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# Effect of row ratios and fertility levels on performance of Guinea grass+*Stylosanthes hamata* intercropping system under rainfed conditions

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## Abstract

A field experiment was conducted on sandy loam soil for four consecutive years (2003-04 to 2006-07) at Central Research Farm of Indian Grassland and Fodder Research Institute, Jhansi to study the effect of row ratios and fertility levels on growth, persistence of legume, productivity and quality of Guinea grass-*S. hamata* intercropping system under rainfed conditions. Intercropping of Guinea grass with *S. hamata* in paired rows produced significantly higher dry forage (4.24, 5.75, 5.27, 4.76 and 5.01 t/ha) and crude protein yields (381.7, 507.1, 467.0 and 399.2 kg/ha) as compared to sole stands of both grass and legume and intercropping in alternate rows. It was however, at par with 3:3 and 4:4 row ratios during all the four years. Application of 75 per cent RDF + 5 tonnes FYM/ha recorded 29.76, 36.43, 22.71 and 25.17 per cent higher dry matter yields over recommended dose of fertilizer during first, second, third and fourth year, respectively. Persistence of *S. hamata* was higher (85.19, 74.72 and 69.78 per cent) in sole stand as compared to alternate rows of grass-legume intercropping systems (76.26, 56.38 and 45.37 per cent) during all the three years. Intercropping of Guinea grass with *S. hamata* in all the row ratios resulted in land equivalent ratio of greater than 1, indicating productivity advantages of intercropping. The maximum RCC value was recorded in paired rows which indicated comparative yield advantage of grass-legume intercropping system over other planting treatments.

**Key words :** Fertility levels, *Panicum maximum*, Productivity, Row ratios, *Stylosanthes hamata*

## Introduction

In India livestock rearing is one of the main occupations of the farmers in arid and semi arid regions. Livestock population is increasing every year and there is ever increasing demand for quality forage. The major part of livestock feed is met either from crop by -products (rice straw/ wheat bhusa/ millet stover) or from the less nutritive grasses leading to low animal productivity. Feeding of livestock with high priced concentrates is not possible for all the farmers due to their poor economic conditions. It is therefore, important that community lands, village grazing lands and marginal lands owned by the farmers should be put under pasture for forage from both the economic and resource conservation point of view (Yadav and Rajora, 1995). This approach would greatly reduce the hazards of soil erosion and mitigate the adverse effect of drought on animal population. In this context, Guinea grass (*Panicum maximum* Jacq.) and *Stylosanthes hamata* are main pasture species suitable for higher forage production in semi arid regions. *S. hamata* is a perennial forage legume which provides cheaper source of quality feed and enhances animal productivity when grown with grasses in the tropics (Thomas *et al.,* 1997). However, row ratios and nutrient management in intercropping system govern the degree of competition between botanically diverse component crops and their productivity. Optimum row ratio for intercropping of grasses with legumes not only play an important role in producing quality forage per unit area but also in facilitating the cultural operations, light interception and root proliferation. The use of fertilizer in grasses is very less which results into poor pasture productivity. Therefore, the nutrient management involving inorganic fertilizers and organic manure could provide a viable option for sustainable forage production. With this background, the present experiment was undertaken to study the effect of row ratios and fertility levels on growth, persistence of legume, productivity and quality of Guinea grass-*S. hamata* intercropping system under rainfed conditions.

