e- ISSN: 2394-5532
p-ISSN: 2394-823X

International Journal of Applied And Pure Science and Agriculture
www.ijapsa.com

LIGHT INTENSITY- NUTRIENT INTERACTION ON THE PRODUCTIVITY, QUALITY AND NET RETURNS OF GUINEA GRASS (*Panicum maximum* J.)

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ABSTRACT

A study was conducted to assess the nutrient requirement of guinea grass (Panicum maximum J.) under open and shaded condition during 2003 to 2005 at College of Agriculture, Vellayani, Kerala under AICRP on Forage Crops. The experiment was laid out in split plot design with two main treatments of open and coconut tree shade and sub plot treatments of five nutrient levels viz. recommended dose of fertilizers (200: 50: 50 kg NPK/ha) 25, 50, 75 and 100 percent above the recommended dose. The results indicated that the yield of guinea grass is 7 to 25 percent higher in open compared to coconut tree shade while the crude protein content was always higher under shade. The treatment receiving the highest level of nutrients, viz 100 percent above the recommended dose recorded significantly higher green fodder yield, dry fodder yield, crude protein content and crude protein yield throughout the study. Under both light intensities, the highest level of nutrients contributed the highest yield and net returns. Hence it can be concluded that for obtaining high yield and net returns application of NPK fertilizers @ 100 percent above the recommended dose (400:100:100 kg/ha) is required in open conditions as well as under coconut tree shade.

KEY WORDS: Guinea grass, Panicum maximum, Light intensity, Shade, Nutrient, Fodder yield, Fodder quality, net returns.

I. INTRODUCTION

The non availability of good quality fodder and feed resources is a major limitation in the Indian livestock sector. In Kerala shortage in fodder production is mainly due to the very limited area available for fodder cultivation. A possible solution to this problem is to raise fodder as an intercrop in the coconut plantations. Studies conducted in coconut gardens indicate that coconut roots exploit only 20 to 25 percent of land area and depending upon the canopy coverage, multiple cropping can be adopted before the tenth year and from twentieth year of planting coconut. Guinea grass (*Panicum maximum* J.)

has been identified to be a very suitable intercrop for coconut gardens. But its fodder yield is highly varying under shade. Shading has both direct and indirect effects on forage production in that it can alter morphological development and yield. (Kephart and Buxton, 1996).Light intensity and nutrients are the major growth resources that determine productivity of silvopastoral ecosystems (Koukoura *et al*.,2009). In this context, the nutrient requirement of guinea grass was studied under open and shade for obtaining maximum productivity and quality.

II. MATERIALS AND METHODS

The study was conducted in the AICRP on Forage Crops , College of Agriculture, Vellayani during 2003 to 2005. Wet tropical climate prevailed in the experimental location. The soil was red sandy clay loam (oxisol, Vellayani series).The soil was low in available N and K_2O and medium in available P_2O_5 with an acidic p^H. The experiment was laid out in split plot design with three replications. The main plot treatments were two light intensities. viz. open (s_0) and coconut tree shade(s_1) and the sub plot treatments consisted of five nutrient levels viz.(i) recommended dose of NPK (RDF) (f1), (ii) 25% above the RDF (f2), (iii) 50% above the RDF (f3), (iv) 75% above the RDF (f4), (v) 100% above the RDF (f5). The recommended dose of fertilizer (RDF) is 200:50:50 kg NPK/ha. The variety used was Riversdale and FYM@ 10 t/ha was applied uniformly to all the plots as basal. Full dose of P and K were also applied as basal and half N was applied during June and the remaining half N in equal splits after each harvest. Coconut was given nutrients as per the recommended dose and this nutrient application schedule was repeated in all the three years for both guinea grass and coconut. The crop was raised under irrigated condition and the first cut was taken 75 days after planting and subsequent cuttings at 45 days interval.

III. RESULTS AND DISCUSSION

Influence of shade on growth characters, yield, quality and net returns Growth characters (Table 1, 2, 3)

The plant height was more under shade throughout the growth period. In open, the phytochrome pigment will be in the Pr form which prevents stem elongation and under shade it gets converted to Pfr form which enhances stem elongation and result in increased internodal length.

