Forage Res., **47** (1) : pp. 105-112 (2021) **http://forageresearch.in**

GROWTH AND YIELD PERFORMANCE OF HYBRID NAPIER AND FODDER COWPEA INTERCROPPING UNDER DIFFERENT PLANTING PATTERNS

SUSHMA H. A.[1], DINESH KUMAR M.[1], VENKATESHA, M. M.*[,2] AND ASHOK MADAPURADA[3]

[1]Department of Agronomy, Agricultural College,
University of Agricultural and Horticultural Sciences, Shivamogga (Karnataka), India
[2]Dept of LFC, Veterinary College, Shivamogga (Karnataka), India
[3]Krishi Vigyan Kendra, UAHS, Shivamogga (Karnataka), India
(e-mail : venka5033@gmail.com)

(Received : 11 June 2021; Accepted : 29 June 2021)

SUMMARY

Field experiment was conducted during *kharif* season of 2019 at Department of Livestock Farm Complex, Veterinary College, Shivamogga. The experiment was laid out in a randomized complete block design with thirteen treatments having three replications. During the experiment, three hybrid napier cultivars, *i.e.,* Dharwad Hybrid Napier-6, CO-5 and Taiwan Super Napier-1 & three fodder cowpea genotypes, *i.e*., Cowpea local, MFC-09-1 and MFC-08-14 were used. Fodder cowpea genotypes were tested as an intercrop in different hybrid napier cultivars under normal spacing and paired row. Combinations of hybrid napier cultivar Taiwan Super Napier-1 with fodder cowpea improved genotypes (MFC-08-14 and MFC-09-1) in paired row performed better and found significantly superior over cultivar Dharwad Hybrid Napier-6 with different genotypes of fodder cowpea. The combination registered higher plant height (373 cm), number of tillers/plant (73.67) and number of leaves/plant (434.67), green fodder yield (321.21 t/ha), dry fodder yield (66.09 t/ha) and per plant yield (17.35 kg). This was closely followed by hybrid napier cultivar CO-5 with fodder cowpea improved genotypes. Different genotypes of fodder cowpea did not differ in green and dry fodder yields but normal planting resulted maximum tonnage of green and dry fodder (7-8 and around 1.5 t/ha, respectively) compared to paired row system (5-6 and around 1.0 t/ha) due to difference in population.

Key words : Fodder cowpea, Green fodder yield, Dry fodder yield, Intercropping

Hybrid napier (*Pennisetum purpureum* L. Schumach) is an inter specific hybrid between bajra and napier grass, which combines high quality and faster growth of bajra with the deep root system and multicilient habit of napier grass. Apart from high herbage yield capacity, it possesses low oxalic acid content with wider adaptability for varying climatic conditions and moderate resistance to insect-pest and diseases (Faruqui *et al.,* 2009). Commonly referred as elephant grass, it is popular among small-scale dairy farmers in both high and medium potential dairy production areas of Karnataka under the cut and carry system of production.To increase the quality aspect of feed for cattle, intercropping of napier grass with appropriate legumes is essential for providing nutritional security without loss in herbage yield. Plasticity of these plants to row spacing provides an opportunity for inclusion of intercrop hence become compatible by reducing competition. The highest yield advantage and complementary effects occur when the component crops have different growth habits, which show less competition for the resources in the system, including the use of local environment (Mahapatra, 2011). Further, criteria for selecting forage legumes include high protein content without antagonistic interaction and should produce maximum yield at the same harvest time. Anantawiroon *et al*. (2006) found that compared to sole crops intercropping of grass: legume with a 1:1 yielded higher fodder yield. From time to time, several cultivars were released from different centers that are tolerant of low temperature in the *winter* and high temperature in the *summer*, high nutritional quality, suitability for intercropping, suitability for growth on problem soil *etc.*, For any researcher, it is a mandate to evaluate these different cultivars for the said features in different locations and make valid recommendations to the farmers. On these lines, the feasibility of intercropping different fodder cowpea genotypes with hybrid napier cultivars for higher fodder biomass with nutritive value was studied.