## Materials and Methods

A field experiment was conducted during July 2003 to 2007 at Central Research Farm ($25^0$27' N latitude, $78^0$37' E longitude and 275 m above mean sea level) of Indian Grassland and Fodder Research Institute, Jhansi, India to study the effect of row ratios and fertility levels on growth, persistence of legume, productivity and quality of Guinea grass-*S. hamata* intercropping system under rainfed conditions. The soil of the experimental field was sandy loam, low in organic carbon (0.42%), available nitrogen (161.43 kg/ha) and phosphorus (8.52 kg/ha) and medium in available potash (169.45 kg/ha). The total rainfall of 1187.10, 486.10, 440.7 and 416.2 mm was received in 37, 30, 31 and 33 rainy days during 2003, 2004, 2005 and 2006, respectively. There were 18 treatment combinations replicated thrice in split plot design. Six treatments comprising sole Guinea grass (*Panicum maximum*), sole *S. hamata* and their intercropping systems as alternate row, paired rows, 3:3 and 4:4 row ratios were allocated to main plots and three fertility levels *viz.*, recommended dose of fertilizer (NPK), 50 per cent of the recommended dose of fertilizer (RDF) + 5.0 tonnes farmyard manure/ha and 75 per cent of the RDF + 5.0 tonnes farmyard manure/ha to sub-plots. The recommended doses of NPK for sole Guinea grass, sole *S. hamata* and alternate row of grass-legume intercropping were applied @ 80:30:30, 20:40:30 and 60:40:40 kg/ha, respectively. For paired row, 3:3 and 4:4 row ratios of grass-legume intercropping, the recommended doses of fertilizer for sole Guinea grass and sole *S. hamata* were applied in their respective strips. On the basis of recommended doses of fertilizer, 50 and 75 per cent of recommended doses of fertilizer was calculated. The seedlings of Guinea grass were transplanted in the month of July at 100 cm row to row spacing and seeds of *S. hamata* were sown in line between two rows of grass. In sole treatment, grass was planted and legume was sown at 50 cm row to row spacing. Dry matter content was determined by drying 500g plant sample from each plot in hot-air oven. The crude protein content of the fresh samples was estimated as per the procedure of AOAC (1995). Persistence of legumes was recorded based on the surviving plants on yearly basis. Land equivalent ratio (Willey, 1979) and relative crowding co-efficient (De Wit, 1960) was calculated by the following formula.

$$\text{Land equivalent ratio} = \frac{Yab}{Yaa} + \frac{Yba}{Ybb}$$

Where, Yab is the yield of species a in association with species b and Yba is the yield of species b in association with species a, Yaa and Ybb represent the pure stand-yield of species a and b respectively.

$$\text{Relative crowding co-efficient} = \frac{\text{Mixture yield of species a}}{\text{Pure stand yield of species a} - \text{mixture yield of species a}}$$

## Results and Discussion

### Growth parameters

Intercropping of *S. hamata* did not show significant variations in plant height of Guinea grass. However,

**Table 1 : Effect of intercropping treatments and fertility levels on growth parameters of Guinea grass**

| Treatment | Height (cm) | | | | Tillers/ plant | | | | Tussock diameter (cm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2003-04 | 2004-05 | 2005-06 | 2006-07 |
| Intercropping systems | | | | | | | | | | | | |
| G sole | 140.8 | 148.7 | 134.6 | 123.3 | 13 | 22 | 30 | 34 | 7.8 | 19.0 | 23.6 | 24.5 |
| G+L (1:1) | 147.4 | 156.1 | 143.0 | 130.2 | 15 | 25 | 34 | 39 | 9.2 | 21.5 | 26.4 | 27.9 |
| G+L (2:2) | 149.3 | 157.4 | 144.7 | 131.9 | 15 | 26 | 36 | 43 | 9.3 | 22.2 | 27.4 | 29.2 |
| G+L (3:3) | 146.2 | 153.7 | 140.8 | 128.6 | 14 | 25 | 35 | 41 | 9.1 | 21.2 | 25.9 | 27.4 |
| G+L (4:4) | 145.1 | 152.2 | 138.6 | 126.7 | 14 | 24 | 34 | 39 | 9.0 | 20.5 | 25.0 | 26.2 |
| CD (P=0.05) | NS | NS | NS | NS | 2 | 3 | 4 | 5 | 1.1 | 2.7 | 3.3 | 4.9 |
| Fertility levels | | | | | | | | | | | | |
| RDF (NPK) | 137.1 | 146.4 | 134.2 | 117.8 | 13 | 22 | 31 | 33 | 8.4 | 19.1 | 23.6 | 24.6 |
| 50 % RDF + 5t FYM/ha | 141.8 | 151.0 | 140.5 | 130.6 | 13 | 24 | 34 | 39 | 8.6 | 20.5 | 25.7 | 27.1 |
| 75 % RDF + 5t FYM/ha | 158.4 | 163.6 | 146.4 | 135.9 | 15 | 27 | 37 | 45 | 9.7 | 23.1 | 27.6 | 29.4 |
| CD (P=0.05) | 9.8 | 12.6 | 9.4 | 11.2 | 1 | 2 | 3 | 3 | 0.7 | 1.8 | 3.1 | 2.2 |

G- Guinea grass, L- *Stylosanthes hamata* intercropping of *S. hamata* with Guinea grass in paired rows recorded significantly higher number of tillers/ plant and tussock diameter of Guinea grass as compared to its sole stand (Table 1). The trend of variation among the treatments was similar in all the four years. In *S. hamata* significantly higher plant height and number of branches/ plant were observed in its sole stand as compared to alternate row of grass-legume intercropping but it was at par with paired rows, 3:3 and 4:4 row ratios (Table 2).

