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RESEARCH ARTICLE

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Relative performance of grass, cowpea varieties and row ratios on growth, productivity and economics of fodder crops

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ABSTRACT : Field experiment was conducted at the Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram during January 2012 to March 2014 to find out the effect of grass-fodder cowpea mixtures and row ratio on the growth characters, yield and economics of fodder grasses and fodder cowpea in open and in partial shade. The investigation was conducted as two separate experiments, one in open and another in shaded situation (25-35 % shade). The experiment was laid out in RBD with three replications, comprising of two grasses [G_1-Hybrid napier (Suguna), G_2-Guinea grass (Harithasree)], two fodder cowpea varieties (V_1-COFC-8 (open and shade), V_2-UPC-622 (open), UPC-618 (shade) and three grass legume row ratios (R_1-1:1, R_2-1:2, R_3-1:3). The results indicated the superiority of the grass legume mixture of hybrid napier cv. SUGUNA and with both the fodder cowpea varieties in the grass legume row ratio of 1:2 with respect to growth characters, green fodder yield and net returns. Based on the results, it can be concluded that hybrid napier cv. SUGUNA intercropped with fodder cowpea varieties COFC-8 and UPC-622 in open condition and with COFC-8 and UPC-618 in partial shade (30 %) in the row ratio of 1:2 is the best for obtaining maximum yield, quality and net returns.

KEY WORDS : Grass, Cowpea varieties, Row ratios, Growth, Productivity, Fodder crops

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INTRODUCTION

In India, Kerala State has the highest percentage of cross bred animals with higher genetic potential for milk production. But the average yield of cow day^{-1} is only 7.508 kg milk and the total milk productions do not meet the requirement of the state. A weak feed and fodder base is a major factor hindering the full expression of the increased genetic potential created in the state. A serious drawback of sustainable livestock production system in Kerala is the inadequate seasonal distribution of fodder production. The quantity and quality of herbage available in the lean dry months from January to May is very low. Therefore, it is imperative to develop a fodder production

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system that increases the availability and improves the quality of herbage in the dry summer months.

Inclusion of fodder legumes in the fodder production system is the most efficient way to increase herbage production and quality (Mwangi *et al.*, 2005) and the most economic feed supplement than the commercial concentrates (Njarui *et al*., 2004). Legume in fodder grass production system would not only provide a nitrogen source to promote grass growth but enhance the quality of feed. Legumes benefit grasses by contributing Nitrogen is contributed to the soil through atmospheric fixation, decay of dead root nodules or mineralization of shed leaves. The inclusion of a legume in Napier grass based diet has shown to improve animal performance in terms of milk production because of their high nutrient contents (Muinga *et al*., 1992). Thus combining grasses with legumes capable of improving protein content of the overall ration clearly has nutritional and financial potential.

Development of compatible persistent grass legume mixtures could alleviate acute seasonal livestock feed deficiency in dry seasons. The major problem in grass fodder cowpea mixtures is the low legume plant density and shading of cowpea by grasses. To overcome this problem, cropping systems using optimum cowpea densities and different crop combinations are to be standardized. Perennial fodder grasses like hybrid napier and guinea grass are widely accepted by the dairy farmers all over Kerala as these grasses are well adapted to tropical conditions with potential for higher yields per unit area and shade tolerance. Grass legume mixtures yielded as much or more dry matter than grasses alone and showed better seasonal distribution of forage production than grasses alone and were superior to grasses in forage quality during summer (Posler *et al*., 1993).

The dairy homesteads of Kerala are mostly experiencing light stress of varying intensities. Poor adaptation of many improved fodder crops/ varieties in shade environment limits fodder production in homesteads and shade affects persistence, yield and quality of understory forages. Keeping this in view, the present study was taken up with the following objective of evaluating the performance of fodder cowpea in varying proportions of mixtures with hybrid napier and guinea grass which are the popular fodder grasses of Kerala, for improving the quantity, quality and economics of fodder production under open and shaded situations during the lean dry months.

