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Effect of Temperature and Fertilizer Level on the Chemical Composition and Nutritive Value of Green Panic (*Panicum maximum* var. *trichoglume cv.* Petrie)

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The effect of temperature and fertilizer level on the chemical composition and nutritive value of green panic (*Panicum maximum var. trichoglume cv.* Petrie) was studied. There were three temperature treatments i. e., 20, 25 and 30°C; and three fertilizer treatments at the rate of 0.98, 1.96 and 2.94 kg N, P_2O_5 and K_2O per are i.e., F_1, F_2 and F_3 respectively. Plants were raised from seeds and were grown in the open for seven weeks before transferring into the phytotron. The plants were harvested after 10, 20 and 30 days in the temperature rooms. Dry matter yield increased with increased fertilizer level but was little affected by temperature. Nitrogen increased with increased fertilizer level but decreased with advancing growth period and increasing temperature. All the cell wall constituents increased with increasing temperature but was little affected by fertilizer level.

In vitro organic matter digestibility (IVOMD) decreased with increasing temperature ($P<0.01$) and F_1 was higher than both F_2 and F_3 ($P<0.05$). IVOMD decreased at the rate of 0.78% unit per degree rise in temperature. Both temperature and nitrogen were negatively correlated with IVOMD but only that of temperature was statistically significant.

INTRODUCTION

Two of the most important factors influencing the growth and development of herbage and hence its nutritive value are growth temperature and soil nitrogen when moisture is not limiting (Wilson, 1982).

With tropical forages, the level of temperature maximum for photosynthesis is reported to be high (Ludlow and Wilson, 1968) and this together with the high insolation to which they are exposed, make them potentially more productive in terms of dry matter production compared to temperate or cool season forages (Cooper and Tainton, 1968; Cooper, 1970).

Even though temperature has been thought to influence the digestibility of pastures through increasing the fibre and lignin content, it is only recently that direct evidence of this has been established. Minson and McLeod (1970) reported a negative correlation (r=-0.76) between growth temperature and digestibility. Minson and Wilson (1980) also reported an average decline of 0.60 % unit in digestibility per unit rise in growth temperature. These latter workers noted that temperature accounted for about 60 % of the variations in digestibility.

The nitrogen content of most tropical forages is relatively lower than that of most temperate forages (Minson, 1976) mainly because of the low fertility status of the soils on which they are grown, and also their rapid maturity leading to a dilution of the crude protein content. Tropical forages respond well to fertilizer nitrogen which not only increases the crude protein content but also productivity. However, the effect of nitrogen fertilization on dry matter digestibility has been mixed (Wilson, 1982).

Thus, this experiment was initiated to examine the effect of ambient growth temperature and fertilizer levels on the trend of changes in the chemical composition and nutritive value of tropical forages.

MATERIALS AND METHODS

The species used in this experiment was green panic (*Panicum maximum* var. *trichoglume cv.* Petrie). Three fertilizer levels and three growth temperatures were employed. The three temperatures imposed were 20, 25 and 30°C day and night i. e., T_{20}, T_{25} and T_{30}; and a compound fertilizer (14 % N, 14% P_2O_5 and 14 % K_2O) was applied at the rate of 0.98, 1.96 and 2.94 kg per are of each element i. e., F_1, F_2 and F_3 respectively. There were three pots per treatment.

Pots of diameter 12 cm and depth 12 cm were loosely filled to the brim with sandy-clayey loam soil which had been sifted through a 3mm sieve and air-dried. The pots were divided into three groups, each of which received one of the three levels of fertilizer in two equal applications at sowing and six weeks thereafter. Thinning and transplanting of plants to 5-6 per pot was done at three weeks after germination such that plants would be of approximately equal size at the beginning of temperature treatment. A week after the second fertilizer application, plants of three pots from each of three fertilizer groups were harvested. The remainder of each of the fertilizer groups were then subdivided into three groups and placed in the constant temperature rooms of the phytotron. The relative humidity of each of the temperature rooms was 70% throughout the experiment. Natural sunlight passing through the glass wall and roof of the phytotron was employed.

Harvesting of plants was done 10, 20 and 30 day i. e., P_1, P_2 and P_3 respectively, after placement in the phytotron. Plants were harvested at 5cm above soil level. After harvesting, samples were dried at 70°C for more than 24 hours for dry matter determination. The dried samples were bulked for each temperature and fertilizer groups, ground to pass through lmm sieve and stored until analyses.

Samples were analyzed for total nitrogen by the Kjeldahl method, cell wall constituents by the method of Goering and Van Soest (1970) excluding sodium sulphite and antifoaming agents; and *in vitro* organic matter digestibility (IVOMD) by the method of Minson and McLeod (1972).

