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Evaluation of Hybrid Napier (NB-21) for its Forage Quality by Cell-Wall Component Analysis

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An investigation was made to evaluate the forage quality of hybrid Napier (NB-21) by cell-wall component analysis. The fresh yield, dry matter content and dry matter yield increased, whereas, leaf to stem ratio and crude protein content decreased with crop maturity. The cell-wall components namely neutral-detergent fibre (NDF), acid-detergent fibre (ADF), acid-detergent lignin (ADL) and silica increased with crop maturity. The cell-wall components were more in stem than in leaf except silica where it was just reverse. Leaf registered more digestible dry matter per cent (DDM%) than stem and the DDM % decreased with crop growth. The annual DDM yield was maximum when the crop was cut at 50 days interval.

Hybrid Napier is one of the important perennial forages mainly cultivated in sewage farms of Municipalities. It is more palatable and nutritious with appreciable amount of protein and minerals like calcium and phosphorus. A strong fodder based agriculture is essential for cattle development programme. Increasing the production of quality fodder is the only way to cope up with the existing fodder deficit. Among the factors which alter the quality, stage of harvest plays a dominant role. The valuable protein content, fibre fractions, palatability, voluntary intake, digestibility, animal performance and minerals like calcium, phosphorus etc., are unfavourably affected by maturity of crops. So a study was conducted to evaluate hybrid Napier at different stages based on cell-wall components and to fix the optimum stage of cutting to get maximum digestible dry matter yield.

MATERIAL AND METHODS

Hybrid Napier grass (NB-21) was raised in the plots near Animal Nutrition Block of Tamil Nadu Agricultural University, Coimbatore. The spacing adopted was 90 cm x 90 cm. After establishment, the crop was cut uniformly at 15 cm height above ground level and allowed for regrowth. After 20 days, the samples of regrowth were collected at on interval of 5 days, up to its complete maturity (60 days). The whole plant was separated into leaf and stem fractions and the dry matter content was calculated separately. This samples dried at 50°C were ground in a Wiley mill fitted with 1mm sieve and subjected for analysis.

The N content was estimated by microkjeldahl method (Humphries, 1956) and the crude protein was taken as 6.25 times the percentage of N. The cell-wall constituents namely neutral-

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detergent fibre (NDF), acid-detergent fibre (ADF), acid-detergent lignin(ADL) and silica were estimated and digestible dry matter per cent (DDM per cent) was calculated by method outlined by Goering and Van Soest (1970). The digestible dry matter yield was calculated from dry matter yield and DDM per cent.

RESULTS AND DISCUSSION

The yield, dry matter content, crude protein, cell-wall constituents, and DDM per cent are given in Table 1 and 2. A progressive increase in dry matter per cent with advancing maturity of crop was observed. This is quite possible because the growing crops accumulate and translocate photosynthates. Further the ratio of leaf to steam decreaed with age of the crop, also might have increased the dry matter content of the crop with maturity. This was reported in hybrid Napier by Sharma and Mudgal (1966).

Dry matter production steadily increased with crop maturity. This was expected since the increased dry matter per cent with crop growth was responsible for increased trend in dry matter yield. This was evidenced by the positive relationship between the age and dry matter yield of the crop ($r = 0.990^{**}$).

Crude protein content was found to decrease with the age of the crop. The leaf fractions were found to contain a higher proportion of crude protein than the stem. Increased accumulation of carbohydrate and other structural materials such as lignin (Sharma and Mudgal, 1966) and silica (Johnson *et al.*, 1971) with the maturity of the crop and reduction in leaf to stem ratios, could be attributed to the decrease in the crude protein content with crop maturity (Blaser, 1964). The positive relationships observed between leaf to stem ratio and crude proten content ($r = 0.930^{**}$) and negative relationship between the age of the crop and crude protein content ($r = -0.911^{**}$) further supported this assumption, that the decrease in crude proten content was due to changes in cell-wall materials and alterd leaf to stem ratios. Similar decrease in crude protein content with maturity was reported in Napier grass (Gupta and Talapatra, 1970).

NDF content or cell-wall constituent was found to increase with crop maturity irrespective of plant parts viz., leaf, stem or whole plant. The similar observation was made by Johnson *et al.* (1975) in Napier grass. This could be attributed due to the deposition of structural materials such as ligno-cellulose (ADF) and silica with maturity of the crop (Table 2). Since the NDF is the cell-wall which comprises of hemicellulose, cellulose, lignin and silica (Deinum and Van Soest, 1969). This reasoning is furthr supported by that positive relationships of the NDF ($r = 0.952^{**}$), ADF ($r = 0.911^{**}$) and ADL ($r = 0.969^{**}$) contents with age of the crop. The NDF content of stem was higher than that of leaf at any one stage. Similar observation was made by Mowat, *et al*, (1969).

As in the case of NDF content, the ADF content also increased with maturity of the forage. Further a positive relationship was observed between the age of the crop and ADF content (r= 0.980**). Similar results were reported by Johnson *et al.* (1973) in Napier grass. This increase in ADF content could have been possible due to the increased deposition of lignin, cellulose, (Sood *et al.*, 1974) and silica with maturity of the crops. Since ADF comprises of lignin, cellulose and silica (Deinum and Van Soest, 1969). This increase in ADF content of forages might also be due to the decrease in leaf to stem ratio.

The ADF content of stem remained higher than that of leaf portion. Similar observation was made in forages by Mowat *et al.* (1969).