MATERIALS AND METHODS

The study was conducted during *kharif*, 2019 at Veterinary College, Shivamogga (13° 96′N to 14° 27′N Lat and 75° 53′E to 76° 43′E Long) with an altitude of 625 m above the mean sea level situated in southern transition zone (STZ) of Karnataka. The soil of the experimental site is sandy clay, moderately acidic in reaction (5.82), low in nitrogen and potassium (208.68 and 102.45 kg/ha, respectively), but medium in concern to phosphorous (22.64 kg/ha) status. Experiment includes three hybrid napier cultivars *i.e.* Dharwad Hybrid Napier-6, CO-5 and Taiwan Super Napier-1 & three fodder cowpea genotypes, *i.e.*, Cowpea local, MFC-09-1 and MFC-08-14. The main crop hybrid napier was transplanted along with their root slips during First fortnight of July and spaced at 90X60 cm for normal spacing and 60/120X60 cm for paired row planting. Whereas, fodder cowpea intercrop was sown during August 2nd fortnight during first time and subsequently followed by each harvest so as to get the harvest of intercrop together with main crop. The experiment was laid out in Randomized Block Design with three replications. The following are the details of treatments T_1-Sole crop of Dharwad Hybrid Napier-6 with normal spacing, T_2- Sole crop of CO-5 with normal spacing, T_3- Sole crop of Taiwan Super Napier-1 with normal spacing, T_4-Intercrop of Dharwad Hybrid Napier-6 with cowpea local with normal spacing, T_5: Intercrop of CO-5 with MFC-09-1 with normal spacing, T_6: Intercrop of CO-5 with MFC-08-14 with normal spacing, T_7: Intercrop of Taiwan Super Napier-1 with MFC-09-1 with normal spacing, T_8: Intercrop of Taiwan Super Napier-1 with MFC-08-14 with normal spacing, T_9: Intercrop of Dharwad Hybrid Napier-6 with Cowpea local in paired rows, T_{10}: Intercrop of CO-5 with MFC-09-1 in paired rows, T_{11}: Intercrop of CO-5 with MFC-08-14 in paired rows, T_{12}: Intercrop of Taiwan Super Napier-1 with MFC-09-1 in paired rows and T_{13}: Intercrop of Taiwan Super Napier-1 with MFC-08-14 in paired rows. Here sole crop of hybrid napier cultivars were related with intercrop of cowpea under normal spacing (90X60 cm for hybrid napier and 30X10 cm for fodder cowpea) and in paired row system (60/120x60 cm for hybrid napier and 30X10 cm for fodder cowpea). In normal planting ten rows of main crop accommodated eighteen rows of intercrop while paired row accommodated twelve rows of intercrop, thereby population varied for fodder cowpea. A common dose of farm yard manure @ 20 t/ha was applied three weeks before transplanting uniformly to all the plots. The recommended dose of fertilizers (180:120:80 kg/ha NPK) was applied commonly to all the plots, wherein the entire P&K was applied as basal dose, N is equally split into five times (one basal dose for first crop and four splits after each harvest). The sources of nutrients applied were in the form of urea (46 % N), Di Ammonium Phosphate (18 % N, 46% P_2O_5) and complex formation of 17 all. The first irrigation was applied immediately after planting and thereafter irrigation was given at an interval of 15 days depending upon the climatic conditions. The first cutting was taken at 90 days after transplanting (DAT) and subsequent cuttings at an interval of 45 days. During first year (2019-2020) five cuts were taken. The growth and yield observations were recorded from the net plots. Green and dry fodder yield of various treatments were converted on hectare basis in tonnage.

RESULTS AND DISCUSSION

Main crop

Data indicated significant variation for plant height, number of tillers/plant and number of leaves/plant for the cultivars of hybrid napier. Plant height (Table 1) and number of leaves (Table 2) of the different cultivars of hybrid napier in test increased with advance in growth of the crop from first to fifth harvest. Plant height did not differ significantly during first cut whereas during the subsequent cuts (second to fifth) it remained significant while number of leaves influenced statistically due to different treatments. It is seen from the data that three cultivars tested did not show any statistical significance when grown in pure stand without any intercrop. In that, cultivar Taiwan Super Napier-1 performed numerically better than cultivars Dharwad Hybrid Napier-6 and CO-5 which together recorded same tallness with number of leaves. The development and increase in number of leaves along with talllness is a natural phenomenon of growth and consolidate the autotrophic nature of the plants. The extraneous factors and management aspects play a dominant role for its expressivity. However, among intercrop treatments, intercrop with paired row treatments recorded maximum plant height (281.10, 329.33, 365.90 and 373.00 cm at second, third, fourth and fifth cuttings, respectively) and number of leaves plant^{-1}(309.73, 387.33, 416.67, 429.67 and 434.67 from first cut to fifth cut, respectively) in Taiwan Super Napier-1 cultivar with fodder cowpea genotype

TABLE 1
Plant height (cm) of Hybrid Napier and fodder cowpea as influenced by different planting patterns