Growth parameters *viz*., plant height, number of tillers/ plant, tussock diameter of Guinea grass and number of branches/ plant of *S. hamata* increased significantly with the application of 75% of the recommended dose of fertilizer in combination with 5 tonnes FYM/ ha over recommended dose of fertilizer and 50% of the RDF + 5 tonnes FYM/ha (Tables 1 and 2). It is evident that pasture receiving 75 per cent of the recommended dose of fertilizer + 5.0 t FYM/ ha was benefited more owing to adequate combinations of inorganic and organic fertilizer.

### Persistence of *S. hamata*

Persistence of *S. hamata* continued to be the highest (85.19, 74.72 and 69.78 per cent) in its sole stand closely followed by 4:4 row ratio, while it was minimum (76.23, 56.38 and 45.37 per cent) in the alternate row of grass-legume intercropping during second, third and fourth years, respectively. This might be due to no competition in sole stand of *S. hamata* and less competition in 4:4 row ratios as compared to alternate row of grass-legume intercropping. Among fertility levels, application of 75% of the RDF + 5 t FYM/ ha recorded higher persistence of *S. hamata* (85.11, 70.39 and 63.38 per cent) as compared to RDF only (83.63, 64.26 and 56.53 per cent) during all the three years (Table 2). Higher persistence of *S. hamata* might be due to more beneficial effect of inorganic and organic fertilizer on *S. hamata* as compared to inorganic fertilizer only.

### Dry forage yield

Dry forage yield was significantly influenced by row ratios in intercropping and fertility levels (Table 3). Intercropping of Guinea grass with *S. hamata* in paired rows produced significantly higher total dry forage yields as compared to sole stand of grass or legume and alternate row but remained at par with 3:3 and 4:4 row ratios. This might be due to more favourable environment for growth of both Guinea grass and *S. hamata* in paired rows system. Higher yield in paired row planting was also obtained by Hazra and Behari (1993) and Singh (2000). Grass-legume intercropping in paired row recorded 14.38, 28.71, 33.85 and 36.54 per cent higher dry matter yields of *S. hamata* as compared to alternate row (1.37, 1.49, 1.29, 0.99 tonnes / ha) in first, second, third and fourth years, respectively. The decrease in forage yield of *S. hamata* was more in narrow row ratios of grass-legume intercropping than in wider row ratios owing to competitive effect of grass, leading to lower growth parameters of legumes under narrow row ratio.

Combined application of 75 percent of the recommended dose of fertilizer + 5 tonnes FYM/ ha gave significantly

**Table 2 : Effect of intercropping treatments and fertility levels on growth parameters and persistence of *S. hamata***

| Treatment | Height (cm) | | | | Branches/ plant | | | | Persistence (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2003 -04 | 2004 -05 | 2005 -06 | 2006 -07 | 2003 -04 | 2004 -05 | 2005 -06 | 2006 -07 | 2004 -05 | 2005 -06 | 2006 -07 |
| **Intercropping systems** | | | | | | | | | | | |
| L sole | 44.3 | 58.4 | 54.3 | 48.5 | 4.8 | 7.3 | 6.0 | 5.1 | 85.19 | 74.72 | 69.78 |
| G+L (1:1) | 35.8 | 50.4 | 46.7 | 40.1 | 3.8 | 5.5 | 4.4 | 3.1 | 76.23 | 56.38 | 45.37 |
| G+L (2:2) | 42.7 | 54.0 | 50.0 | 43.5 | 4.6 | 6.4 | 5.2 | 4.0 | 81.17 | 65.60 | 57.60 |
| G+L (3:3) | 43.2 | 55.7 | 51.6 | 45.3 | 4.6 | 6.8 | 6.6 | 4.5 | 82.83 | 68.38 | 61.76 |
| G+L (4:4) | 44.0 | 57.1 | 53.0 | 46.9 | 4.7 | 7.1 | 6.9 | 4.9 | 84.20 | 71.65 | 64.76 |
| CD (P=0.05) | 5.4 | 6.20 | 5.4 | 5.1 | 0.5 | 0.8 | 0.7 | 0.6 | - | - | - |
| **Fertility levels** | | | | | | | | | | | |
| RDF (NPK) | 38.1 | 51.8 | 48.0 | 41.7 | 4.2 | 5.9 | 4.5 | 3.4 | 82.63 | 64.26 | 56.53 |
| 50 % RDF + 5t FYM/ha | 40.4 | 54.0 | 50.8 | 44.8 | 4.3 | 6.3 | 5.3 | 4.3 | 83.98 | 67.44 | 59.73 |
| 75 % RDF + 5t FYM/ha | 47.5 | 59.5 | 54.6 | 48.1 | 4.1 | 8.2 | 6.5 | 5.3 | 85.19 | 70.39 | 63.38 |
| CD (P=0.05) | 3.6 | 4.1 | 3.6 | 3.4 | 0.3 | 0.6 | 0.5 | 0.4 | - | - | - |

