Grassland Research in Nigeria — A Survey with Recommendations

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SUMMARY

PAST and present attempts to upgrade grassland productivity in Nigeria are briefly surveyed. The considerable potential of the Nigerian environment for grassland farming and the tremendous research efforts applied are not reflected in the level of animal production which, at this stage, is low. The imbalance is attributed to shortage of expertise, limited application of tropical agronomic principles and weakness in the dissemination of research findings. Proposals are made in respect of a proper integration of the soil, pasture and animal systems whereby the need for expensive conservation and supplementary feeding procedures will be reduced. The implications of the suggestions are discussed.

INTRODUCTION

THE need for an increased animal protein supply in the average Nigerian diet is fully recognised. Reliance on proteins from plant sources has reached such high proportions that the man-animal competition for plant proteins is now considerable. The present evidence from the reviews of the literature has indicated clearly that among the factors limiting animal protein supply, particularly via livestock and their products, deficiency in the plane of nutrition of livestock continues to be outstanding (Oyenuga, 1966; Adegbola, 1973; Ademosun, 1973). This paper examines briefly previous investigations aimed at solving or minimising the nutrition problems of livestock in Nigeria and suggests an approach which, if implemented, could result in an accelerated achievement of this goal.

NATURAL RESOURCES

Climatic, vegetation and rangeland studies have shown the Nigerian environment to be suitable for grassland development (Ahlgren, Adegbola, Eweje and Salami 1959; Keay 1959; Clayton 1961; Pullan 1962; Rains 1963; Hopkins 1965; Mckell and Adegbola 1966). The average radiant energy of nearly 500 calories/cm^2/day received (Kowal 1971) is sufficient to keep assimilation rates high throughout the year. However, the south-north gradient in total annual rainfall (4060-510 mm) and the length of the rainy period (12-3 months) results in the support of predominantly perennial and annual pasture plants in the south and north, respectively. This climatic disparity is further aggravated by the presently occurring increase in drought intensity particularly north of latitude 11° 30', and therefore suggests that a single management approach is inapplicable to the entire Nigerian grasslands. It would be inferred from general observations that provided water is available, pasture growth can proceed unimpeded throughout most of the year in the south, whilst in the north, low temperature due to harmattan incidence (November-February) may retard, but cannot completely stop absolute growth.

Nigerian soils have been associated with severe deficiency, particularly in P and N. Although no straightforward answer has been provided for pasture

responses to K, a recent study (Chheda and Saleem 1973a) indicates the necessity for K application only under a cut-and-carry herbage utilisation system, in contrast with grazing in which this element is returned in the animal urine. There is a paucity of information on forage production as influenced by soil levels of pH and the other major and micro elements. It is recognised, however, that under continuous cropping heavey applications of P and N have induced deficiency of Ca, K, S, Bo, Mo, and Zn at Samaru (Kowal, personal communications).

HERBAGE YIELD

Past research activities on improved pastures have been reviewed by McIlroy (1962), Adegbola (1969), Akinola (1969) and Ademosun (1973) in terms of the ecological zones between the Forest and the Southern Guinea Savanna, and by Rains (1963) and Haggar (1969) in relation to the higher latitudes of Nigeria. These studies indicate generally that a vast majority of the agronomic assessments of natural, sown pure and mixed pastures, notably in regard to quantitative and qualitative yield following defoliation and nutrient application had been directed mainly towards biological productivity.

High yields of dry matter and crude protein per unit area may accrue from densely planted productive cultivars, deferred defoliation and/or high rates of fertiliser application. However, herbage on offer has been found to be of little value. Cattle performances have been most favourably associated with the quantity of organic matter intake, which itself is markedly influenced by pasture foliage density and accessibility, and therefore the overall size of herbage grasped by the grazing animal (Stobbs 1973a, 1973b). Poor average beef production performance from adapted Zebu (White Fulani) steers on various grass-legume mixtures in the Western State of Nigeria was explicable in terms of the decline in available organic matter, characteristic of the dry season (Olubajo and Oyenuga, 1971).

Pastures of *Cynodon nlemfuensis* (*C. plectostachyus*) / *Centrosema pubescens* mixtures (Oyenuga and Olubajo, 1966), *C. nlemfuensis* cv *nlemfuensis* (*Cynodon* IB 8) (Chheda and Saleem, 1973b), *Andropogon gayanus* (Adegbola, 1969; Haggar, 1969), *Stylosanthes guyanensis* (*S. gracilis*), *Panicum maximum* and *Pennisetum purpureum* are known to be high yielding and adapted for cattle grazing in Nigeria. Intensive management studies demonstrate the suitability of *Digitaria smutsii* for dairy animals (Olayiwole, 1972). Although sufficient and comprehensive data are not available in regard to nutrient and defoliation responses to justify the use of other pasture species and varieties, interest is increasing particularly in *Chloris gayana* and drought resistant *Brachiaria brizantha*, which appear to have potential for grazing. Considerable research is required on the evaluation of newly developed cultivars of *Setaria anceps* (*S. sphacelata*) and *Cenchrus ciliaris*, which offer a good scope for profitable pasture development in the higher and lower rainfall zones, respectively.