Treatments	Hybrid Napier						Cowpea				
	1st cut	2nd cut	3rd cut	4th cut	5th cut	Mean	1st cut	2nd cut	3rd cut	4th cut	Mean
T_1	182.48	190.32	201.49	212.20	225.40	202.38	-	-	-	-	-
T_2	182.71	192.55	203.31	221.73	239.13	207.89	-	-	-	-	-
T_3	199.13	207.37	230.63	235.91	250.43	224.69	-	-	-	-	-
T_4	207.10	227.57	247.90	264.67	269.67	243.38	40.32	41.32	42.98	41.95	41.64
T_5	209.28	229.23	255.67	276.27	281.63	250.42	41.27	41.90	43.00	42.40	42.14
T_6	209.58	230.55	256.04	271.07	277.63	248.97	42.08	42.78	43.18	43.04	42.77
T_7	212.77	251.44	285.80	292.67	302.37	269.01	42.37	43.21	44.08	43.64	43.33
T_8	216.40	251.47	295.35	308.07	315.03	277.26	42.44	43.31	45.61	43.13	43.62
T_9	203.18	262.81	296.20	339.70	346.97	289.77	43.40	44.60	46.57	44.47	44.76
T_{10}	205.42	271.08	309.67	344.90	351.80	296.57	43.67	45.33	46.77	45.17	45.24
T_{11}	207.15	277.00	319.60	356.23	363.73	304.74	43.95	45.47	47.77	45.87	45.77
T_{12}	223.47	279.20	322.08	364.07	372.87	312.34	45.19	46.85	48.19	46.88	46.78
T_{13}	219.30	281.10	329.33	365.90	373.00	313.73	45.67	47.67	48.73	47.90	47.49
S.Em ±	10.72	12.78	12.94	14.43	14.40		2.29	2.09	2.28	2.06	
CD at 5%	NS	37.31	37.79	42.13	42.03		NS	NS	NS	NS	

TABLE 2
Number of leaves/plant of Hybrid Napier and fodder cowpea as influenced by different planting patterns

Treatments	Hybrid Napier						Cowpea				
	1st cut	2nd cut	3rd cut	4th cut	5th cut	Mean	1st cut	2nd cut	3rd cut	4th cut	Mean
T_1	217.67	234.60	254.73	265.80	270.80	248.72	-	-	-	-	-
T_2	219.00	239.60	264.93	275.40	280.40	255.87	-	-	-	-	-
T_3	224.33	268.67	291.10	306.83	311.83	280.55	-	-	-	-	-
T_4	239.67	275.67	314.87	345.27	350.27	305.15	16.26	16.62	16.78	16.44	16.53
T_5	242.00	288.40	327.53	351.67	356.67	313.25	16.36	16.65	16.78	16.55	16.59
T_6	244.70	290.40	330.50	359.67	364.67	317.99	16.49	16.78	16.95	16.67	16.72
T_7	266.33	328.03	376.33	378.17	383.17	346.41	16.59	16.92	17.10	16.79	16.85
T_8	278.67	352.33	378.67	395.67	400.67	361.20	16.62	17.00	17.18	17.10	16.98
T_9	280.10	360.70	382.67	397.67	402.67	364.76	17.38	17.65	17.81	17.18	17.51
T_{10}	290.43	366.70	389.30	404.33	409.33	372.02	17.40	17.77	17.93	17.28	17.60
T_{11}	294.67	368.23	392.87	415.33	420.33	378.29	17.60	17.90	18.07	17.37	17.74
T_{12}	308.07	386.33	410.40	426.67	431.67	392.63	17.68	17.98	18.12	18.03	17.95
T_{13}	309.73	387.33	416.67	429.67	434.67	395.61	17.71	18.00	18.20	18.10	18.00
S.Em ±	13.40	16.08	16.08	18.32	20.47		0.80	0.81	0.81	0.51	
CD at 5%	39.11	46.95	46.95	53.49	59.75		NS	NS	NS	NS	

Treatment details for Table 1 and 2 :

T_1 : DHN-6 (90X60 cm)
T_2 : CO-5 (90X60 cm)
T_3 : Taiwan Super Napier-1 (TSN-1) (90X60 cm)
T_4 : DHN-6 with cowpea local (90X60 cm and 30X10 cm)
T_5 : CO-5 with MFC-09-1 (90X60 cm and 30X10 cm)
T_6 : CO-5 with MFC-08-14 (90X60 cm and 30X10 cm)
T_7 : TSN-1 with MFC-09-1 (90X60 cm and 30X10 cm)
T_8 : TSN-1 with MFC-08-14 (90X60 cm and 30X10 cm)
T_9 : DHN-6 with Cowpea local (60/120 cmX60 cm and 30X10 cm)
T_{10} : CO-5 with MFC-09-1 (60/120 cmX60 cm and 30X10 cm)
T_{11} : CO-5 with MFC-08-14 (60/120 cmX60 cm and 30X10 cm)
T_{12} : TSN-1 with MFC-09-1 (60/120 cmX60 cm and 30X10 cm)
T_{13} : TSN-1 with MFC-08-14 (60/120 cmX60 cm and 30X10cm)

MFC-08-14 closely followed by CO-5 hybrid napier with fodder cowpea improved genotypes. Lowest plant height (262.81, 296.20, 339.70 and 346.97 cm at second, third, fourth and fifth cuttings, respectively) and number of leaves (280.10, 360.70, 382.67, 397.67 and 402.67 from first cut to fifth cut, respectively) was recorded in cultivar Dharwad Hybrid Napier-6 with fodder cowpea genotype Cowpea local. Among all the treatments tested, at any given point of time intercropping of Taiwan Super Napier-1 and CO-5 cultivars in paired rows with improved genotypes of fodder cowpea recorded highest of these parameters.