EXPERIMENTAL METHODS

Field experiment was conducted at the Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram during January 2012 to March 2014 to find out the effect of grass-fodder cowpea mixtures and row ratio on the growth characters, yield and economics of fodder grasses and fodder cowpea in open and in partial shade. The investigation was conducted as two separate experiments, one in open and another in shaded situation (25-35 % shade). The experiment was laid out in RBD with three replications, comprising of two grasses [G_1-Hybrid napier (Suguna), G_2-Guinea grass (Harithasree)], two fodder cowpea varieties (V_1-COFC-8 (open and shade), V_2-UPC-622 (open), UPC-618 (shade) and three grass legume row ratios (R_1-1:1, R_2-1:2, R_3-1:3). FYM @ 12 t ha^{-1} was applied in the trenches taken for planting BN hybrid and guinea grasses. FYM @ 10 t ha^{-1} was applied in the rows taken for planting fodder cowpea and incorporated in the soil. For grasses, entire dose of P and K was given as basal each @ 50 kg ha^{-1}. N @ 200 kg ha^{-1} was given in two equal splits, first as basal and second one month after planting. For fodder cowpea, entire dose of P and K was given as basal each @ 30 kg ha^{-1}. N @ 40 kg ha^{-1} was given in two equal splits, first as basal and second one month after sowing. Three nodded stem cuttings of BN hybrid were planted in the channels @ 1 sett per hill, at a spacing of 60 cm x 60 cm. Slips of guinea grass were planted in the channels @ 2 slips per hill at a spacing of 60 cm x 30 cm. Seeds of fodder cowpea were sown @ 2 seeds per hole at a spacing of 30 cm x 15 cm in between the rows of fodder grasses as per the treatments. In 1:1 row ratio, 1 row of fodder cowpea was sown in the interspaces of fodder grasses. In 1:2 and 1:3 row ratios, 2 rows and 3 rows of fodder cowpea were sown in the interspaces, respectively. Harvest of both grasses and fodder cowpea were done separately for recording the growth characters like plant height, number of branches/number of tillers and leaf: stem ratio. The green fodder yield from the net plot area was recorded for six cuts in BN hybrid and seven cuts in guinea grass in the entire year and the total green fodder yield in t ha^{-1} was worked out for the entire year (for 1st year and 2nd year). In the case of fodder cowpea, a single harvest was done in summer season and the green fodder yield from the net plot area was recorded. The economics of cultivation was worked out based on cost of cultivation

and prevailing market price of the fodder.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads :

Growth characters:

The results revealed that grasses and grass-legume row ratio had significant impact on plant height and number of tillers of grasses in open. Hybrid Napier (Suguna) (G_1) recorded highest plant height (185.58 cm and 184.25 cm) in open in the first and second year, respectively. Hybrid napier (Suguna) (G_1) recorded significantly higher number of tillers plant^{-1} in open (32.00 and 31.11) in first year and second year, respectively. BN hybrid is a clump grass, with erect nature and superior in growth compared to guinea grass which is short statured, which explains the difference in plant height and tiller number between two grasses. Fodder cowpea varieties (V) had no significant influence on plant height and number of tillers of grasses. Among the row ratios, 1:3 (R_3) row ratio recorded significantly higher plant height (180.70 cm) in first and second year (179.55 cm) in open condition. The row ratio of 1:3 (R_3) recorded significantly higher number of tillers plant^{-1} in open (27.23 and 26.20) in first and second year, respectively (Table 1). Legumes are known to fix nitrogen directly which aid the growth of companion grasses. More N could have been fixed by 3 rows of leguminous crop. This observation agrees with the result of Tripathi and Psychas (1992) and Alalade *et al*. (2013) in guinea grass-stylosanthes mixture.

In partial shade, number of tillers plant^{-1} was significant in first year only and hybrid napier recorded significantly higher number of tillers (22.65) in the first year. Fodder cowpea varieties had no significant effect on number of tillers plant^{-1} of grasses. The row ratio of 1:3 (R_3) recorded significantly higher number of tillers plant^{-1} in shade (23.75 and 23.04) in first and second year, respectively. The interaction effects were non significant.

The number of branches plant^{-1} in fodder cowpea was significantly higher (1.87 and 1.85) in open when intercropped in between guinea grass (G_2) in first and second year. Among the varieties, COFC-8 (V_1) registered higher number of branches plant^{-1} in open (1.87 and 1.85) in both the years. This difference in plant height of cowpea varieties may be due to their varietal difference. Among the row ratio, 1:2 (R_2) recorded significantly higher number of branches plant^{-1} (2.08 and 2.06) in open in the first and second year, respectively. Spread for fodder cowpea was superior when grown with guinea grass than when grown with napier grass and consequently resulted in higher plot cover than with napier grass, an indication that guinea grass is less competitive than hybrid napier grass (Njarui *et al*., 2007). Among the fodder cowpea varieties, COFC-8 recorded higher plant height and number of branches compared to UPC-622 in open and UPC-618 in shade. This difference in plant height of cowpea varieties may be due to their varietal difference. The interaction effects were not significant.

