https://doi.org/10.29321/MAJ.10.A02196

*Madras Agric. J.* 74 (8 & 9) 393—399; August & September, 1987

# EFFECT OF NITROGEN, ZINC AND IRON ON THE CELL-WALL COMPONENTS OF BN 2 GRASS

M. GOVINDASWAMY and T. S. MANICKAM

Total cell-wall constituents (CWC) of bajra-napier hybrid, BN 2 grass decreased significantly with each increment of fertilizer N. With addition of N, the value decreased from 64.77 to 62.17 per cent at 150 Kg N/ha. The treatment with 5.0 Kg $ZnSO_4$/ha recorded the lowest cell-wall components. Successive reduction in lignin due to N addition was noticed. A progressive decrease in silica from 5.794 to 5.130 per cent was noticed at 150 Kg N/ha. The results of the present study indicated that by proper N management it is not only possible to enhance the yield but also improve the quality of fodder by decreased cell-wall constituents

Forage dry matter may be conveniently fractioned into two major groups viz., cellular contents and cell-wall constituents (CWC). Among the cell wall constituents, lignin and silica are very important since these are totally indigestible and also affect the digestibility of the other ingredients of the fodder. Estimation of these constituents will help in the prediction of the correct stage of cutting the forage crops to derive the maximum digestibility in the animal system. Fertiliser management practice especially N was found to play a significant role in reducing the cell-wall components (Schneider, 1972; Sureshkumar, 1977) of forage plants. However, information on these aspects with reference to the popularly cultivated BN 2 grass is lacking and hence this study was conducted with different levels of N besides, Zn and Fe.

## MATERIALS AND METHODS

An investigation was carried out during 1980-81 at Tamil Nadu Agricultural University farm in a split plot design, replicated three times There were seven main plots (control 2.5 and 5.0 Kg $ZnSO_4$/ha, 0.5 per cent $ZnSO_4$ spray, 5.0 and 10.0 Kg $FeSO_4$/ha and 2.0 per cent $FeSO_4$ spray after each cut) and four sub-plots (0, 50 100 and 150 Kg N/ha/cut). The soil of the experimental area was clay loam in texture, deficient in available N, P, Zn and Fe and sufficient in K, Cu and Mn. The grass slips were planted adopting 50x50 cm spacing. It was cut after 60 days of growth at 15 cm height and the treatments were imposed. Nitrogen was applied as urea A common dose of 50 kg $P_2O_5$ and 40kg $K_2O$/ha as single super phosphate and muriate of potash respectively were applied uniforml

Department of soil science Tamil Nadu Agrl. University, Coimbatore-641 003.

to all the plots at the time of planting of slips. Spraying of $ZnSO_4$ and $FeSO_4$ was done after 20 days of each cut.

Eight periodical cuts were taken at 45 days interval for one year. Representative plant samples were collected from all the plots immediately after each cut and a known quantity

Table 1 Influence of N, Zn and Fe on the Neutral detergent fibre (NDF) (Mean values in per cent)

(A) Nitrogen

| Cuts | Treatments | | | | | S. E. | C. D. |
|---|---|---|---|---|---|---|---|
| | $N_0$ | $N_1$ | $N_2$ | $N_3$ | Mean | | |
| 1 | 61.69 | 60.01 | 58.13 | 57.49 | 59.33 | 0.21 | 0.60 |
| 2 | 62.95 | 61.88 | 60.59 | 60.17 | 61.40 | 0.20 | 0.58 |
| 3 | 63.67 | 62.71 | 61.67 | 61.33 | 62.34 | 0.11 | 0.33 |
| 4 | 64.71 | 63.39 | 63.25 | 62.87 | 63.55 | 0.19 | 0.56 |
| 5 | 65.32 | 64.01 | 63.43 | 63.24 | 64.00 | 0.23 | 0.65 |
| 6 | 65.85 | 64.42 | 63.43 | 63.33 | 64.26 | 0.24 | 0.69 |
| 7 | 66.39 | 65.33 | 64.67 | 64.87 | 65.31 | 0.24 | 0.68 |
| 8 | 67.32 | 66.61 | 65.44 | 64.92 | 66.07 | 0.19 | 0.55 |
| Mean | 64.77 | 63.58 | 62.61 | 62.17 | — | 0.06 | 0.16 |