RESULTS

Dry matter yield as affected by temperature and fertilizer levels is presented in Table 1. Dry matter yield increased with fertilizer level ($P<0.01$) but differences among temperature groups were not significant.

'**Table 1.** Dry matter yield and cell wall constituents of green panic as affected by fertilizer level and temperature.

Characteristic	Period	T_{20} F_1	T_{20} F_2	T_{20} F_3	T_{25} F_1	T_{25} F_2	T_{25} F_3	T_{30} F_1	T_{30} F_2	T_{30} F_3
Dry Matter	1	**4.63**	**10.10**	**12.37**	**6.35**	**13.86**	**12.27**	**9.09**	**15.33**	**9.63**
	2	8.81	16.09	16.86	11.47	19.88	17.98	10.91	18.47	18.02
	3	11.93	24.87	19.42	12.14	22.53	16.23	12.14	17.59	18.57
	1									
Neutral	2	74.47 66.96	72.74 66.96	**66.18**	68.**78**	**69.29**	71.01	72.40	69.96	70.20
Detergent				74.42	**75.41**	**73.71**	74.94	76.24	74.65	76.56
Fibre	3	**74.29**	**77.53**	76.71	**74.00**	**75.94**	74.55	77.79	76.20	78.14
Acid	1			35.90	37.10	40.58	38.24	43.47	40.12	40.28
Detergent	2	34.37 43.50	35.91 44.25	43.31	46.65	43.51	43.98	49.16	47.69	47.91
Fibre	3	44.40	46.56	46.70	46.92	46.03	46.33	48.09	48.93	48.93
	1									
	2	40.32 31.53	39.59 32.86	32.57	33.51	36.79	34.65	39.14	35.71	35.62
Cellulose				38.56	39.84	38.19	38.70	41.25	41.42	41;10
	3	39.85	41.25	41.47	38.24	40.15	40.22	41.36	40.56	42.58
Acid	1	1.96	2.43	2.21	2.35	3.03	2.91		3.32	3.17
Detergent	2	2.83	3.73	3.86	4.20	4.88	4.79	4.96	5.16	5.59
Lignin	3	3.59	4.53	4.35	4.81	5.36	5.52	5.68	6.23	6:01

Nitrogen content is shown in Fig. 1. Nitrogen content increased with increasing level of fertilization but decreased with advancing growth period. There was a significant decrease in nitrogen content with increasing temperature ($P<0.01$). Nitrogen content decreased most at T_{30} by the end of P_1 in the phytotron; however, by the end of P_3 it has decreased to about 32-38 % in T_{25} and T_{30} and 35-40 % in T_{20} of the pre-temperature treatment value.

The results of cell wall constituents analyses are shown in Table 1. In general, significant increase ($P<0.01$) occurred between P_1 and P_2 but no difference was observed between P_2 and P_3.

Neutral detergent fibre (NDF) : There was a consistently large increase in NDF with increasing temperature ($P<0.01$) than with increasing level of fertilization. There was a difference of about 3-5 % units as temperature moved from T_{20} to T_{25} or T_{30} during P_1 but by the end of P_3 these differences have greatly narrowed down. On the contrary, differences due fertilizer level were negligible throughout the temperature treatment period.

Acid detergent fibre (ADF) : The differences in ADF were 2.88, 3.02 and 5.09 for T_{20} and T_{25}, T_{25} and T_{30}, and T_{20} and T_{30} respectively during P_1. However, by the end of P_2 and P_3 there were no differences between T_{20} and T_{25} but these were about 3 % units lower than that at T_{30} ($P<0.05$). No differences were observed among fertilizer levels.