The ADL content of the plant parts increased with crop maturity. The lignin content of the stem was higher than that of the leaf. Similar results were obtained in hybrid Napier by Sharma and Mudgal (1966). The increase in lignin content of forages with maturity was further confirmed by the positive relationship between lignin and age of the crop (r=0.990**). This could be due to the increased lignification as the plant parts attain maturity.

An increasing trend of silica content with advancement of crop growth was noticed. The silica content in leaf remained higher than that of stem at any one stage. This corroborates with the results reported by Johnson *et al.* (1971) in Napier grass. The higher silica content of leaf was due to the occurrence of higher transpiration in leaf blades and low physiological mobility of silica in plants (Shouichi Yoshida, 1975).

The dry matter digestibility of leaf, stem and whole plant declined with advancing maturity of the grass. Similar result was noticed in Napier grass by Sharma and Mudgal (1966). The increased deposition of ligno-celluloes (ADF), silica (Table 2) and decrease in crude protein content (Table 1) with advancing age of the crop would have been responsible for the decrease of dry matter digestibility. This view was confirmed by the negative relationships of dry matter digestibility with ADF (r = -0.960**) and silica (r -0.930** contents and a positive relationship with crude protein content (r= 0.899**). The dry matter digestibility of leaf was higher than that of stem at any one stage. This was evidently due to higher ligno-cellulose content of stem than that of the leaf (Table 2) even though leaf contained more silica. The lower centent of crude protein of stem also is a possible factor which may be responsible for this. Sharma and Mudgal (1966) held the view that progressive lignification was responsible for the reduction of digestibility of Napier grass with maturity. Arroyo-Aguilu *et al.* (1973) found that high contents of structural carbo-hydrates namely lignin and cellulose were reported to be present with increase in maturity of tropical grasses which reduced the digestibility. They also noticed that the leaf to stem ratio was negatively associated with digestibility of Napier grass.

The annual yield of digestible dry matter increased with the increase in the cutting interval up to 50 days and then decreased. The maximum digestible dry matter yield was obtained when the cutting interval was 50 days.

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Table. 1

Effect of stage maturity on dry matter content, yield, leaf and stem yields, leaf to stem ratio and crude protein content of napier grass (NB-21)

Stage of maturity in days	Mean height (cm)	Green yield per cutting (tonnes/ha)	Dry matter per cent	No. of cuttings per year	Total dry matter yield per year (tonnes/ha)	Total leaf yield per year (tonnes/ha)	Total stem yield per year (tonnes/ha)	Leaf to stem ratio	Crude protein per cent		
									Leaf	Stem	Whole
20	75	9.0	10.7	14.5	14.0	10.0	4.0	2.4	17.8	12.6	16.3
25	90	14.0	9.2	11.6	15.0	10.3	4.6	2.2	14.7	9.4	13.0
30	105	22.9	9.6	9.6	21.2	14.0	7.1	1.9	12.6	9.3	11.5
35	160	37.2	9.6	8.2	29.9	18.7	11.2	1.6	12.2	6.5	10.1
40	200	42.2	13.4	7.2	41.3	17.3	23.9	0.7	9.2	5.0	6.8
45	235	50.0	15.7	6.4	50.5	16.0	34.4	0.4	8.4	4.5	5.7
50	270	54.3	19.3	5.8	61.1	16.0	45.0	0.3	8.4	4.4	5.5
55	295	57.4	22.3	5.3	68.4	15.9	52.5	0.3	8.0	3.9	4.9
60	320	61.1	24.7	4.8	73.2	15.8	57.3	0.2	7.9	3.1	4.1

*After establishment harvested on 31st July, 1975.

Table 2 : Effect of stage maturity on neutral-detergent fibre, acid-detergent fibre, acid-detergent lignin, silica, DDM content and DDM yield per year of napier grass (NB-21)

Stage of maturity in days	NDF per cent			ADF per cent			ADL per cent			SiO_2 per cent			DDM per cent			DDM yield per year (tonnes/ha)
	Leaf	Stem	Whole plant	Leaf	Stem	Whole plant	Leaf	Stem	Whole plant	Leaf	Stem	Whole plant	Leaf	Stem	Whole plant	
20	60.5	65.5	61.9	32.6	43.0	38.4	3.2	4.8	3.7	5.3	4.5	5.0	47.1	42.0	45.2	6.3
25	61.0	67.5	61.1	38.7	43.7	40.2	4.6	5.5	4.8	5.3	4.8	5.1	38.3	36.6	37.8	5.6
30	66.8	70.3	68.0	42.0	45.9	43.3	4.7	6.2	5.2	6.4	5.0	5.9	34.3	32.0	32.9	7.0
35	68.3	75.1	70.9	45.7	48.5	44.9	4.7	6.8	5.5	6.4	5.3	6.0	33.6	26.5	31.4	9.4
40	68.7	71.1	74.1	45.1	51.0	48.5	4.9	7.0	6.1	6.5	5.3	5.8	33.2	25.9	28.9	11.9
45	69.4	78.2	75.4	45.1	51.3	49.3	5.0	7.4	6.6	8.5	5.3	6.3	25.1	24.9	24.4	12.3
50	70.8	78.3	76.3	45.7	52.5	50.7	5.2	7.8	7.1	8.5	5.3	6.1	23.6	23.9	23.6	14.4
55	71.7	79.8	77.6	46.1	53.4	51.7	5.7	8.9	8.9	8.5	5.5	6.2	21.5	14.2	15.8	10.8
60	71.9	80.5	78.5	46.7	56.3	53.4	6.3	10.4	7.5	8.5	6.4	6.8	17.7	9.4	12.0	8.8