(B) Micronutrients

| Cuts | C | $Zn_1$ | $Zn_2$ | $Zn_3$ | $Fe_1$ | $Fe_2$ | $Fe_3$ | S.E. | C.D. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 59.84 | 59.68 | 58.93 | 59.08 | 59.31 | 58.91 | 59.97 | 0.27 | N.S. |
| 2 | 61.99 | 61.49 | 60.91 | 61.44 | 61.64 | 60.89 | 61.42 | 0.25 | N.S. |
| 3 | 63.22 | 62.44 | 61.48 | 62.70 | 62.53 | 61.94 | 62.09 | 0.20 | 0.61 |
| 4 | 63.96 | 63.43 | 63.27 | 63.23 | 63.71 | 63.68 | 63.61 | 0.31 | N.S. |
| 5 | 64.28 | 63.29 | 63.49 | 63.94 | 63.96 | 64.11 | 64.93 | 0.34 | N.S. |
| 6 | 64.38 | 64.01 | 64.43 | 64.16 | 64.41 | 64.19 | 64.21 | 0.29 | N.S. |
| 7 | 65.33 | 65.36 | 65.26 | 65.64 | 65.15 | 65.57 | 64.89 | 0.20 | N.S. |
| 8 | 66.66 | 66.03 | 65.97 | 66.33 | 65.79 | 65.97 | 65.75 | 0.23 | N.S. |
| Mean | 63.71 | 63.20 | 62.97 | 63.32 | 63.31 | 63.13 | 63.35 | 0.12 | 0.37 |

of the sample was dried in air oven at 60°C to constant weight. The samples were powdered in a wiley mill with stainless steel blades and used for chemical analyses. The cell-wall components viz., neutral-detergent fibre, acid-detergent, lignin and silica were estimated by adopting the procedure outlined by Goering and Van Soest (1970). The digestibility of the dry matter was estimated by the Tilley and Terry (1963) technique. From the values correlation coefficients were worked out.

## RESULTS AND DISCUSSION

### Neutral-detergent fibre (NDF)

The NDF value is an indication of the total cell-wall constituents and have a great bearing on the digestibility of the forage and thus it occupies a prime position in the evalution of forage material. It is proven fact that higher the NDF, lower will be the digestibility and vice-versa. The results revealed a significant influence for the applied N in the NDF content with addition of N, the value decreased from 64.77 in control to 62.17 per cent at 150 kg N/ha. (Table 1). Addition of every increment of N the NDF decreased significantly over the lower level. The decrease in NDF may be attributed to the significant role of N in protein synthesis and consequent reduction in carbohydrates with increased N application besides, succulence and lush growth of the grass. This fact could further be supported by the highly significant negative relationship obtained in the study between crude protein content and NDF per cent (r-0.957**). Similar trend was reported earlier by Wilkinson *et al.*, (1970) and Mani (1979).

Application of $ZnSO_4$ at 5.0 kg/ha recorded the lowest value of NDF (62 97 per cent) among the treatments with micronutrient. Eventhough the levels of $ZnSO_4$ and $FeSO_4$ failed to differ among themselves, a significant reduction over control was noticed. The decrease in NDF may be attributed to the influence of these micronutrients on the luxuriant growth of the grass.

The NDF content of the grass at different cuts indicated that significantly higher accumulation of NDF in the control plots in all the eight cuts was recorded which clearly revealed the significant role of N from the point of view of the quality of the fodder. Soil application of $ZnSO_4$ at 5.0 kg/ha registered significantly lower NDF than the other treatments in the third cut. Since the yield of green forage was increased by 15 84 per cent in that cut by this treatment such a trend could be expected. The influence of Fe $SO_4$ was similar to that of mean NDF.

### ACID DETERGENT LIGNIN (ADL)

The influence of lignin on the digestibility of forage is cocognised and efforts are being made to keep this constituent at the minimum level. Lignin is the most resistant fraction of the fooder and besides being indigestible also causes considerable set

Table 2 Influence of N, Zn, and Fe on the Acid detergent lignin (ADL)
(Mean values in per cent)

(a) Nitrogen

| Cuts | Treatments | | | | | S.E. | C.D. |
|---|---|---|---|---|---|---|---|
| | $N_0$ | $N_1$ | $N_2$ | $N_3$ | Mean | | |
| 1 | 6.02 | 5.69 | 5.25 | 5.14 | 5.52 | 0.04 | 0.13 |
| 2 | 6.29 | 6.16 | 5.97 | 5.93 | 6.09 | 0.04 | 0.10 |
| 3 | 6.39 | 6.24 | 6.14 | 6.05 | 6.20 | 0.03 | 0.09 |
| 4 | 6.58 | 6.36 | 6.32 | 6.08 | 6.33 | 0.07 | 0.21 |
| 5 | 6.82 | 6.55 | 6.41 | 6.27 | 6.51 | 0.06 | 0.17 |
| 6 | 6.85 | 6.51 | 6.33 | 6.23 | 6.48 | 0.06 | 0.16 |
| 7 | 6.83 | 6.51 | 6.19 | 6.03 | 6.39 | 0.04 | 0.13 |
| 8 | 6·88 | 6.43 | 6.20 | 6 11 | 6.40 | 0.07 | 0.21 |
| Mean | 6.58 | 6.31 | 6.09 | 5.97 | — | 0.02 | 0.06 |