(For persistence year 1 is taken as 100), G- Guinea grass, L- *Stylosanthes hamata* higher total dry forage yield as compared to RDF and 50 percent RDF + 5 tonnes FYM/ ha. The difference in dry forage yields with the application of 50 per cent RDF + 5 tonnes FYM/ha and RDF was also significant. Application of 75 per cent RDF + 5 tonnes FYM/ha recorded 29.76, 36.43, 22.71 and 25.17 per cent higher dry matter yields over recommended dose of fertilizer during first, second, third and fourth years, respectively (Table 3). The beneficial effect of organic manure and inorganic fertilizer in term of sustained production could be on account of enhanced biological activities in the rhizosphere, improved soil structure and increased nutrients availability. These results corroborate with the findings of Arya *et al*. (2000) and Kumar *et al*. (2004). The effect of interaction between intercropping row ratios and fertility levels was found to be non significant.

### Crude protein yield

Crude protein yield increased significantly with the intercropping of Guinea grass and *S. hamata* in paired rows than their sole stands and 1:1 row ratio. It was however, statistically at par with 3:3 and 4:4 row ratios. This was due to higher dry matter yield with intercropping of grass and legume in paired row ratio. Application of 75 per cent recommended dose of fertilizer + 5 tonnes FYM/ ha recorded significantly higher crude protein yield than other fertility levels. The gain in crude protein yield was maximum (121.3, 180.0, 113.8 and 105.1 kg/ ha) with the application of 75 per cent recommended dose of fertilizer + 5 tonnes FYM/ ha over RDF during first, second, third and fourth years, respectively. However, the corresponding increases in crude protein yield were 28.2, 56.1, 55.9 and 54.3 kg/ ha over 50 % RDF + 5 tonnes FYM/ ha (Table 4). Kumar *et al*. (2004) also observed an improvement in crude protein content and yield of forage crop with the use of farm yard manure. The interaction effect between intercropping row ratios and fertility levels was not significant.

### Land equivalent ratio (LER)

Intercropping of Guinea grass with *S. hamata* resulted in land equivalent ratio greater than 1, indicating the advantages of intercropping. It was higher in paired rows (1.28, 1.35, 1.33 and 1.30) when compared to alternate row of grass-legume intercropping (1.18, 1.20, 1.10 and 1.06) during all the four years of the study. Maximum LER was recorded at 75% RDF + 5 t FYM/ ha while it was lowest in the treatment where only inorganic fertilizer was applied (Table 5).

### Relative crowding coefficient (RCC)

Guinea grass and *S. hamata* maintained relative crowing coefficient (RCC) values more than 1 in all the intercropping systems indicating that both grass and legume produced more yield than expected, except in alternate row of arrangement where *S. hamata* gave RCC of less than 1, showing that it produced less yield than expected. The maximum RCC was recorded in paired

**Table 3 : Dry forage yield of Guinea grass and *Stylosanthes hamata* as influenced by intercropping row ratios and fertility levels**