The need for further species introduction and testing cannot be over-emphasised now. So far as economic herbage yield depends on an ideal canopy structure cha-

racterised by a high leaf: stem ratio, selection for this attribute will have to rely on a large number of materials exposed to different climatic conditions.

HERBAGE QUALITY

Tropical forage crops are known to attain maturity rapidly and their nutritive value declines at a correspondingly high rate. At a comparable growth stage, the legume is superior to the grass in terms of both organic and mineral constituents. Although improvements in herbage quality and animal response have been sought severally through nitrogen use and legume incorporation in Nigeria, animal production data cannot be adequately interpreted as no clear attempts have been made to link original soil constitutions with applied fertilisers and pasture characteristics. Thus it is necessary that intensified activity be geared towards integrating the soil, pasture and livestock systems. The awareness exists that, judged by the rainfall pattern, both nitrogen — and legume-based pastures can be recommended for southern Nigeria, whilst prominence should be accorded the use of legumes on sown and native pastures in the drier areas lying between the Northern Guinea Savanna and the Sahel zone.

The maintenance of an adequate grass-legume balance is prerequisite for obtaining high forage value. The *A. gayanus* and *Hyparrhenia* dominant savannasl for example, are likely to be more favourably associated with a climbing legume such as *C. pubescens* or a tall-growing erect species such as pigeon pea (*Cajanus cajan*) than with any members of the genus *Stylosanthes*. In the short-season zone between the Northern Guinea Savanna and the Sahel, reasonable mixtures will be anticipated between *C. ciliaris* and annual, self-regenerating legumes such as *S. humilis* and *S. hamata*. However, preliminary secreening of legumes for *Rhizobium* requirements in response to nutrient elements particularly P, K, Ca, Mo, Co, Cu, Mg and Zn should receive a more immediate attention. There is a shortage of pasture nutritionists in Nigeria.

Herbage crude protein content is a universally accepted nutritive index whilst the concept of crude fibre content is being modified. Miller (1961) advocated a substitution of lignin for crude fibre and Van Soest (1963) suggested the use of acid detergent fibre (ADF). As far as is known very few investigations have applied the ADF procedure to forages evaluated in Nigeria (Ademosun and Baumgardt, 1967). The *in vitro* ADF analysis technique McLeod and Minson, 1972) has the advantage of providing rapid information and should be handy both in herbage selection and in following seasonal chemical changes in yield and yield components of whole pastures (Haggar, 1970; Haggar and Ahmed, 1971) or stratified sward layers under varying management conditions. Since digestible dry matter availability is an important factor limiting animal production in Nigeria information so obtained may assist in formulating appropriate defoliation pressures.

Whilst herbage quality is often reflected in animal performance, variations have been recorded in the efficiency of herbage utilisation due to differences in animal breed (Herbers, Schalles, Okoyee and Zemmelink 1972). Recent investigation at Shika comparing the progeny resulting fromm ating Bunaji cows with Charolais, Friesian and Bunaji bulls showed that up to the post-weaning stage, cross breds surpassed purebreds in parameters of economic importance (Johnson, 1974)

This study suggested the need to import superior exotic breeds in order to improve the indigenous stock.

FORAGE CONSERVATION

Pasture conservation in form of hay or silage has assumed wider dimensions in research conducted in the Northern States of Nigeria than elsewhere in the country. In addition to conserving native and introduced grasses and legumes (Rains, 1963) cereal and cereal-legume mixtures have been used to produce ensiled material (Miller Rains and Thorpe, 1963). However, the authenticity of incorporating conservation in grassland development towards profitable animal production throughout Nigeria should be appraised.

Pasture-based animal production programmes have advanced considerably in Europe, the United States of America (U.S.A.) and Australia. Whilst forage conservation is a common practice in Europe and the U.S.A., it is less important in grassland husbandry schemes in Australia particularly Queensland. Although Nigeria has a total land area about half that of Queensland, with comparable tropical and sub-tropical soil and vegetation types, Nigeria is inhabited by nearly 20 times more people. It would appear that a significant factor in fodder conservation may be population pressure, which in addition to land tenure problem, is far more prenounced in the south than in the north of Nigeria. A logical proposition is that to alleviate animal hunger during the dry season forage must be preserved, but the extent of this practice should decline in a north-bound direction.

Up to date, production of valuable hay and silage has been prohibited by limited technical know-how and the magnitude of the financial implications. Numerous long term trials under temperate conditions have revealed that the final quality of stored herbage is related to the original nutritive value of the standing crop; artificially cured hay compares favourably with silage of the same material produced in the tower silo; and field cured hay is the most inferior. Quality and palatability of hay cured in swaths have been improved by using fine stemmed grasses and legumes, drying over a short period (to prevent leaf shattering in good weather and adding sodium chloride during baling.) Hay can best be made in Nigeria at the onset of the dry season, by which time the quality of adapted crops is on a rapid decrease Although the nutritive value of grass hay at this time may be improved by late season fertilisation of cut and grazed swards to stimulate a delay in maturity, legumes are likely to provide the best hay material (Miller, 1969).