(b) Micronutrients

| Cuts | C | $Zn_1$ | $Zn_2$ | $Zn_3$ | $Fe_1$ | $Fe_2$ | $Fe_3$ | S. E. | C. D |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.84 | 5.36 | 5.53 | 5.45 | 5.57 | 5.45 | 5.48 | 0.06 | 0.20 |
| 2 | 6.16 | 6.14 | 6.06 | 6.01 | 6.09 | 6.05 | 6.09 | 0.08 | N.S. |
| 3 | 6.37 | 6.20 | 6.19 | 6.20 | 6.17 | 6.15 | 6.16 | 0.05 | N.S |
| 4 | 6.40 | 6.30 | 6.31 | 6.41 | 6 35 | 6.27 | 6.31 | 0.09 | N.S. |
| 5 | 6.37 | 6.40 | 6.50 | 6.58 | 6.53 | 6.56 | 6.43 | 0 09 | N.S. |
| 6 | 6.53 | 6.51 | 6.51 | 6.39 | 6.43 | 6.48 | 6.52 | 0.11 | N.S. |
| 7 | 6.45 | 6.55 | 6·31 | 6.35 | 6.30 | 6.41 | 6.36 | 0.07 | N.S. |
| 8 | 6.49 | 6.25 | 6.64 | 6.25 | 6.36 | 6.41 | 6.44 | 0.07 | 0.23 |
| Mean | 6.35 | 6.21 | 6.25 | 6.21 | 6.21 | 6.221 | 6.2 | 0.03 | N.S. |

back in the digestion of other nutrients. The results obtained in the present study indicated a highly significant and negative influence of N on ADL. There was successive reduction in ADL due to increased levels of N (Table 2).

The reduction with N may be due to lush growth of the grass leading to succulence, besides synthesis of

Table 3. Influence of N, Zn and Fe on the silica content
(Mean values in per cent)

(a) Nitrogen

| Cuts | Treatments | | | | | S. E. | C. D. |
|---|---|---|---|---|---|---|---|
| | $N_0$ | $N_1$ | $N_2$ | $N_3$ | Mean | | |
| 1 | 5.02 | 4.82 | 4.33 | 4.24 | 4.60 | 0.03 | 0.09 |
| 2 | 5.32 | 5.15 | 4.85 | 4.72 | 5.01 | 0.04 | 0.13 |
| 3 | 5.41 | 5.27 | 5.08 | 4.98 | 5.18 | 0.03 | 0.09 |
| 4 | 5.65 | 5.24 | 5.13 | 4.86 | 5.22 | 0.07 | 0.21 |
| 5 | 5.88 | 5.58 | 5.42 | 5.29 | 5.54 | 0.06 | 0.18 |
| 6 | 5.97 | 5.61 | 5.40 | 5.30 | 5.57 | 0.05 | 0.14 |
| 7 | 6.47 | 6.37 | 5.77 | 5.70 | 6.08 | 0.08 | 0.22 |
| 8 | 6.59 | 6.35 | 6.14 | 5.77 | 6.21 | 0.06 | 0.17 |
| Mean | 5.79 | 5.55 | 5.27 | 5.13 | ... | 0.02 | 0.07 |

(b) Micronutrients

| Cuts | C | $Zn_1$ | $Zn_2$ | $Zn_3$ | $Fe_1$ | $Fe_2$ | $Fe_3$ | S. E. | C. D. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.62 | 4.67 | 4.52 | 4.55 | 4.54 | 4.63 | 4.67 | 0.05 | N. S. |
| 2 | 5.22 | 5.08 | 4.92 | 4.95 | 4.99 | 4.95 | 4.97 | 0.05 | 0.17 |
| 3 | 5.32 | 5.31 | 5.18 | 5.13 | 5.07 | 5.17 | 5.12 | 0.05 | N. S. |
| 4 | 5.19 | 4.97 | 5.17 | 5.33 | 5.29 | 5.38 | 5.21 | 0.14 | N. S. |
| 5 | 5.50 | 5.58 | 5.44 | 5.62 | 5.63 | 5.51 | 5.50 | 0.09 | N. S. |
| 6 | 5.64 | 5.58 | 5.70 | 5.47 | 5.42 | 5.59 | 5.59 | 0.11 | N. S. |
| 7 | 5.82 | 6.01 | 6.04 | 6.19 | 6.17 | 6.21 | 6.11 | 0.11 | N. S. |
| 8 | 6.09 | 6.39 | 6.15 | 6.26 | 6.17 | 6.21 | 6.22 | 0.06 | N. S. |
| Mean | 5.42 | 5.46 | 5.40 | 5.44 | 5.41 | 5.49 | 5.42 | 0.04 | N. S. |

higher protein and other cellular contents. This view could be corroborated by the significant negative relationship obtained between crude protein and ADL (r-0.930**). This trend was in conformity with the earlier findings reported by Deinum *et al.* (1968). However, application of Zn as well as Fe failed to exercise significant influence on the lignification of this grass.