| Treatment | Dry matter yield (t/ha) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2003-04 | | | 2004-05 | | | 2005-06 | | | 2006-07 | | |
| | G | L | Total | G | L | Total | G | L | Total | G | L | Total |
| **Intercropping systems** | | | | | | | | | | | | |
| G sole | 3.92 | - | 3.92 | 5.19 | - | 5.19 | 4.71 | - | 4.71 | 4.59 | - | 4.59 |
| L sole | - | 2.58 | 2.58 | - | 3.41 | 3.41 | - | 3.23 | 3.23 | - | 2.60 | 2.60 |
| G+L (1:1) | 2.58 | 1.37 | 3.95 | 3.55 | 1.49 | 5.04 | 3.23 | 1.29 | 4.52 | 3.11 | 0.99 | 4.10 |
| G+L (2:2) | 2.64 | 1.60 | 4.24 | 3.66 | 2.09 | 5.75 | 3.32 | 1.95 | 5.27 | 3.20 | 1.56 | 4.76 |
| G+L (3:3) | 2.52 | 1.63 | 4.15 | 3.43 | 2.18 | 5.61 | 3.17 | 2.02 | 5.19 | 3.06 | 1.65 | 4.71 |
| G+L (4:4) | 2.47 | 1.65 | 4.12 | 3.25 | 2.25 | 5.50 | 2.99 | 2.08 | 5.07 | 2.87 | 1.71 | 4.58 |
| CD (P=0.05) | 0.27 | 0.12 | 0.41 | 0.51 | 0.30 | 0.52 | 0.57 | 0.24 | 0.45 | 0.54 | 0.26 | 0.39 |
| **Fertility levels** | | | | | | | | | | | | |
| RDF (NPK) | 2.50 | 1.60 | 4.10 | 3.27 | 2.00 | 5.27 | 3.11 | 1.91 | 5.02 | 2.98 | 1.51 | 4.49 |
| 50 % RDF + 5t FYM/ha | 2.69 | 1.68 | 4.37 | 3.65 | 2.20 | 5.85 | 3.51 | 2.09 | 5.60 | 3.41 | 1.69 | 5.10 |
| 75 % RDF + 5t FYM/ha | 3.29 | 2.03 | 5.32 | 4.54 | 2.65 | 7.19 | 3.83 | 2.33 | 6.16 | 3.71 | 1.91 | 5.62 |
| CD (P=0.05) | 0.18 | 0.08 | 0.40 | 0.34 | 0.20 | 0.51 | 0.38 | 0.16 | 0.43 | 0.36 | 0.17 | 0.35 |

G- Guinea grass, L- *Stylosanthes hamata*

**Table 4 : Crude protein yield of Guinea grass and *Stylosanthes hamata* as influenced by intercropping and fertility levels**

| Treatment | Crude protein yield (kg/ha) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2003-04 | | | 2004-05 | | | 2005-06 | | | 2006-07 | | |
| | G | L | Total | G | L | Total | G | L | Total | G | L | Total |
| Intercropping systems | | | | | | | | | | | | |
| G sole | 257.4 | - | 257.4 | 340.3 | - | 340.3 | 303.7 | - | 303.7 | 294.2 | - | 294.2 |
| L sole | - | 325.3 | 325.3 | - | 425.4 | 425.4 | - | 396.6 | 396.6 | - | 313.2 | 313.2 |
| G+L (1:1) | 175.0 | 168.3 | 343.3 | 238.4 | 181.1 | 419.5 | 218.7 | 154.0 | 372.7 | 203.5 | 117.1 | 320.6 |
| G+L (2:2) | 182.2 | 199.5 | 381.7 | 250.3 | 256.8 | 507.1 | 231.0 | 236.0 | 467.0 | 212.7 | 186.5 | 399.2 |
| G+L (3:3) | 169.2 | 204.7 | 373.9 | 230.7 | 269.3 | 500.0 | 197.8 | 246.5 | 444.3 | 200.1 | 197.9 | 398.0 |
| G+L (4:4) | 163.1 | 208.1 | 371.2 | 215.1 | 279.2 | 494.3 | 202.4 | 254.9 | 457.3 | 185.8 | 205.6 | 391.4 |
| CD (P=0.05) | 25.4 | 29.0 | 34.2 | 34.0 | 38.35 | 46.7 | 30.6 | 35.9 | 39.7 | 29.4 | 27.5 | 27.3 |
| Fertility levels | | | | | | | | | | | | |
| RDF (NPK) | 164.3 | 196.5 | 360.8 | 214.3 | 244.5 | 458.8 | 202.2 | 229.6 | 431.8 | 191.3 | 178.9 | 370.2 |
| 50 % RDF + 5t FYM/ha | 179.1 | 209.9 | 389.0 | 242.2 | 271.7 | 514.9 | 232.4 | 255.3 | 487.7 | 221.9 | 202.6 | 424.5 |
| 75 % RDF + 5t FYM/ha | 225.0 | 257.1 | 482.1 | 308.4 | 330.4 | 638.8 | 257.6 | 288.0 | 545.6 | 244.6 | 230.7 | 475.3 |
| CD (P=0.05) | 16.8 | 19.2 | 33.5 | 22.5 | 25.4 | 45.8 | 20.3 | 23.8 | 37.8 | 19.5 | 18.2 | 26.5 |