The treatments had significant effect on the number of branches plant^{-1} in fodder cowpea in partial shade. Significantly higher number of branches plant^{-1} of 1.75 and 1.74 was recorded when intercropped in between guinea grass (G_2) in first and second year. Among the varieties, COFC-8 (V_1) registered higher number of branches plant^{-1} in shade (1.75 and 1.74) in both the years. Among the row ratio, 1:2 (R_2) recorded significantly higher number of branches plant^{-1} (1.96 and 1.95) in open in the first and second year, respectively. The interaction effects were not significant.

Yield parameters :

The results revealed that grasses and grass legume row ratio had significant impact on green fodder yield of grasses in open in both the years. Significantly higher green fodder yield was recorded by hybrid napier (G_1) in open (282.54 t ha^{-1} year^{-1} and 281.20 t ha^{-1} year^{-1}) in first and second year of experimentation (Table 2). Hybrid napier was superior in growth than guinea grass and this could attributed to difference in vigour during regrowth after cutting. Moreover, the stem of hybrid napier is thicker and is likely to store more carbohydrate reserves for growth than that of guinea grass and consequently survive better under reduced moisture than guinea grass. Similar results were reported by Njoka-Njiru (2006) in a grass-legume intercropping system. Fodder cowpea varieties had no significant effect on green fodder yield of grasses. Among the grass-legume row ratio, 1:3 (R_3) registered significantly higher green fodder yield of grasses in open (219.40 t ha^{-1} year^{-1}) in first and (218.15 t ha^{-1} year^{-1}) in

second year. This might be attributed to the growth behaviour and plant density of the legumes with respect to the grass. The increase in biomass yield was due to increase in leaf production, increased number of tillers and increased rate of leaf extension which stimulated the greater light capture and hence, photosynthesis and thus increased yield. This was in harmony with the report of Reynolds (1995) that inter planting of grass with legume at a more proportion transferred more nitrogen in legume grass mixture than the low proportion. Alalade *et al*. (2013) also observed similar results in *Panicum Stylosanthes* intercropping system. The improved growth in hybrid napier resulted to the development of a larger canopy at a row ratio of 1:3. Similar results were reported by Njarui *et al.* (2007) in grass legume mixture. Among the interaction effect, grass-row ratio interaction was significant in open condition and g_1r_3 (hybrid napier + 1:3 row ratio) recorded higher green fodder yield (284.66 t ha^{-1} year^{-1}) in grasses in first year and 283.45 t ha^{-1} year^{-1} in second year. Hybrid napier (G_1) recorded significantly higher dry fodder yield in open (84.74 t ha^{-1} year^{-1} and 84.67 t ha^{-1} year^{-1}) in the first and second years, respectively. Grass intercropped with fodder cowpea in the row ratio of 1:3 (R_3) recorded higher dry fodder yield in open (65.78 t ha^{-1} year^{-1} and 65.74 t ha^{-1} year^{-1}) in the first and second years, respectively.

The results revealed that grasses and grass legume row ratio had significant impact on green fodder yield of grasses in shade in both the years. Significantly higher green fodder yield was recorded by hybrid napier (G_1) in open (203.26 t ha^{-1} year^{-1} and 202.98 t ha^{-1} year^{-1}) in first and second year of experimentation. Fodder cowpea varieties had no significant effect on green fodder yield of grasses. Among the grass-legume row ratio, 1:3 (R_3) registered significantly higher green fodder yield of grasses in open (162.45 t ha^{-1} year^{-1}) in first and (162.06 t ha^{-1} year^{-1}) in second year. The interactions effects were not significant.

Hybrid napier (G_1) recorded significantly higher dry fodder yield in shade (61.91 t ha^{-1} year^{-1} and 60.90 t ha^{-1} year^{-1}) in the first and second years, respectively. Grass intercropped with fodder cowpea in the row ratio of 1:3 (R_3) recorded higher dry fodder yield in open (48.73 t ha^{-1} year^{-1} and 48.61 t ha^{-1} year^{-1}) in the first and second years, respectively. Interaction effects were non-significant.