C. pubescens in southern Nigeria and *S. guyanensis* cv Schofield are potentially outstanding hay legumes at present. A wider scope for future selection is likely to be facilitated by introducing legumes such as greenleaf desmodium (*Desmodium intortum*) and silverleaf desmodium (*D. uncinatum*) for areas south of the Northern Guinea savanna and *S. guyanensis* cv Oxley fine stem and siratro (*Macroptilium atropurpureum Phaseolus atropurpureus*) (Humphreys, 1969) or areas further north.

Recommendations for ensiling succulent forage may be summarised as pre-wilting chopping or lacerating, and pre-sealing storage treatments such as consolidation and addition of molasses, dried cereal gains, sulphur dioxide or sodium metabisulphite, carbon dioxide and sodium chloride. Of a number of grasses, cereals, legumes and combinations of these studied

in a silage quality investigation, Miller *et al.* (1963) recorded the most efficient ensilage in the sodium metabisulphite — treated *P. maximum* stored in a miniature tower silo. The silage had a low seepage, a greenish-yellow colour and a pleasant acid smell but the digestible crude protein value was low. Future research should embrace the agronomy and then the ensilage of high-yielding varieties of *P. pur pureum*, *P. maximum*, maize, forage sorghum and late millet ("Maiwa"), and the possibility of improving trench silos or substituting tower silos should be investigated. It is suggested that silage can be made more economically in southern Nigeria where the climate, particularly the more abundant rainfall, favours, higher vegetative yield so that concentrated carbohydrate sources such as yam, cassava and sweet potato can be produced more cheaply to support cereal grains currently in use for the fermentation process.

SUPPLEMENTARY FEEDING

The utilization of crop residues is not new in Nigeria (Miller, 1969; van Raay and de Leeuw, 1970). Ademosun (1973) discussed aspects of supplementary feeds, particularly the use of concentrates, during the dry season. However, with the present trend of drought invasion in the country, and the resultant soaring cost of the major sources of concentrates, a re-examination of the feeding economy is warranted.

Although groundnut cake has proved to be one of the most popular concentrates in ruminant feeding in Nigeria, its use on a large scale is prohibited by high costs and suggests the need to supplement with other protein sources. To this end, studies are being initiated at the Institute for Agricultural Research, Ahmadu Bello University, Zaria, to investigate the potential of early-maturing, protein-rich soyabean varieties and high-yielding pigeon pea genotypes. Three crops of short season soyabeans can be produced in a year provided that irrigation facilities are available. In a variety trial under south-eastern Queensland conditions, Akinola and Whiteman (1972) recorded an annual seed yield of 7600 kg/ha in a pest and disease-free pigeon pea accession.

Advanced tropical and subtropical Australian experience provides support for the optimistic view that selective grazing based on correct pasture combinations should result in year-round grazing involving a carrying capacity of 1—2 animals per hectare in the high rainfall areas and nearly half this stocking rate in the more arid regions of Nigeria. Allowing livestock themselves to do the harvesting *in situ* reduces supplementary feeding costs but an appropriate feeding regime can be achieved only by improving rangeland productivity and increasing acreages of sown and fertilised pastures. Range productivity will be enhanced by a judicious manipulation of burning, oversowing with legumes and seasonally varying stocking intensity. Pasture management sys tems using irrigation supply during drouth, as practised in Kano State, have the important advantage of promoting out season forage yield for cattle fattening and finishing.

SEED PRODUCTION

The only investigation on pasture seed production in Nigeria appears to be that by Haggar (1966) on *A. gayanus*. This is probably explicable in terms of little need for seed as a greater majority of past research involved vegetatively propagated grasses. With increasing interest in mixed pastures, there will be a rising demand for

seed. Properly organised and extensive seed production and storage units should be developed to facilitate local seed supply. Cheap seed of the improved pasture species can be used in increasing the productivity of ranges impoverished as a result of leaching due to annual burnings and should go a long way to aid the settlement of the nomadic livestock owners.

CONCLUSION

It is considered vital that immediate priority should be given to remedying the present shortage of research, technical and extension personnel as well as laboratory and field facilities in pasture and range management. In this direction, attention is drawn to the vast opportunities provided in Australia, especially by the government-owned Commonwealth Scientific and Industrial Research Organisation (C.S.I.R.O.), the State Departments of Primary Industry and the University of Queensland, where considerable depth has been reached in the science of tropical pastures. Greater functional cooperation is needed between the universities the research institutes and the State Ministries of Agriculture and Natural Resources if a viable and worthwhile pasture programme is to be realized.

Substantial governmental, institutional industrial and group financial supports would be invaluable in meeting the challenge of grassland research aimed at solving the problems of human needs for animal protein in Nigeria.

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