G- Guinea grass, L- *S. hamata*

**Table 5 : Land equivalent ratio and relative crowding coefficient of Guinea grass and *Stylosanthes hamata* as influenced by intercropping and fertility levels**

| Treatment | Land equivalent ratio | | | | Relative crowding coefficient | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2003-04 | | 2004-05 | | 2005-06 | | 2006-07 | |
| | | | | | G | L | G | L | G | L | G | L |
| Intercropping systems | | | | | | | | | | | | |
| G+L (1:1) | 1.18 | 1.20 | 1.10 | 1.06 | 1.93 | 1.16 | 2.15 | 0.78 | 2.37 | 0.66 | 2.13 | 0.61 |
| G+L (2:2) | 1.28 | 1.35 | 1.33 | 1.30 | 2.06 | 1.63 | 2.38 | 1.57 | 2.70 | 1.52 | 2.28 | 1.51 |
| G+L (3:3) | 1.26 | 1.33 | 1.25 | 1.30 | 1.79 | 1.70 | 1.95 | 1.76 | 1.73 | 1.67 | 2.03 | 1.74 |
| G+L (4:4) | 1.26 | 1.31 | 1.30 | 1.29 | 1.70 | 1.78 | 1.67 | 1.92 | 1.92 | 1.82 | 1.81 | 1.92 |
| Fertility levels | | | | | | | | | | | | |
| RDF (NPK) | 1.24 | 1.24 | 1.2 | 1.23 | 1.80 | 1.56 | 1.78 | 1.30 | 2.04 | 1.32 | 2.17 | 1.33 |
| 50 % RDF + 5t FYM/ha | 1.22 | 1.28 | 1.24 | 1.23 | 1.73 | 1.50 | 1.88 | 1.47 | 2.18 | 1.42 | 2.00 | 1.45 |
| 75 % RDF + 5t FYM/ha | 1.28 | 1.38 | 1.28 | 1.24 | 2.08 | 1.64 | 2.45 | 1.75 | 2.32 | 1.52 | 2.02 | 1.56 |

G- Guinea grass, L- *S. hamata*

rows of grass-legume intercropping, which indicated comparative yield advantage of this system over other intercropping treatments. Application of 75% RDF +5 tonnes FYM/ ha gave higher RCC values of both grass (2.08, 2.45, 2.32 and 2.02) and legume (1.64, 1.75, 1.52 and 1.56) which showed that it produced higher yield than expected as compared to RDF and 50 % RDF + 5 tonnes FYM/ ha during all the four years (Table 5).

Thus, intercropping of Guinea grass with *S. hamata* in alternate paired rows along with application of 75% recommended dose of fertilizer + 5 tonnes farmyard manure/ ha in sandy loam soil was found optimum for better growth of component species, persistence of legume, productivity and quality of herbage under rainfed semi-arid conditions of Bundelkhand.

## References

AOAC, 1995. *Official Methods of Analysis*. Association of Official Analytical Chemists. Washington, D.C.

Arya, R. L., K. P. Niranjan, A. Singh and J. B. Singh. 2000. Effect of manurial schedules on growth and yield of different cropping systems under rainfed alley system. *Indian J. Agron.* 45: 687-692.

De Wit, C. T. 1960. *On competition*, Verslag Landbouwkundige onderzoek 66: 1-82.

Hazra, C. R. and Pradeep Behari. 1993. Effect of legume intercropping in rainfed pearlmillet on forage yield, microclimate and soil fertility. *Range Mgmt. and Agroforestry* 14: 125-130.

Kumar, Sunil, C. R. Rawat and N. P. Melkania. 2004. Effect of integrated nutrient management on growth, herbage productivity and economics of forage sorghum (*Sorghum bicolor*). *Forage Res.* 30: 140-144.

Singh, V. P. 2000. Planting geometry in maize (*Zea mays*) and blackgram (*Phaseolus mungo*) intercropping system under rainfed low hill valley of Kumaon. *Indian J. Agron.* 45: 274-278.

Thomas, R. J., N. M. Asakawa, M. A. Randon and H. F. Alarcon. 1997. Nitrogen fixation by three tropical forage legumes in an arid-soil Savanna of Columbia. *Soil Bio. and Biochem.* 28: 801-808.

Willey, R. W. 1979. Intercropping - Its importance and research needs. Competition and yield advantage. *Field Crops Abstr.* 32: 1-10.

Yadav, M. S. and M. P. Rajora. 1995. In: *New Vistas in Forage Production*, Hazra, C.R. and Bimal Misri (eds). All India Coordinated Research Project on Forage Crops. Indian Grassland and Fodder Research Institute, Jhansi (U.P.), India. pp. 97-112.