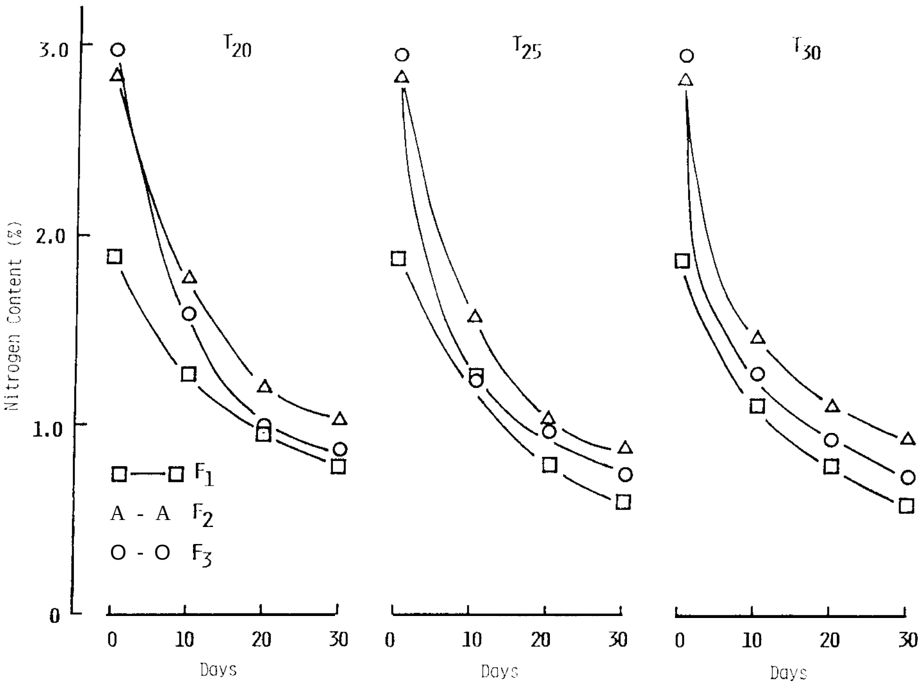

Fig. 1. Effect of temperature and fertilizer level on the nitrogen content of green panic.

Cellulose: The increase in cellulose occurred mainly between P_1 and P_2 after which it remained virtually unchanged. No differences were observed among fertilizer levels but the differences among temperature groups were significant ($P<0.01$).

Acid detergent lignin (ADL) : ADL increased with both fertilizer levels ($P<0.01$) and temperature ($P<0.01$) but the interaction between these two factors was not significant. The lignin contents of F_2 and F_3 were almost the same but higher than that of F,.

In vitro organic matter digestibility (IVOMD) is shown in Fig. 2. There was a general decline in IVOMD with advancing growth period. T_{30} was about 6.0 % units lower than T_{20} by the end of P_1 and the difference reached about 9.0 and 7.5 % units at the end of P_2 and P_3 respectively. The differences between T_{20} and T_{25} were 2.9, 5.0 and 6.0 % units, while those between T_{25} and T_{30} were 3.1, 4.0 and 1.5 % units for the three periods respectively. These differences were significant ($P<0.01$). With regard to fertilizer level, though there were smaller differences compared to those due to temperature, only F_1 was significantly higher ($P<0.05$) than those of F_2 and F_3. There were, however, no interactions between temperature and fertilizer level.

In Fig. 3 are shown the response curves of IVOMD to temperature and fertilizer level. The graphs indicate that IVOMD was affected linearly by temperature and quadratically by fertilizer level.

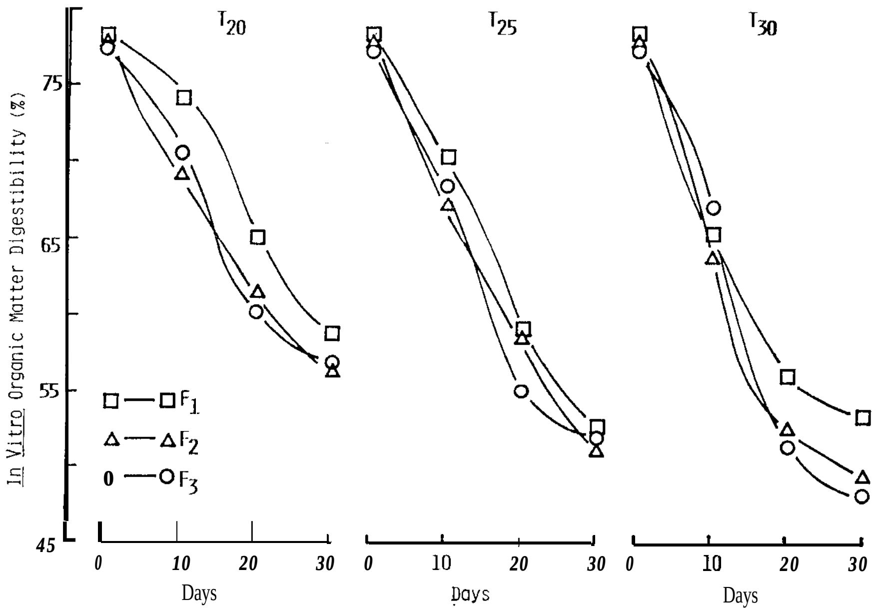

Fig. 2. Effect of temperature and fertilizer level on the in vitro organic matter digestibility of green panic.