The results revealed that shade has a dominating influence on inhibition of tiller production. Production of auxins are more under shaded condition which results in strong apical growth preventing side shoot sprouting and further development.

Yield and quality (Table 4,5,6,7)

The green fodder yield was 16.5, 7.4 and 25.9 percent higher in open compared to shade in three years respectively. In general, the yield of forages is linearly related to the amount of light available and in a coconut plantation of 50 percent light transmission, the yield of a highly productive grass like *Panicum maximum* will be approximately 50 percent of the yield achieved in full sunlight (Reynolds,1995). The shade intensity in the present experimental field was 30 percent. Yield reduction in agro forestry systems due to reduction in solar radiation availability has been reported by Sato and Dalmacio, 1991 and Sharma et al., 1996. This finding justifies the fact that a warm season C4 plant continues the Co_2 uptake for photosynthesis at higher light levels closer to full sunlight and uses the high light intensity effectively (Gardener *et al*., 1985)

Compared to the open condition, there was a reduction of 15.3, 9.8 and 13.3 percent in dry fodder yield in shade for the respective years. In shade spongy tissues are developed in plants which may be responsible for lesser dry matter accumulation. Wong (1993) reported that shade depressed total dry matter production of two tropical fodder grasses, *Paspalum malacophyllum* and *Paspalum wettsteini*, the depression being proportional to the quantum of photo synthetically active radiation reduction.

The crude protein content increased significantly in shade, since it is highly responsive to shading than other quality parameters. Plants adapted to shade have lower nonstructural carbohydrate concentrations than those adapted to full sunlight (Kephart and Buxton, 1996). Increased concentration of nitrogenous compounds from shading is usually at the expense of soluble carbohydrates (Buxton, 2001).

Net returns (Table 8)

The net returns were Rs.4544, Rs.8685 and Rs.3105 higher in open compared to shade in the three years respectively due to higher yield under open condition.

Influence of nutrient levels on growth characters, yield, quality and net returns Growth characters (Table 1, 2, 3)

The growth characters like plant height, number of tillers and leaf stem ratio of the first two years were significantly higher in the treatment receiving 100 percent above RDF (f5). Enhanced nitrogen application might have resulted in increase in cell division and cell elongation (Tisdale.*et al*., 1995) resulting in longer plants and enhanced vegetative growth contributing to higher tiller production (Parihar and Agarwal,2002). Nitrogen also improved leaf stem ratio owing to enhanced production of leafy material compared to stem (Kothari and Saraf, 1987).

Increased availability of phosphorus would have encouraged root growth which in turn resulted in higher nutrient absorption which manifested in the growth characters. More over application of higher level of potash could have promoted growth of meristematic tissues resulting in increased plant height (Tisdale *et al*; 1995).

Yield and Quality (Table 4, 5, 6, 7)

The treatment receiving the highest level of nutrients (f5) recorded significantly higher green fodder yield, dry fodder yield, crude protein content and crude protein yield throughout the study. The increase in fodder yield and dry fodder yield can be due to the higher rate of nutrient application as reflected in the growth attributes viz, increased plant height, tiller number and L:S ratio (Agrawal *et al*.,2002; Meerabai *et al*., 1993). Potassium increased number of stomata and its apertures; net photosynthesis and efficiency of carbon dioxide assimilation and hence better potassium nourished plants grow vigorously (Jacob *et al*., 1973).

Since nitrogen and phosphorus are the chief constituents of protein, the application of these nutrients might have favored the increase in protein content (Singh et al.,2002) and consequently crude protein yield.

<u>Net returns</u> (Table 8)

The highest nutrient dose of 100 percent above the recommended dose (400:100:100kg NPK ha^{-1}) recorded significantly higher net returns of Rs.5471, Rs.15790 and Rs.6318 respectively over the recommended dose (f1) in the three years respectively.

Interaction effect of light intensity and nutrients Growth characters (Table 1, 2, 3)

The height of the plants increased with increasing levels of nutrients both under shade and open. But the results had significant variation only in the third year. In all the cases, the height of the plant was higher in shade compared to open at all the nutrient levels.

The number of tillers was higher in open compared to shade under all nutrient levels. However significant variation was noticed in second year only and s_0f_1 was on par with s_1f_5 which recorded the highest number of tiller (34.3) in shaded condition. Hence for increasing tiller production more nutrients is required under shade compared to open.