Plant growth basically being a varietal character, is also genetic that can be considerably modified by the environment and practices followed. Intercrops showed statistical improvement in tallness, wherein cultivar Taiwan Super Napier-1 improved from 250 to 300 cm plus in regular planting and 350 cm plus with paired row. On the similar lines, both cultivars Dharwad Hybrid Napier-6 and CO-5 also marked significance by achieving almost 50 (regular planting) and 100 (paired row planting) cm plus with intercrop of fodder cowpea genotypes. Intercropping with normal planting and paired row evidenced almost 20 and 45 per cent enhancement in number of leaves. Legumes being spreading in growth habit cover the entire interspaces and later compete with main crop for solar radiation and other resources which also results in the increased height of the hybrid napier (Paneerselvam, 1986). Availability of more space between paired rows of hybrid napier also contributed to this effect due to less competition for moisture, nutrients, light and space. Gardner *et al.* (1985) reported that leaf number and size are affected by genotype and environment. The results of the present study confirm the results of Nilanthi *et al.* (2004) in hybrid napier.

Among agronomic traits, tillering ability is considered as most important. The number of tillers plant^{-1} increased as the growth advanced after planting and seen positive trend after each cut. There was a significant effect on tiller production by adopted treatments throughout the growth period (Table 3). On the similar lines of plant height, tillers plant^{-1} obtained from three cultivars when grown without any intercrop produced moderate tillers (22-30 from first to second cut) and with each cut ability of tllering progressively enhanced. With each cut numerically higher number of tillers was recorded by cultivar Taiwan Super Napier-1 compared to other cultivars in test and from fourth cut onwards it turned significant. Intercropping with paired row planting produced significantly more tillers (36.33, 44.67, 54.67, 66.67 and 73.67 first cut to fifth cut, respectively) in cultivar Taiwan Super Napier-1 with fodder cowpea genotype MFC-08-14 and lower tiller numbers were counted (32.00, 39.33, 47.67, 59.67 and 68.00 from first cut to fifth cut, respectively) in cultivar Dharwad Hybrid Napier-6 with fodder cowpea genotype Cowpea local. Among all the treatments, intercropping of Taiwan Super Napier-1 and CO-5 cultivars in paired rows with different improved genotypes of fodder cowpea recorded highest tillers with advance in growth. In fact, the behavior and control of tillering has proven to be multi-factorial and very complex. Tillering number usually controlled by genetic factors, hormonal influence, intensities and quality of light, maximum and minimum temperature, a favorable rhizosphere environment for various resources including minerals, content of minerals and their proportion in roots and basal stem parts *etc.* (Gardner *et al.* 1985). The tillering production remained largely higher with intercrop combination of treatments, in that regular planting achieved ten and paired row recorded as many as twenty more tillers by different cultivars. The study is supported by Dhillon and Panwar (1979) indicated that cowpea as a legume contributes nutrients to the soil which in turn efficiently used by hybrid napier. The wider space between paired rows allowed taking full advantage of light and plant nutrients, resulting in the production of more number of tillers. The results obtained was in accordance with the findings of Veeraraghaviah *et al.* (1979).

The data on different yield aspects viz., per plant yield, green fodder yield and dry fodder yield were recorded at different harvests as influenced by intercropping and different planting patterns adopted.The measure of per plant yield is said to be a reality indicator as the individual plants are subjected to all kinds of luxury, stress *etc*., during growth period which receives direct environmental impact. Crops grown for fodder value need due consideration for its healthy vegetation till harvest. It is reiterated from the research results that per plant yield was significantly affected by different cultivars and planting patterns adopted (Table 4). Among the cultivars in pure stand, in each cut cultivar Taiwan Super Napier -1 recorded marginally higher yield compared to other cultivars in test totaling 13.35 kg/ha closely followed by cultivars CO-5 (12.55 kg/ha) and Dharwad Hybrid Napier-6 (12.34 kg/ha). Compared to solid stand, intercropping

TABLE 3
Number of tillers/plant Hybrid Napier and number of branches of fodder cowpea as influenced by different planting patterns