Significant reduction in the lignification of the grass was associated with N addition in all the eight cuts but the magnitude varied among the cuts the highest in the seventh and the lowest in the fifth cut. Except the seventh and fourth cuts, the difference between the two higher levels of N was only marginal. Fertilisation with Zn and Fe also brought out considerable reduction of the lignin accumulation in the first and last cuts.

Reduction in ADL content, which is desirable from the point of view of fodder quality was coupled with N fertilisation, besides Zn and Fe in certain cuts. The undersirable effect of ADL was further supported by the negative correlation between ADL and digestibility (r-0.944**) recorded in the study. Similar negative relationships were reported by Jones (1970) Mudgal and Somnath (1981) and RamRatan *et al* (1982).

SILICA CONTENT

Silica is yet another important factor which brings out considerable reduction in the digestibility of forage material, since this constituent is highly resistant to the action of rumen microflora. The results showed that successive levels of N produced significant reduction in the silica content of the grass (Table 3). It decreased progressively from 5.80 (control) to 5.12 per cent at 150 kg N/ha. This observation was in accordance with the findings of Mani (1977). Increase in the proportion of soluble cellular contents such as protein, fat and carbohydrates due to N fertilisation may probably reduce the accumulation of silica. This view could be supported by the negative relationship obtained in the study between silica and crude protein (r=-0.937**). The applied Zn and Fe failed to reduce the silica content of this grass.

Silica content of grass in different cuts indicated a significant reduction with N application in all the cuts. Application of Zn and Fe also brought out significant reduction in the silica content in the second cut.

The highly significant and negative relationship obtained between silica and digestibility (r=-0.953**) proved the deterent effect of silica on the quality of the forage. However, it was interesting to note that even this constituent could be varied by the judicious application of N.

The results of the present study indicated the significant role of added N in brining out a betterment in the quality of fodder by reducing the undesirable cell - wall components besides increasing the yield and desirable constituents.

ACKNOWLEDGEMENT

The first author is grateful to the Tamil Nadu Agricultural University for according permission to publish the data which formed part of his Ph. D. thesis.

## REFERENCES

DEINUM, B., A. J. H. VANES and P. J VAN SOEST. 1968. Climate, nitrogen and grass II. The influence of light intensity, temperature and nitrogen on *in vivo* digestibility of grass and the prediction of these effects from some chemical procedures. Neth. J. Agric. Sci. 16 : 217-223.

GOERING, H. K. and P. J. VAN SOEST. 1970 Forage fibre analysis. (Apparatus, reagents procedures and some applications). Agr Handbook 379, USDA

JONES, D. I. H. 1970. Cell - wall constituents of some grass species and varieties. J Sci Fd. Agrc. 21 : 559-562.

MANI, K. 1977. Studies on the influence of different stages of maturity and nitrogen levels on the cell-wall components and nutrient contents of forage grasses. M.Sc (Ag.) Dissertation submitted to and approved by Tamil Nadu Agricultural University.

MANI, A. K. 1979. Studies on the influence of nitrogen and stages of cutting on the yield and quality of hybrid napier grass varieties. M. Sc. (Ag.) Dissertation submitted to and approved by Tamil Nadu Agricultural University.

MUDGAL, V. D and SOMNATH 1981. Nutritive evaluation of feed and fodders of temperate zones by *in vitro* techniques in calves, buffalo and goat. Indian J. Dairy Sci. 34 : 110-113.

RAM RATAN, S. S. KUNDU and D. R. BHATIA. 1982. Note on the nutritive value of *Clitoria ternatea* hay for sheep. Indian J. Anim. Sci. 52 : 265-267.

SCHNEIDER, B. A. 1972. Influence of soil fertilzation on the nutritive value of corn and alfalfa Disser. Abstr. International B. 32 : 5581.

SURESHKUMAR, P. 1977. Evaluation of fodde maize varieties as influenced by nitrogen fertilisation and stages of cutting M. Sc. (Ag.) Dissertation submitted to and approved by Tamil Nadu Agricultural University

TILLEY, J. M. A. and R. A TERRY. 1963. A two stage technique for the *in vitro* digestion of forage crops. J. Brit. Grass Soc. 18 104-111.

WILKINSON, S R., W. E. ADAMS and W. A. JACKSON. 1970. Chemical composition and *in vitro* digestibility of vertical layers or coastal bermuda grass. Agron. J. 62 : 39-43