The leaf stem ratio also recorded significant variation in the second year of study only. Significantly higher leaf stem ratio was recorded by s_0f_5 (3.5) followed by S1f5 (3.0). This indicates that even if there is light intensity variation, leaf stem ratio is more related to nutrient availability which may be due to the higher nitrogen availability leading to more vegetative growth.

Yield and quality (Table 4, 5, 6, 7)

The green fodder yield recorded significant light intensity nutrient interaction in first and third years. In the first year, the highest yield of 710.7 q/ha was recorded by s_0f_5 which was on par with s_1f_5 (671.3 q/ha). In the third year, the highest yield was for s_0f_5 (980.2 q/ha) and s_1f_5 (796.9 q/ha) in open and shade respectively. S_1f_5 was on par with S_1f_4 (738.7 q/ha) and both of them were on par with S_0f_1 (735.9 q/ha). This indicates the necessity of increased nutrient requirement for guinea grass under shade.

The dry fodder yield also followed the same trend as that of green fodder yield. Significant interaction effect was noted in second year only. Highest yield was recorded by s_0f_5 (311.8 q/ha) while under shade also f5 recorded the higher yield of 251.4 q/ha which was on par with s_0f_3 (257.2 q/ha).

Crude protein content was not influenced by the interaction while crude protein yield was significantly higher in the second year (19.4 q/ha) for S_0f_5 which was followed by s_1f_5 (16.3 q/ha) suggesting the fact that crude protein yield is closely associated with the nutrient availability. Pandey et al.,2011 suggested that forage production under coconut palms can be increased by the application of N fertilizer with both guinea and para grass being more productive under high shade.

Net returns (Table 8)

The highest net returns of Rs.22383, Rs.39983 and Rs.34935 were recorded by S_0f_5 in the three years respectively, while under shade S_1f_5 recorded the highest net returns of Rs.20487, Rs.37810 and Rs.25772 respectively.

Bibliography

Agrawal, R.K, Sharma, K.C and Singh,K.K.2002. Effect of split application of nitrogen on productivity and nutritional traits of perennial grasses. In :Abstract of National Symposium on Grass land and Fodder Research in the New Millennium.(October30 – November1 2002) .Indian Grassland and Fodder Research Institute, Jhansi:116-117

Buxton,R.D.2001. *Growing Forages under variable environmental condition*. Research summaries. No.21.U.S Dairy Forage Research Centre, Iowa State University, Ames.p. 204. Gardener,F.P, Pearce,B.B and Mitchell, R.L.1985.*Physiol of crop plants*. Iowa State University Press, Ames,Iowa, USA p.262.

Jacob,B, Abas.S, and Steinniz,B-1973. Rubidium and potassium absorption of bean leaf slices compared to sodium absorption. *Physiologia plantarum*.28:209-214.

Kephart , K.D and Buxton, D.R 1996 . Non structural carbohydrates in cool and warm season perennial grasses adapted to shaded conditions. Research summaries.No.16.U.S.Dairy Forage Research Centre ,Iowa State University,Ames .p.162

Kothari , S.K and Saraf , C.S 1987 .N economy in fodder sorghum as affected by bacterial seed inoculation and P application in summer green gram . *Indian .J. Agron.* 32:117-120

Koukoura,Z.,Mamolos,A.P.,Kalburtji,K.L.2009. Decomposition of dominant plant species litter in a semi-arid grassland. *Applied Soil Ecology* 23, 13-23.

Meerabai, M., Lakshmi , S. and Pillai , G.R. 1993 P and K nutrition in guinea and congo signal grasses grown in coconut gardens . *J .Trop . Agric* . 31:181-183

Pandey,C.B.,Verma,S,K. and Srivastava,R.C.2011. Forage production and nitrogen nutrition in three grasses under coconut tree shades in the humid-tropics. *Agroforestry systems*. Vol 83,1: 1-12.