Treatments	Hybrid Napier						Cowpea				
	1st cut	2nd cut	3rd cut	4th cut	5th cut	Mean	1st cut	2nd cut	3rd cut	4th cut	Mean
T_1	22.67	25.33	29.33	36.00	41.33	30.93	-	-	-	-	-
T_2	23.33	27.33	32.33	40.00	46.67	33.93	-	-	-	-	-
T_3	24.00	30.00	35.67	45.33	49.67	36.93	-	-	-	-	-
T_4	26.20	30.67	36.33	46.67	50.33	38.04	3.17	5.53	6.23	6.37	5.33
T_5	28.67	33.33	39.33	48.67	56.67	41.33	3.27	5.93	6.40	6.53	5.53
T_6	29.33	34.00	40.00	51.00	62.33	43.33	3.37	6.40	6.53	6.67	5.74
T_7	31.33	39.00	42.67	56.33	65.00	46.87	3.40	6.57	6.70	6.83	5.88
T_8	31.33	39.67	47.00	58.33	66.00	48.47	3.50	6.60	6.73	6.87	5.93
T_9	32.00	39.33	47.67	59.67	68.00	49.33	3.73	6.67	6.80	6.93	6.03
T_{10}	33.33	42.00	50.33	60.33	69.00	51.00	3.80	6.73	6.87	7.00	6.10
T_{11}	33.67	42.33	51.00	62.33	71.33	52.13	3.87	6.83	6.97	7.10	6.19
T_{12}	35.00	43.67	53.33	65.00	72.33	53.87	3.93	6.90	7.03	7.17	6.26
T_{13}	36.33	44.67	54.67	66.67	73.67	55.20	4.00	6.93	7.13	7.30	6.34
S.Em ±	1.57	1.75	1.81	2.40	2.00		0.20	0.30	0.39	0.39	
CD at 5%	4.58	5.11	5.28	7.01	5.85		NS	NS	NS	NS	

TABLE 4
Per plant fodder yield (kg/plant) of Hybrid Napier and fodder cowpea as influenced by different planting patterns

Treatments	Hybrid Napier						Cowpea				
	1st cut	2nd cut	3rd cut	4th cut	5th cut	Mean	1st cut	2nd cut	3rd cut	4th cut	Mean
T_1	1.83	2.10	2.35	2.96	3.11	12.34	-	-	-	-	-
T_2	1.90	2.13	2.40	3.00	3.13	12.55	-	-	-	-	-
T_3	2.18	2.29	2.44	3.07	3.38	13.35	-	-	-	-	-
T_4	1.97	2.26	2.72	3.20	3.24	13.38	6.86	7.54	7.8	7.59	7.45
T_5	1.99	2.31	2.81	3.36	3.38	13.84	6.94	7.63	7.83	7.61	7.50
T_6	2.00	2.34	2.86	3.38	3.41	13.98	7.05	7.72	7.89	7.69	7.59
T_7	2.24	2.76	2.93	3.49	3.94	15.36	7.12	7.79	7.9	7.69	7.63
T_8	2.27	2.78	3.14	3.56	4.03	15.78	7.22	7.89	7.93	7.73	7.69
T_9	2.11	2.53	3.30	3.58	4.08	15.59	4.19	4.47	5.22	5.00	4.72
T_{10}	2.14	2.64	3.36	3.60	4.09	15.83	4.25	4.53	5.27	5.03	4.77
T_{11}	2.16	2.66	3.47	3.61	4.15	16.04	4.32	4.62	5.34	5.09	4.84
T_{12}	2.26	2.77	3.52	3.94	4.28	16.77	4.39	4.68	5.44	5.16	4.92
T_{13}	2.38	2.95	3.58	4.07	4.36	17.35	4.48	4.76	5.55	5.26	5.01
S.Em ±	0.10	0.12	0.15	0.16	0.15		0.24	0.36	0.38	0.23	
CD at 5%	0.28	0.35	0.45	0.47	0.45		0.72	1.08	1.14	0.69	

Treatment details for Table 3 and Table 4 :

T_1 : DHN-6 (90X60 cm)
T_2 : CO-5 (90X60 cm)
T_3 : Taiwan Super Napier-1 (TSN-1) (90X60 cm)
T_4 : DHN-6 with cowpea local (90X60 cm and 30X10 cm)
T_5 : CO-5 with MFC-09-1 (90X60 cm and 30X10 cm)
T_6 : CO-5 with MFC-08-14 (90X60 cm and 30X10 cm)
T_7 : TSN-1 with MFC-09-1 (90X60 cm and 30X10 cm)
T_8 : TSN-1 with MFC-08-14 (90X60 cm and 30X10 cm)
T_9 : DHN-6 with Cowpea local (60/120 cmX60 cm and 30X10 cm)
T_{10} : CO-5 with MFC-09-1 (60/120 cmX60 cm and 30X10 cm)
T_{11} : CO-5 with MFC-08-14 (60/120 cmX60 cm and 30X10 cm)
T_{12} : TSN-1 with MFC-09-1 (60/120 cmX60 cm and 30X10 cm)
T_{13} : TSN-1 with MFC-08-14 (60/120 cmX60 cm and 30X10cm)

combination obtained a positive enhancement, in that successive harvests resulted marginally higher per plant yield with regular planting while paired row succeeded in further improvement. Taiwan Super Napier-1 and CO-5 cultivars with improved genotypes of fodder cowpea registered higher yields (15-17 kg/ha) under paired row planting while the lower yield was observed in cultivar Dharwad Hybrid Napier-6 under both normal and paired row planting. Performances of different cultivars mainly ascribed to the exploitation of the genetic potential in a given environment. The higher per plant yield of cultivar Taiwan Super Napier-1 could be attributed to more tillers/plant and leaves/plant in a given environment as compared to rest of the cultivars. The similar findings have also been reported by Balbatti (1980).

Data pertaining to green fodder yield as influenced by different planting patterns adopted with intercrop is presented in Table 5. Paired row planting obtained maximum tonnage of green fodder compared to normal row planting.The following valid inferences were drawn on the basis of totality of five cuts. Among cultivars tested in pure stand, cultivar Taiwan Super Napier-1 recorded 247.30 t/ha green fodder yield higher than cultivars CO-5 (232.43 t/ha) and Dharwad Hybrid Napier-6 (228.44 t/ha). Different cultivars of hybrid napier together in pure stand recorded 236.05 t/ha (mean of T_1, T_2 and T_3) green fodder yield. With intercropping, it raised to 285.01 t/ha (mean of T_4 to T_{13}) an enhancement of 20.7 per cent. It is also noted that intercropping with normal planting (mean of T_4 to T_8) and paired row (mean of T_9 to T_{13}) successively recorded 13.49 per cent (267.90 t/ha) and 27.98 per cent (302.12 t/ha) higher than that of pure stand. Further, Dharwad Hybrid Napier-6 with Cowpea local cultivars as standard check produced 247.70 t/ha and 288.75 t/ha, respectively while Taiwan Super Napier-1 and CO-5 cultivars with improved genotypes of fodder cowpea yielded about 45 and 25 t/ha higher yields under normal and paired row planting. These variations were reasoned well in explaining growth components, wherein advantages of legume inclusion for nutrition, significant space for architecture development by cultivars *etc.* played a dominant role. The study corroborates the findings of Tripathi *et al.* (1997) and Abdullah & Chaudhry (1996) under different planting patterns in maize with cowpea. Compared to standard check, CO-5 and Taiwan Super Napier-1 cultivars, respectively recorded 4.01 (257.65 t/ha) and 16.37 per cent (288.26 t/ha) higher fodder yield in normal planting. Wherein, together contributed to 10.19 per cent with 272.96 t/ha of green fodder yield. Different cultivars tested in paired row combination together achieved 305.46 t/ha (5.78 per cent), while that of cultivars CO-5 and Taiwan Super Napier-1 yielded 295 and 315.92 t/ha (an enhancement of 2.16 and 9.40 per cent, respectively). Results clearly indicated the importance of paired row intercropping over pure stand. Internal physiological and biochemical processes act chiefly on genetic expressivity under a given set of environmental conditions that together dictates quantities of growth made by plants. In support, it is seen from the earlier discussions that tallness, number of leaves, tillers and per plant yield accounted for growth attributes were significantly higher in paired row system followed by normal planting under intercropping situations.

Total dry matter production is an important parameter of crops performance and most believable indicator of growth. It is seen from the results that cultivar Taiwan Super Napier-1 produced more tallness, number of leaves and tillers indicating it's potentiality to produce higher stable dry matter both as a sole crop and in intercrop situations followed by CO-5 cultivar. Hence these two cultivars produced higher dry fodder yield when grown as a sole crop (47.34 and 41.02 t/ha) and as well intercrop situations of normal (56-58 and 47-48 t/ha) and paired row (63-66 and 56-57 t/ha) planting system. It could be argued that higher values for growth attributes promoted better growth of the crop ultimately resulted in increased dry fodder production. The present findings are in concurrence with the results obtained by Balbatti (1980). The beneficial effect of legume on the non-legume crop was also well established by Khana *et al.* (1996).

Inter crop

Plant height (around 45 cm), number of leaves (16-18) and branching habit of the fodder cowpea were found to be non-significant (Table 1, 2 and 3 respectively) as influenced by different planting patterns. These parameters were found marginal improvement in the paired row system of planting treatment. Bushy habit of main crop provides sufficient space for the growth of fodder cowpea in between and in that paired row planting provided ample space that results in increased growth in terms of height, leaves and more number of branches. However, the growth components steadily increased up to the third cut and later decreased marginally owing to space

TABLE 5
Fresh fodder yield (t/ha) of Hybrid Napier and fodder cowpea as influenced by cultivars and different planting patterns

Treatments	Hybrid Napier						Cowpea				
	1st cut	2nd cut	3rd cut	4th cut	5th cut	Mean	1st cut	2nd cut	3rd cut	4th cut	Mean
T_1	33.80	38.80	43.47	54.80	57.57	228.44	-	-	-	-	-
T_2	35.14	39.47	44.41	55.54	57.87	232.43	-	-	-	-	-
T_3	40.32	42.32	45.22	56.89	62.55	247.30	-	-	-	-	-
T_4	36.42	41.76	50.36	59.24	59.92	247.70	9.26	10.17	10.52	10.24	40.19
T_5	36.78	42.78	52.01	62.20	62.60	256.37	9.36	10.29	10.56	10.27	40.48
T_6	36.96	43.29	52.89	62.56	63.23	258.94	9.51	10.42	10.65	10.37	40.95
T_7	41.46	51.13	54.26	64.63	72.96	284.45	9.60	10.51	10.66	10.38	41.15
T_8	41.97	51.44	58.20	65.89	74.55	292.06	9.73	10.64	10.70	10.43	41.50
T_9	39.11	46.78	61.11	66.21	75.54	288.75	5.66	6.02	7.04	6.75	25.47
T_{10}	39.56	48.90	62.23	66.68	75.68	293.06	5.74	6.12	7.11	6.79	25.76
T_{11}	39.91	49.24	64.24	66.77	76.77	296.94	5.82	6.24	7.20	6.86	26.12
T_{12}	41.92	51.25	65.25	72.92	79.29	310.64	5.93	6.32	7.33	6.96	26.54
T_{13}	44.03	54.69	66.36	75.36	80.76	321.21	6.04	6.42	7.48	7.10	27.04
S.Em ±	2.08	2.73	3.04	3.27	3.42		0.36	0.35	0.37	0.15	
CD at 5%	NS	7.98	8.87	9.56	9.98		1.09	1.04	1.10	0.46	

TABLE 6
Dry fodder yield (t/ha) of Hybrid Napier and fodder cowpea as influenced by cultivars and different planting patterns

Treatments	Hybrid Napier						Cowpea				
	1st cut	2nd cut	3rd cut	4th cut	5th cut	Mean	1st cut	2nd cut	3rd cut	4th cut	Mean
T_1	5.54	6.55	7.57	9.82	10.58	40.06	-	-	-	-	-
T_2	5.80	6.72	7.78	10.01	10.71	41.02	-	-	-	-	-
T_3	7.27	7.84	8.61	11.10	12.52	47.34	-	-	-	-	-
T_4	6.37	7.51	9.30	11.24	11.68	46.10	1.35	1.49	1.54	1.50	5.88
T_5	6.45	7.71	9.63	11.86	12.25	47.90	1.37	1.50	1.55	1.52	5.94
T_6	6.50	7.85	9.84	11.97	12.41	48.57	1.39	1.53	1.57	1.54	6.03
T_7	7.75	9.82	10.68	13.02	15.11	56.38	1.40	1.55	1.57	1.54	6.06
T_8	7.93	9.98	11.58	13.44	15.58	58.51	1.43	1.58	1.59	1.55	6.15
T_9	7.08	8.74	11.67	12.98	15.23	55.70	0.80	0.86	1.00	0.97	3.63
T_{10}	7.22	9.16	11.94	13.14	15.28	56.74	0.82	0.88	1.01	0.98	3.69
T_{11}	7.31	9.23	12.38	13.22	15.53	57.67	0.84	0.90	1.05	1.00	3.79
T_{12}	8.09	10.19	13.22	15.17	16.90	63.57	0.86	0.91	1.06	1.02	3.85
T_{13}	8.57	10.95	13.49	15.78	17.30	66.09	0.87	0.93	1.09	1.04	3.93
S.Em ±	0.37	0.49	0.57	0.60	0.70		0.06	0.07	0.07	0.07	
CD at 5%	1.07	1.43	1.67	1.75	2.06		0.19	0.23	0.22	0.22	

Treatment details for Table 5 and Table 6 :

T_1 : DHN-6 (90X60 cm)
T_2 : CO-5 (90X60 cm)
T_3 : Taiwan Super Napier-1 (TSN-1) (90X60 cm)
T_4 : DHN-6 with cowpea local (90X60 cm and 30X10 cm)
T_5 : CO-5 with MFC-09-1 (90X60 cm and 30X10 cm)
T_6 : CO-5 with MFC-08-14 (90X60 cm and 30X10 cm)
T_7 : TSN-1 with MFC-09-1 (90X60 cm and 30X10 cm)
T_8 : TSN-1 with MFC-08-14 (90X60 cm and 30X10 cm)
T_9 : DHN-6 with Cowpea local (60/120 cmX60 cm and 30X10 cm)
T_{10} : CO-5 with MFC-09-1 (60/120 cmX60 cm and 30X10 cm)
T_{11} : CO-5 with MFC-08-14 (60/120 cmX60 cm and 30X10 cm)
T_{12} : TSN-1 with MFC-09-1 (60/120 cmX60 cm and 30X10 cm)
T_{13} : TSN-1 with MFC-08-14 (60/120 cmX60 cm and 30X10cm)

occupation by main crop with competitions for resources.

Planting pattern adopted allows variation in intercrop population. Accordingly, normal intercrop with 90x60 cm accommodates 33,333 plants while the paired row accommodates 22,222 plants per hectare basis. Mainly this was a cause of concern for differences in the green and dry fodder yield obtained under normal and paired row system. In general, plant population is one of the basic factors contributing to the yield of crop species.

Per plant fodder yield of fodder cowpea showed significant difference under different planting patterns. Significantly greater per plant yield was obtained in normal planting (7-8 kg/plant) compared to paired row planting (4-5 kg/pant). This may be because of the favourable effect of physiological and environmental factors on the plant growth period of growth affected by shade effects and competitions offered by hybrid napier. Cowpea local and improved genotypes of fodder cowpea did not differ in green and dry fodder yield. But, the significantly maximum tonnage of green and dry fodder was obtained under normal planting (7-8 and around 1.5 t/ha respectively) compared to paired row system (5-6 and around 1.t 0 /ha) due to difference in population.

Study revealed the benefit of fodder yield of hybrid napier when grown along with fodder cowpea as an intercrop in paired row system. By following the normal planting a moderate yield of hybrid napier and cowpea can be achieved during the first year of planting.

REFERENCES

Abdullah, M., and M. T. Chaudhry, 1996 : Improved fodder and production in central irrigated Punjab. Proc. Of National Conference on the Improvement Production and utilization of fodder crops in Pakistan, March 25-27 held at NARC, Islamabad, Pakistan. Pp 55-62.

Anantawiroon, P., S. Tudsri, Y. Ishii, S. Sawadihpanich, and Tachaboonyapiwat, S., 2006 : The effects of intercropping with four tropical legume species on the yield and quality of napier grass in Thailand. *Kasetsart J. Nat. Sci*., **40**: 616-624.

Balbatti, M. S., 1980 : Effect of nitrogen levels and row spacings on yield and quality of hybrid napier grown with and without legume. *M.Sc.* (*Ag.*) *Thesis*, Kerala Agricultural University, Trichur.

Dhillon, G. S. and B. S. Panwar, 1979 : Effect on different row spacing on the growth and yield of *Panicum miliaceum. Ind. J. Agron.,* **24** : 264-266.

Faruqui, S. A., S. Kumar, and D. N. Singh, 2009 : Napier bajra hybrid: Excellent perennial fodder, AICRP on fodder crops, IGFRI, Jhansi. 16.

Francis, C. A., C. A. Flor, and S. R. Temple, 1976 : Adapting varieties for intercropping systems in the tropics.*Am. Soc. Agron*., **27** : 235-253.

Gardner, F. P., R. B. Pearce, and R. L. Mitchell, 1985 : *Physiol. of Crop Plants*.The Iowa University Press, 327p.

Khana, P., G. K. Shrivastava, and R. S. Tripathi, 1996 : Response of fodder sorghum *(Sorghum bicolor*) + cowpea (*Vigna ungiculata*) to planting geometry and nitrogen schedules. *Indian J. Agron.,***41**(4) : 638-641.

Mahapatra, S. C. 2011 : Study of grass-legume intercropping system in terms of competition indices and monetary advantage index under acid lateritic soil of India. *Am J Exp Agric*., **1**: 1-6.

Nilanthi, J., S. Premaratne, and G. G. C. Premalal, 2004 : In : Proc. 12th Annual Students' Research Sessions, Dept. of Animal Science, Univ. of Peradeniya. Pasture Division, Veterinary Research Institite, Gannoruwa, Peradeniya. pp. 13-14.

Paneerselvam, S., 1986 : Sorghum based intercropping systems (soyabean and lablab) with different planting patterns under rainfed conditions. *M.Sc.(Ag.)Thesis*.,Tamilnadu Agric. Univ. Coimbatore.

Tripathi, R. K., L. Pradhan, and B. S. Rath, 1997 : Performance of maize (*Zea mays*) and cowpea (*Vignaunguiculata*) forage intercropping system in summer. *Ind. J. Agron.*, **42**(1): 38-41.

Veeraraghaviah, C., Mohd. Saleem Khan, Y., Yogeshwara Rao and Narasimha Reddy, 1979 : Fodder yield of oats in relation to seed rate and nitrogen levels. *Ind. J. Agron*., **24**(3): 291-295.