The green fodder yield of fodder cowpea was the highest in open (5.37 t ha^{-1} and 5.28 t ha^{-1}) in the first and second year when it was intercropped in between guinea grass (G_2). Among the fodder cowpea varieties, COFC-8 (V_1) recorded higher green fodder yield in open (5.14 t ha^{-1} and 5.08 t ha^{-1}) in the first and second year. Higher

Table 1 : Number of tillers / branches of grass and cowpea as influenced by grass, cowpea varieties and row ratios of grass- legume mixture

Treatments	Grass				Cowpea			
	Open		Shade		Open		Shade	
	I Year	II Year	I Year	II Year	I Year	II Year	I Year	II Year
Grasses (G)								
G_1-Hybrid napier	32.00	31.11	22.65	21.69	1.84	1.82	1.72	1.71
G_2-Guinea grass	19.90	18.72	21.83	21.33	1.87	1.85	1.75	1.74
S.E. ±	0.001	0.164	0.152	0.160	0.002	0.002	0.001	0.001
C.D. (P=0.05)	0.312	0.340	0.316	NS	0.006	0.006	0.003	0.002
Fodder cowpea varieties (V)								
V_1 - COFC-8	26.00	25.18	22.23	21.53	1.87	1.85	1.75	1.74
V_2 - UPC-622	25.90	24.65			1.84	1.82		
V_2- UPC-618			22.25	21.48			1.72	1.71
S.E. ±	0.001	0.164	0.152	0.160	0.002	0.002	0.001	0.001
C.D. (P=0.05)	NS	NS	NS	NS	0.006	0.006	0.003	0.002
Grass-legume row ratio (R)								
R_1 - (1:1)	24.20	23.19	19.94	19.18	1.72	1.70	1.60	1.59
R_2 - (1:2)	26.38	25.41	23.04	22.30	2.08	2.06	1.96	1.95
R_3 - (1:3)	27.23	26.20	23.75	23.04	1.77	1.75	1.65	1.64
S.E. ±	0.002	0.201	0.187	0.196	0.003	0.003	0.001	0.001
C.D. (P=0.05)	0.382	0.317	0.387	0.406	0.007	0.007	0.003	0.002

NS=Non-significant

green fodder yield produced by this variety could be primarily due to the difference in growth behaviour such as more plant height, more number of branches etc., which is genetically controlled. Considerable variations in yield characters were reported by Njarui and Wandera (2004) in seca and siratro. Among the row ratios, 1:2 (R_2) recorded significantly higher green fodder yield in open (5.91 t ha^{-1} and 5.94 t ha^{-1}) in first and second year. Legumes planted in double rows between grasses maintained higher plant numbers than in single rows indicating that double rows may give superior legume persistence in fodder grasses. This could be attributed to more space available for growth and less competition for nutrients (Njarui *et al*., 2007). The reverse trend seen in 1:3 grass legume row ratio might be due to higher population of legumes resulting in higher competition for light and soil resources than the grass (Baba *et al.*, 2011). Grass- row ratio interaction was significant in open condition. Significantly higher green fodder yield was registered by g_2r_2 (fodder cowpea intercropped in between guinea grass with a row ratio of 1:2) (6.01 t ha^{-1}) in first year and 6.08 t ha^{-1} in second year. V x R interaction was also significant in open condition in both the years. Significantly higher green fodder yield of fodder cowpea was recorded when fodder cowpea cv. COFC-8 was intercropped in between grasses at a row ratio of 1:2 (v_1r_2) in open condition (6.18 t ha^{-1} and 6.15 t ha^{-1} in first and second years). G x V x R interaction effect was significant in open condition in both the years. Guinea grass intercropped with fodder cowpea cv. COFC-8 at a row ratio of 1:2 ($g_2v_1r_2$) recorded higher green fodder yield of 6.35 t ha^{-1} and 6.21 t ha^{-1} in first and second years, respectively. Fodder cowpea intercropped between guinea grass (G_2) recorded significantly higher dry fodder yield in open in both the years (1.02 t ha^{-1} year^{-1} and 0.91 t ha^{-1} year^{-1}). Fodder cowpea varieties varied significantly on dry fodder yield in open condition. COFC-8 (V_1) recorded higher dry fodder yield of 0.98 t ha^{-1} year^{-1} in first year and 0.88 t ha^{-1} year^{-1} in second year. Among the row ratios, fodder cowpea recorded significantly higher dry fodder yield in open when it was intercropped with grass at a row ratio of 1:2 (R_2) in both the years (1.12 t ha^{-1} year^{-1} in first and 1.01 t ha^{-1} year^{-1} in the second year). The interaction effects were not significant.