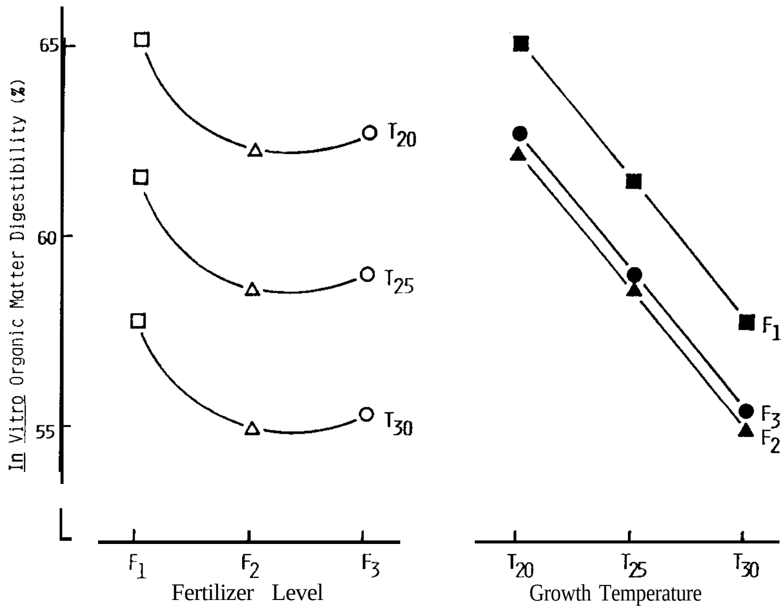

Fig. 3. Temperature and fertilizer response curves of ***in vitro*** organic matter digestibility of green panic.

Table 2. Correlation between in *vitro* organic matter digestibility and temperature or fertilizer level.

Period in Phytotron	Temperature	Fertilizer
All Harvests	−0.4026*	−0.1333
First Harvest	-0.8018**	−0.0741
Second Harvest	−0.8864**	-0.4323
Third Harvest	−0.8567**	−0.2861

* P <0.05, ** P <0.01

In Table 2 is shown the coefficient of correlation between IVOMD and temperature or fertilizer level. Fertilizer level was negatively correlated to IVOMD but the values were small and not significant. On the contrary, the values with regard to temperature were also negative but larger and significant. When all the data for the respective periods were taken together the correlation values were relatively small yet significant with regard to temperature.

DISCUSSION

The lower nitrogen contents with increasing temperature have been reported by Wilson and Ford (1971). In the present experiment temperature had little effect on the dry matter yield and so the lower nitrogen content cannot be fully explained by the increased dry matter alone. Increasing temperature has been reported to increase the rate of leaf senescence (Wilson and t'Mannetje, 1978) and stem developement (McWilliams,1978). Since these plant fractions are generally lower in nitrogen content than green leaves, they might have contributed to the lower nitrogen contents under higher temperatures.

The increase in structural components with increasing temperature is in accordance with published results (Wilson and Ford, 1973; Wilson *et* al., 1976; Moir *et al., 1977).* The increase in NDF beyond P_2 may be due to the increase in ADF content. However, since no increase in cellulose occurred beyond this period it seems reasonable to think that beyond a certain stage of the plant's development photosythates are transformed into lignin as has been reported by Deinum and Knoppers (1979) with maize.

A number of workers have reported a decline in digestibility with increasing growth temperature (Wilson and Ford, 1971, 1973; Wilson *et al.,* 1976; Moir et al., 1977). Minson and McLeod (1970) found a very high negative correlation (r= -0.76) between growth temperature and digestibility. In the present experiment, the correlations were found to range between -0.89 and -0.80 for the three respective periods. The lower correlation value when all the data for the three periods were taken together might suggest that the effect of temperature on IVOMD is modified by stage of development or some other factors (see Fig. 2).

There was an average decline of 0.78 % unit per degree rise in temperature in all the fertilizer groups, which appears higher than 0.60 % unit reported by Minson and Wilson (1980).

The decrease in digestibility with fertilizer was unexpected though there are some supporting literatures to this effect (Blaser, 1964; Gomide *et al., 1969;* Hutton, 1970). One possible reason is the increased and sustained growth brought about by the higher levels of fertilizer (Wood *et al., 1972)* and the increased lignin content with increased fertilizer (Hutton, 1970; Vicente-Chandler, 1974). Nevertheless, the low negative correlation observed between fertilizer level and digestibility compared to that of temperature suggest that their effects differed in extent, and the non-significant interaction between temperature and fertilizer also suggests that these two factors might be affecting IVOMD differently.

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