

Forage quality of some tropical legumes as affected by the genotype and time of harvest.

M. A. M. Khair and S. Rihawi

*Agricultural Research Corporation (ARC).
P. O. Box 126 Wad Medani, Sudan.*

SUMMARY

In an experiment over two seasons, the forage quality of ‘tibia, (*Lablab purpureus*), Clitoria (*Clitoria ternatae*) and Phillipesara (*Vigna trilobata*) was estimated throughout the growing seasons at 14 days intervals. Advancement in the crop age of all species was accompanied by decrease in crude protein (cp%), in vitro dry matter digestibility (IVDMD), leafiness and concurrent rise in acid detergent fibre (ADF) and neutral detergent fibre (NDF). In Clitoria and Phillipesara, crude protein yield (CPY) and digestible dry matter yield (DDM) increased with time to a maximum then declined. In conclusion, Phillipesara showed a higher quality forage yields compared to the other species in the individual harvests, maximum yield and mean across both seasons and harvests. Harvesting the three species in 98 days after emergence had resulted in the highest DDM yield, CPY and acceptable IVDMD, CP%, NDF and ADF.

INTRODUCTION

Variation in the nutritive quality was reported to be a result of genetic diversity and crop age at the time of harvest. This was demonstrated in tropical (Milford and Minson, 1968) and temperate legumes (Abd Elmoniem et al., 1990).

In the intensive cropping system such as in the Sudan Gezira Scheme, the farmers are obliged to handle several crops over a short period of time. Unnecessary delays in forage harvesting is therefore inevitable. Information on forage quality at different stages of growth therefore will help to determine the stage of growth at which the highest quality forage yield is attained.

* The International Centre for Agricultural Research in the Dry Areas (ICARI)A), P.O. Box 5466, Aleppo, Syria.

In this study, three forage legumes viz Lubia, (*Lablab purpureus*), Clitoria (*Clitoria ternatae*) and Phillipesara (*Vigna trilobata*) were grown under uniform management and their chemical compositions were determined at intervals to study

1. Interspecific differences in forage quality at similar age and maximum quality forage yield.
2. Change with time in quality.
3. Time of highest quality forage for each species.

MATERIALS AND METHODS

The experiment was conducted in 1988/89 in the experimental farm of the Gezira Research Station, Wad Medani, Sudan. The growing conditions and experimental layout were as described earlier (Khair, 1988). The species comprised Lubia, Clitoria and Phillippesara. Eight destructive harvests were taken throughout each growing season. These were referred to thereafter as harvest 1, 2, 3, 4, 5, 6, 7 and 8. The corresponding crop ages were 42, 56, 70, 84, 112, 126 and 140 days after emergence (DAE).

In each harvest, a sub-sample was separated to leaves and the rest of the shoot. Leafiness was then calculated as the proportion of the leaves in total weight of the sub-sample on dry matter basis.

The sub-sample was ground and the chemical analysis for the whole sub-sample was carried out in the feed analysis laboratory of ICARDA, TelHadya Syria. The CP% ($N\% \times 6.25$) was determined using the micro kjeldnahl method. The NDF and ADF were measured according to Georing and Van Soest (1970) and expressed as percentage of the dry matter. The IVDMD was measured as described by Tilley and Terry, (1963). The DDM was calculated as $IVDMD \times \text{total dry matter yield}$. The CPY was calculated as $CP\% \times \text{total dry matter yield}$.

For the statistical analysis the data for each parameter were analysed over the 8 harvests and the two seasons in split plot arrangement in which the season was considered as the main plot, species as the subplot and the DAE as sub/subplot. Multiple correlations were performed between the various parameters based on the means.

RESULTS

Dry matter digestibility :

In all species, the IVDMD (Fig. 1) decreased gradually whereas DDM yield (Fig. 2) increased progressively with advancing maturity. Phillippesara and Lubia had maintained their initial IVDMD through 84 DAE. whereas in Clitoria a drastic reduction in the IVDMD was observed since 56 DAE. Phillippesara had the highest IVDMD in most of the harvests (Fig. 1) as well as across all harvests and seasons (Table 1). Clitoria on the other hand had the lowest whereas Lubia had shared the high values of Phillippesara in some of the early harvests.

In relation to the DDM yield, Phillippesara had the highest yields in the individual harvests (Fig. 2), across all harvests and seasons (Table 1) and in the maximum yield (Table 2). Lubia was second to Phillippesara whereas Clitoria had the lowest. In addition to the high DDM yield, Phillippesara was the earliest in attaining the maximum DDM yield, i. e. 98 DAE. Clitoria was second to Phillippesara. In contrast, Lubia showed it's highest DDM yield as late as 126 DAE. The DDM yield of Phillippesara in 84 DAE and that of Clitoria in 98 DAE were not significantly different from their respective maximum DDM yields.

Crude protein :

The general trend in the change of CP% of all species with time (Fig. 1) and that of CPY (Fig. 2), were similar to that of IVDMD (Fig. 1) and DDM yield (Fig. 2) respectively. The three species showed gradual reductions in the CP% through the first 112 DAE. Beyond that however, no significant reductions were observed among the CP% of Phillippesara and Lubia. In relation to the genotypic differences, Clitoria had significantly higher CP% across all harvests and seasons (Table 1) compared to both Phillippesara and Lubia.