Parihar , S.S and Agarwal , P.2002. Effect of nitrogen on seed yielding components and seed quality of spear grass (*Heteropogon contortus*). In : Abstract of National Symposium on Grassland and Fodder Research in the New Millenium . (October 30- November 1, 2002). Indian Grassland and Fodder Research Institute , Jhansi. : 91-92

Reynolds , S.G 1995 . *Cattle production under coconuts* . FAO plant production and protection paper . No.91 FAO of United Nations , Rome , p.126.

Sato , A. and Dalmacio , R.V. 1991 .Maize production under an intercropping system with fast growing tree species , a case study in Philippines . *Japan Agrl. Res. Quarterly* , 24:319-326

Sharma , K.K , Khanna , P. and Gulati , A. 1996 . The growth and yield of wheat and paddy as influenced by *Dalbergia sissoo* Roxb. Boundary plantation . *Indian Forester* , 22:1114-1126

Singh, D., Singh , V and Joshi , Y.P . 2002 . Herbage yield and yield attributes of Napier Bajra Hybrid at different cuts as affected by cutting intervals and varying levels of nitrogen. *Forage Res* . 27: 267-271.

Tisdale , S.L., Nelson , W.L, Beaton , J.D. and Havlin , J.L 1995 . Soil Fertility and Fertilizers . Fifth edition , Prentice Hall of India (Pvt.) Ltd ., New Delhi , 735 p.

Wong , C.C 1993 . Strategies for sustainable production of tropical forages under shade . Res . Bull. No.11 , MARDI, Malaysia , p 143-153.

Table 1 : Effect of light intensity nutrient interaction on plant height (cm) of guinea grass

	2003			2004			2005		
	s0	s1	Mean	s0	s1	Mean	s0	s1	Mean
f1	110.7	129.8	118.2	120.8	124.3	122.5	71.0	77.2	74.1
f2	114.9	131.1	120.7	127.8	132.4	130.1	75.3	92.8	84.1
f3	119.7	131.7	124.3	132.9	138.9	135.9	82.3	95.9	89.1
f4	126.1	131.0	130.4	137.5	143.9	140.7	85.6	108.6	97.1
f5	126.0	134.6	135.5	145.1	155.8	150.4	95.1	121.6	108.3
Mean	119.5	132.2		132.8	139.0		81.8	99.2	
CD	Shade 9.4 Fertilizer 6.7 Interaction NS					NS 7.5 NS			8.6 5.9 8.4

Table 2: Effect of light intensity nutrient interaction on number of tillers /plant of guinea grass

	2003			2004			2005		
	s0	s1	Mean	s0	s1	Mean	s0	s1	Mean
f1	23.8	23.3	23.2	30.4	27.5	28.9	49.9	32.0	40.9
f2	25.9	25.5	25.6	40.4	26.5	33.4	61.0	42.1	51.5
f3	28.8	27.8	28.3	42.5	29.3	35.9	52.9	44.2	53.5
f4	30.0	31.2	30.6	46.7	31.6	39.2	76.8	47.9	62.3
f5	31.9	33.5	32.7	50.5	34.3	42.4	86.5	60.8	73.6
Mean	28.1	28.2		42.1	29.8		67.4	45.4	
CD	Shade NS Fertilizer 1.5 Interaction NS					5.4 4.4 6.3			5.2 4.4 NS

Table 3: Effect of light intensity nutrient interaction on L:S Ratio of guinea grass

	2003			2004			2005		
	s0	s1	Mean	s0	s1	Mean	s0	s1	Mean
f1	1.3	0.9	1.1	0.8	1.3	1.0	1.2	1.5	1.3
f2	1.7	1.7	1.7	1.3	1.8	1.6	1.2	1.8	1.5
f3	1.7	1.7	1.7	1.6	2.5	2.0	1.5	2.2	1.9
f4	1.9	2.0	1.9	2.1	2.5	2.3	2.1	2.0	2.1
f5	2.4	2.3	2.4	3.5	3.0	3.3	1.1	1.6	1.3
Mean	1.8	1.7		1.9	2.2		1.4	1.8	
CD	Shade NS Fertilizer 0.4 Interaction NS					NS 0.4 0.6			NS 0.3 NS

Table 4: Effect of light intensity nutrient interaction on green fodder yield (q/ha) of guinea grass