In partial shade, grasses and fodder cowpea varieties had significant influence on green fodder yield of fodder cowpea only in the first year. During first year, significantly higher green fodder yield (3.85 t ha^{-1}) was recorded when it was intercropped in between guinea grass (G_2). Among the fodder cowpea varieties, COFC-8 recorded higher green fodder yield of 3.70 t ha^{-1} in the first year. Among

Table 2 : Green fodder yield of grass and cowpea as influenced by grass, cowpea varieties and row ratios of grass-legume mixture, t ha^{-1} year^{-1}

Treatments	Grass				Cowpea				Total			
	Open		Shade		Open		Shade		Open		Shade	
	I Year	II Year	I Year	II Year	I Year	II Year	I Year	II Year	I Year	II Year	I Year	II Year
Grasses (G)												
G1-Hybrid napier	282.54	281.20	203.26	202.98	4.66	4.64	3.39	3.40	287.21	285.84	206.65	206.39
G2-Guinea grass	152.39	151.12	118.12	117.66	5.37	5.28	3.85	3.87	157.77	156.40	121.99	121.53
S.E. ±	0.031	0.036	0.053	0.020	0.012	0.001	0.010	0.221	0.034	0.037	0.056	0.022
C.D. (P=0.05)	0.074	0.065	0.111	0.041	0.026	0.004	0.021	NS	0.077	0.071	0.117	0.046
Fodder cowpea varieties (V)												
V1-COFC-8	217.49	216.18	160.69	160.33	5.14	5.08	3.70	3.70	222.63	222.26	164.40	164.03
V2-UPC-622	217.45	216.14	160.68		4.90	4.83			222.35	220.97	164.23	
V2-UPC-618				160.32			3.54	3.57				163.90
S.E. ±	0.031	0.036	0.053	0.020	0.012	0.001	0.010	0.221	0.034	0.037	0.056	0.022
C.D. (P=0.05)	NS	NS	NS	NS	0.026	0.004	0.021	NS	NS	NS	NS	NS
Grass-legume row ratio (R)												
R_1 - (1:1)	214.78	213.45	158.32	157.93	4.33	4.27	3.09	3.06	219.11	217.72	161.45	160.99
R_2 - (1:2)	218.22	216.90	161.29	160.99	5.91	5.94	4.45	4.47	224.13	222.84	165.74	165.47
R_3 - (1:3)	219.40	218.15	162.45	162.06	4.82	4.75	3.31	3.37	224.23	222.80	165.77	165.44
S.E. ±	0.038	0.044	0.065	0.024	0.015	0.002	0.012	0.271	0.042	0.045	0.069	0.027
C.D. (P=0.05)	0.091	0.080	0.136	0.051	0.032	0.004	0.026	0.563	0.095	0.088	0.144	0.057

NS=Non-significant

the row ratios, 1:2 (R_2) recorded significantly higher green fodder yield in open (4.45 t ha^{-1} and 4.47 t ha^{-1}) in first and second years. In partial shade, fodder cowpea intercropped between guinea grass (G_2) recorded significantly higher dry fodder yield in both the years (0.73 t ha^{-1} $year^{-1}$ and 0.73 t ha^{-1} $year^{-1}$). Fodder cowpea varieties had no significant influence on dry fodder yield in partial shade. Among the row ratios, fodder cowpea recorded significantly higher dry fodder yield in open when it was intercropped with grass at a row ratio of 1:2 (R_2) in both the years (0.84 t ha^{-1} $year^{-1}$ in first and 0.85 t ha^{-1} $year^{-1}$ in the second year). The interaction effects were not significant.

Economics analysis :

Net income and BCR :

The results summarized in Table 3 revealed that grasses, fodder cowpea varieties and row ratio had significant impact on net income of fodder crops both in open and shaded conditions in two years. Hybrid napier cv. SUGUNA (G_1) recorded significantly higher net income in open in both the year (Rs. 204853 in the first year and Rs. 204594 in the second year). This is mainly due to the higher green fodder and dry fodder yields realized from this grass. Among the grass legume row ratio, 1:2 (R_2) recorded significantly higher net income in open in both the year (Rs. 152593 in the first year and Rs. 152647 in the second year) which is also due to the high green fodder yield produced at this row ratio. Grass row ratio interaction was significant in open condition in the second year of experimentation. Fodder cowpea intercropped with guinea grass cv. HARITHASREE at 1:2 row ratio (g_1r_2) recorded significantly higher net income (Rs. 2,09,010) in open in the second year.