Considerable differences were observed among the CPY of the various species (Fig. 2 and Table 1). Exception to the first two and last two harvests, Phillippesara had significantly higher CPY than the other species. In addition, it out yielded the other species across all harvests and seasons (Table 1). Moreover, Phillippesara had significantly higher CPY than Lubia. The highest CPY attained were 0.91, 0.86 and 0.76 t/ha for Phillippesara, Clitoria and Lubia respectively. Those were attained in 98 DAE for both Phillippesara, and Lubia and in 126 DAE for Clitoria. The CPY of both Lubia and Phillippesara in 84 DAE were not significantly different from their respective maximum CPY.

Fig. 2: Digestible dry matter yield (solid line) and crude protein yield (broken line) of lubia (○), clitoria (V) and phillipesara (□) as affected by the time of harvest.

Table I: Seasonal mean (across all harvests and seasons) nutrient yields (t/ha) and

Leafiness :

Leafiness in the three species across both seasons is depicted in Fig. 3. During the first 98 DAE. The reduction in the leafiness in both of Clitoria. and Phillippesara were very steep compared to that of Lubia. The reduction in the leafiness of Phillippesara beyond 98 DAE and that of Lubia and Clitoria beyond 84 DAE were not significant. Limited differences were observed among the species during the first 3 harvests. Phillippesara and Clitoria had higher leafiness than Lubia. The values of the leafiness beyond 98 DAE whether among species or between harvests were not significant and showed that the leaves had constituted about 30% of the total dry matter when those species had attained both maximum CPY and DDM yields (Table 2).

Fibres :

The mean NDF and ADF (across both seasons) for each species is depicted in Fig. 4. Both NDF and ADF increased progressively in almost similar rates with the advancement in the ages of the three species. The increase was gradual during the first 98 DAE. On the other hand, no significant increase was observed in neither NDF or ADF of the three species beyond 112 DAE.

The NDF of Lubia (across all harvests and seasons) was significantly higher than that of Phillippesara and Clitoria (Table 1). Differences among the NDF of the species in different harvests were not significant (Fig. 4). In contrast, considerable differences were observed among the species in relation to ADF. In almost all harvests Phillippesara had the lowest ADF (Fig. 4). Clitoria in turn had the highest. Added to the mean ADF of Phillippesara across all harvests and seasons was significantly lower than that of Lubia and Clitoria.

Correlations :

Highly significant correlations were observed among the various forage quality **parameters** (Table 3). Both NDF and ADF were negatively correlated with CP%, IVDMD and leafiness. CP%, and IVDMD on the other hand were positively correlated with leafiness. Added to that IVDMD was highly positively correlated with CP%.

DISCUSSION

The change in the various quality parameters of the three species with advancement in time in this study, is in agreement with those reported for temperate forage grasses (Corral, 1980) and for temperate forage legumes (Atxl Elmoneim et. al., 1990). As expected, the NDF and ADF had increased while the leafiness, CP% and IVDMD had decreased in the three species with the advancement in crop age.

An inverse relationship was reported for the voluntary intake (VI) with leafiness (Marten, 1985) and with NDF (Van Soest and Roberson, 1979) when this latter exceeds 60% (Pigden, 1969). The NDF of three species in this study were below 60% even at 140 DAE. Hence, their NDF in this study is unlikely to limit their VI by the animals even at 140 DAE.

The mean CP% and IVDMD of Lubia in this study, compared closely with that of earlier reports (Milford and Minson, 1968). Similarly, the CP% in this study is consistent with earlier finding in Clitoria (Osman et. al., 1968) and in Clitoria and Phillippesara (Osman and Abu Deik, 1982).

The CP% required by high yielding cows was reported to be 12% (Pigden, 1969). It thus appears that the CP% of both Lubia and Phillipesa beyond 98 DAE would not meet the requirements of such cows. Clitoria was an exception as it retained a higher CP% at 126 DAE.

Phillipesara was characterised by higher DDM yields, CPY, high IVDMD and low ADF compared to Clitoria. Lubia was however, intermediate between both Phillipesa and Clitoria. Phillipesa had its maximum CPY and DDM yield in 98 DAE. Lubia on the other hand had its maximum CPY and 85% of its maximum DDM yield in 98 DAE. For Clitoria, the maximum DDM yield and 95% of the maximum CPY had occurred in 98 DAE. In addition to those high quality yields in 98 DAE, the various species were characterised in such age by high CP%, IVDMD, leafiness and relatively lower NDF and ADF.

In conclusion Phillipesa showed a higher quality forage yields compared to both Clitoria and Lubia. Cutting the three species in 98 DAE would result in highest DDM yields, CPY and acceptable CP%, IVDMD, NDF and ADF for each species.

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Authors:

Dr. Mohammed Ahmed Mohammed,
Gezira Research Station

Wad Medani, Sudan.

Safouh Rihawi,

International Centre for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria.