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RESEARCH ARTICLE

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Effects of row ratios of grass fodder cowpea mixtures on the yield and quality of forages

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ABSTRACT : A 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 of fodder grasses and fodder cowpea in open and in partial shade. The experiments were 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 with both the fodder cowpea varieties in the grass legume row ratio of 1:3 with respect to yield and quality of fodder crops in open and shaded experiments.

KEY WORDS : Hybrid napier grass, Guinea grass, Crude protein, Crude fibre, Row ratio

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INTRODUCTION

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 system that increases the availability and improves the quality of herbage in the dry summer months. Intensive fodder production system based on grasses is increasingly becoming important to the dairy farmers of Kerala. Dry matter yield of the grass is generally low due to poor soil fertilization regimes and erratic rainfall. The fodder is productive during the wet season and the nutritive value is generally low and does not meet the animal requirements throughout the year. It contains low to moderate crude protein (CP) content (6-12 %) during the wet season, but declines to less than 5 per cent during the dry period. Below a critical level of 6-8 per cent CP in cattle diet, digestibility and voluntary intake of forages are likely to be reduced (Humphreys, 1991). The major challenge is to overcome the inadequate quantity and quality of these cultivated fodders.

Inclusion of fodder legumes in the fodder production system is the most efficient way to increase herbage production and quality (Mwangi *et al*., 2006) 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

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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. Grass legume mixtures yielded as much or more drymatter 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. *V. unguiculata* grows well in shade and is useful as a component crop of silvipastoral systems (Bazil John, 2011). Keeping this in view, the present study was taken up to evaluate 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 yield and quality of fodder 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 physiological aspects of fodder grasses and fodder cowpea in open and in partial shade. The experiment was laid out in Randomized Block Design 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 tha^{-1} was applied in the trenches taken for planting BN hybrid and guinea grasses. FYM @ 10 tha^{-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 @ 1sett 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 yield and quality aspects such as crude protein content and crude fibre content.

EXPERIMENTAL RESULTS AND ANALYSIS

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

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. 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 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. 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. 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 also 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.

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. 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 effect was significant only in open condition in both the years. Fodder cowpea planted inbetween guinea grass at 1:2 row ratio recorded higher green fodder yield of cowpea in open condition. This is in conformity with the findings of Njarui *et al*. (2007).

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.

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 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.

Quality aspects :

The results showed that grasses and row ratio had significant impact on crude protein content of grasses in open in both the years. Significantly higher crude protein content was recorded by hybrid napier (G_1) in open (9.21 % in first year and 9.20 % in second year). This may be attributed to the higher nitrogen content in this grass (Fig. 1). The genetic superiority of this grass in this character has been an added advantage in this respect. Grass-legume row ratio of 1:3 (R_3) recorded significantly higher crude protein content in open (8.65%) in both the years (Fig. 2). The triple rows of cowpea were superior to double or single row (Sleugh *et al*., 2000; Berdahl *et al*., 2001; Albayrak and Ekiz, 2005 and Sima *et al*., 2010) owing to utilization of symbiotically fixed nitrogen

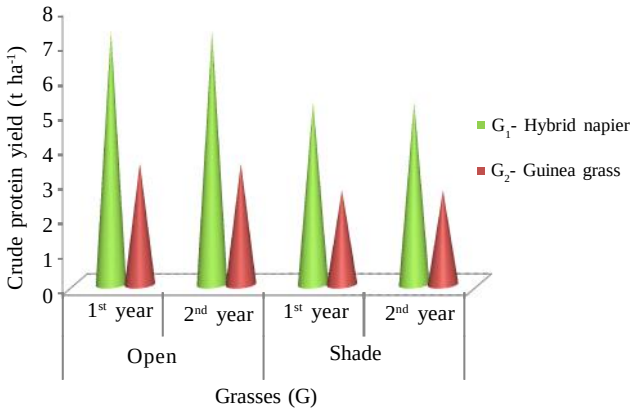

Fig. 1 : Effect of grasses on crude protein yield of grass (t ha^{-1})

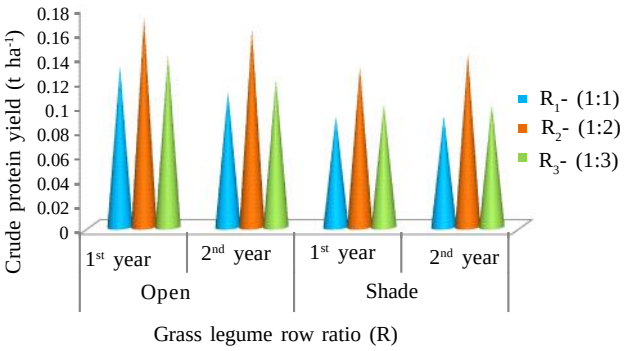

Fig. 2 : Effect of row ratio on total crude protein yield (t ha^{-1})

(Whitehead, 1995), more enhanced interception of light (Hay and Walker, 1989) and allelopathic (Pudnam and Duke, 1978) and other effects. These factors created a micro-environment that favoured higher protein content than those obtained from sole legume or grass stands (Sengul, 2003). Generally, mixing of legumes in grass fodder is a better way to increase the quality of grass fodder. That is because fodder quality of grassy hay is lower than that required to meet production goals for many livestock classes (Karadau, 2003). Ta and Faris (1987) reported that the nitrogen released from legumes was used by the grasses in mixtures. Thus, the mixtures had higher CP contents than the monoculture grasses (Sanderson, 2010; Kim and Albrecht, 2011). This is in conformity with the findings of Alalade *et al*. (2013) in Stylosanthes - guinea grass intercropping system. Grass-row ratio interaction was significant in open condition with G_1R_3 (hybrid napier + fodder cowpea planted at 1:3 row ratio) recording significantly higher crude protein content of 9.24 per cent in both the years.

The results also showed that grasses and row ratio had significant impact on crude protein content of grasses in shade in both the years. Significantly higher crude protein content was recorded by hybrid napier (G_1) in open (9.22% in first year and 9.21% in second year). Grass-legume row ratio of 1:3 (R_3) recorded significantly higher crude protein content in open (8.66 %) in both the years. The interaction effects were not significant.

The results also revealed that the treatments and their interactions had no significant impact on crude protein content of fodder cowpea.

The results revealed that the grasses varied significantly with respect to crude fibre content in open. Significantly lower crude fibre content (25.86 % and 24.97 %) was recorded by hybrid napier (G_1) in open in first and second years, respectively. The genetic superiority of this variety in this character has been an added advantage in this respect. The crude fibre content decreased with increase in level of crude protein content in the grass. This is in line with the findings of Adepoju (2005) who observed a decrease in crude fibre percentage as the crude protein percentage increased. This might be due to the fact that the more the crude protein content of forage the lesser the fibre fraction.

Fodder cowpea varieties, row ratio and the interactions had no significant effect on crude fibre content of grasses in open.

The results also revealed that the grasses varied significantly with respect to crude fibre content in partial shade. Significantly lower crude fibre content (26.96 % and 26.10 %) was recorded by hybrid napier (G_1) in shade in first and second years, respectively. Fodder cowpea varieties, row ratio and the interactions had no significant effect on crude fibre content of grasses in shade.

The results also revealed that the treatments and their interactions had no significant impact on crude fibre content of fodder cowpea.

Conclusion :

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 1:3 is the best for obtaining maximum yield and quality during the dry months in the dairy homesteads of Kerala.

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