	2003			2004			2005		
	s0	s1	Mean	s0	s1	Mean	s0	s1	Mean
f1	566.1	454.0	510.0	770.7	672.9	721.8	735.9	647.0	691.4
f2	610.5	495.4	552.9	877.2	815.9	846.5	852.9	674.8	763.3
f3	646.6	518.7	582.6	955.2	866.9	911.1	927.4	660.9	794.2
f4	675.2	613.9	644.5	976.8	964.1	970.4	935.8	738.7	837.2
f5	710.7	671.3	691.0	1081.4	1020.0	1050.7	980.2	796.9	888.6
Mean	641.8	550.6		932.2	868.0		886.4	703.7	
CD	Shade		NS			30.6			36.5
	Fertilizer		32.7			32.7			46.9
	Interaction		46.2			NS			66.2

Table 5: Effect of light intensity nutrient interaction on dry fodder yield (q/ha) of guinea grass

	2003			2004			2005		
	s0	s1	Mean	s0	s1	Mean	s0	s1	Mean
f1	144.2	122.9	133.6	223.7	178.7	201.2	263.3	233.8	248.2
f2	157.3	142.2	149.7	235.3	236.0	235.7	271.5	243.4	257.4
f3	176.4	155.2	165.8	257.2	259.8	258.5	282.9	244.8	263.8
f4	185.5	160.1	172.8	262.4	249.9	256.2	287.1	257.0	272.0
f5	202.8	170.1	186.4	311.8	251.4	281.6	305.8	264.8	285.0
Mean	173.3	150.1		258.1	235.2		282.1	248.6	
CD	Shade		NS			7.0			4.9
	Fertilizer		11.6			8.9			5.3
	Interaction		NS			12.6			NS

Table 6: Effect of light intensity nutrient interaction on crude protein content (%) of guinea grass

	2003			2004			2005		
	s0	s1	Mean	s0	s1	Mean	s0	s1	Mean
f1	5.3	7.1	6.2	4.7	5.8	5.3	6.7	7.5	7.1
f2	5.6	7.1	6.3	5.4	5.9	5.6	7.4	7.9	7.7
f3	6.0	7.6	6.8	5.5	6.1	5.8	7.5	8.1	7.8
f4	6.2	8.0	7.1	5.7	6.1	5.9	7.7	8.1	7.6
f5	6.4	8.3	7.3	6.2	6.5	6.4	8.2	8.5	8.4
Mean	5.9	7.6		5.5	6.1		7.4	8.0	
CD	Shade		1.1			0.2			0.2
	Fertilizer		0.2			0.3			0.8
	Interaction		NS			NS			NS

Table 7: Effect of light intensity nutrient interaction on crude protein yield (q/ha) of guinea grass

	2003			2004			2005		
	s0	s1	Mean	s0	s1	Mean	s0	s1	Mean
f1	7.6	8.7	8.1	10.5	10.4	10.4	17.7	17.5	17.6
f2	8.7	10.1	9.4	12.6	13.9	13.2	19.4	19.3	19.3
f3	10.4	11.8	11.1	14.2	15.9	15.0	21.2	19.9	20.5
f4	11.5	12.8	12.1	14.9	15.3	15.1	20.6	20.6	20.6
f5	12.8	14.0	13.4	19.4	16.3	17.9	25.1	22.5	23.8
Mean	10.2	11.5		14.3	14.3		20.8	19.3	
CD	Shade 0.3 Fertilizer 0.8 Interaction NS					NS 0.7 1.0			NS 2.1 NS

Table 8: Effect of light intensity nutrient interaction on net returns (Rs./ha) of guinea grass

	2003			2004			2005		
	s0	s1	Mean	s0	s1	Mean	s0	s1	Mean
f1	18765	13162	15963	27993	23107	25550	26256	21813	24035
f2	20102	14345	17223	32436	29383	30906	28201	22317	25259
f3	21022	14625	17823	35451	31038	33245	34065	19987	27026
f4	21567	18502	20034	34647	34645	35146	33397	23742	28669
f5	22383	20487	21434	39983	37810	38897	34935	25772	30353
Mean	20768	16224		34302	31197		31411	22726	
CD	Shade NS Fertilizer 1645.3 Interaction 2326.8					1813.5 1798.7 NS			2343.9 3104.6 4390.5