Hybrid napier cv. SUGUNA (G_1) recorded significantly higher net income in shade in both the year (Rs. 134987 in the first year and Rs. 134560 in the second year). Among the fodder cowpea varieties, COFC-8 (V_1) recorded significantly higher net income (Rs. 98419) under partial shade in the first year. Among the grass legume row ratio, 1:2 (R_2) recorded significantly higher net income in shade in both the year (Rs. 100890 in the first year and Rs. 100698 in the second year). Grass row ratio interaction was significant in partial shade in the second year of experimentation. Fodder cowpea intercropped with guinea grass cv. HARITHASREE at 1:2 row ratio (g_1r_2) recorded significantly higher net income (Rs. 138850) in shade in the first year.

The results also revealed that grasses, fodder cowpea varieties and row ratio had significant impact on BCR of fodder crops in open and shade. Hybrid napier cv. SUGUNA (G_1) recorded significantly higher BCR in open in both the year (3.24 in first year and 3.23 in second year). Grass-legume row ratio of 1:2 (R_2) recorded significantly higher BCR in open in both the year (2.79). Grass row ratio interaction was significant in the first year under open. Fodder cowpea intercropped with guinea grass cv. HARITHASREE at 1:2 row ratio (g_1r_2) recorded

Table 3 : Net income and BCR of grass and cowpea as influenced by grass, cowpea varieties and row ratios of grass-legume mixture

Treatments	Net income (Rs ha^{-1})				BCR			
	Open		Shade		Open		Shade	
	I Year	II Year	I Year	II Year	I Year	II Year	I Year	II Year
Grasses(G)								
G_1-Hybrid napier	204853	204594	134987	134560	3.24	3.23	2.72	2.72
G_2-Guinea grass	93617	93048	61310	60910	2.25	2.24	1.97	1.89
S.E. ±	265.24	50.06	61.94	209.49	0.003	0.002	0.001	0.99
Fodder cowpea varieties (V)								
V_1-COFC-8	149744	149216	98419	97853	2.75	2.74	2.34	2.30
V_2-UPC-622	148726	148427			2.74	2.73		
V_2-UPC-618			97878	97618			2.33	2.30
S.E. ±	265.24	50.06	61.94	209.49	0.003	0.002	0.001	0.99
Grass-legume row ratio(R)								
R_1 - (1:1)	146268	145419	96900	94823	2.73	2.72	2.33	2.30
R_2 - (1:2)	152593	152647	100890	100698	2.79	2.79	2.36	2.34
R_3 - (1:3)	148843	148397	97900	97685	2.71	2.70	2.30	2.27
S.E. ±	324.85	61.31	75.86	256.58	0.004	0.003	0.002	1.21

higher BCR (3.28) in open in the second year.

In partial shade, hybrid napier cv. SUGUNA (G_1) recorded significantly higher BCR in both the year (2.72). Grass-legume row ratio of 1:2 (R_2) recorded significantly higher BCR in shade in both the year (2.36 in first year and 2.34 in second year). Grass row ratio interaction was significant in both the year. Fodder cowpea intercropped with guinea grass cv. HARITHASREE at 1:2 row ratio (g_1r_2) recorded higher BCR (2.78) in the first year and second year. Hybrid napier grass intercropped with fodder cowpea at 1:2 row ratio recorded higher BCR due to the higher fodder yield produced at this row proportion. G x V x R interaction were not significant.

Conclusion :

The results indicated the superiority of the grass legume mixture of hybrid napier cv. SUGUNA and with both the fodder cowpea varieties in the grass legume row ratio of 1:2 with respect to growth characters, green fodder yield and net returns. Based on the results, it can be concluded that hybrid napier cv. SUGUNA intercropped with fodder cowpea varieties COFC-8 and UPC-622 in open condition and with COFC-8 and UPC-618 in partial shade (30 %) in the row ratio of 1:2 is the best for obtaining maximum yield, quality and net returns.

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