.V. and CHHEDA, H.R. (1974) Forage and Fodder Crops. Reprint of chapter in "Food Crops of the lowland Tropics with special reference to West Africa" (Oxford University Press, London; in press). International Institute of Tropical Agriculture Ibadan.

GUENTHER, W. C. (1973.) Concepts of Statistical Inference. (2nd Edition) Mcraw-Hill Book Co., New York.

MORRISON, F. B. (1949.) Feeds and Feeding. (8th Edition) The Morrison Publishing Co., Ithaca, New York.

OYENUGA, V. A. and OLUBAJO, F. O. (1966.) Productivity and nutritive value of Tropical pastures at Ibadan. Proc. 10th Intl. Grassl. Congr. pp. 962–969.

TILLEY, J. M. A. and TERRY, R. A. (1963.) A two-stage technique for the *in-vitro* digestion of forage grasses. J. Brit. Grassl. Soc. **18:** 104–111