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# Assessing the vegetative growth of fodder legumes intercropped with maize

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## ABSTRACT

*A field experiment was conducted during the kharif season of 2022-23 at Agronomy Farm, School of Agricultural Sciences, Nagaland University with objectives to study the effect of row proportion of fodder maize on growth and yield of fodder legumes. The present investigation encompassing fodder maize with fodder cowpea and fodder rice bean intercropped with different row ratio. The treatments included $C_1$ - Sole Maize, $C_2$ - Sole Cowpea, $C_3$ - Sole Rice bean, $C_4$ - Maize + Cowpea (1:1), $C_5$ - Maize + Rice bean (1:1), $C_6$ - Maize + Cowpea (2:1), $C_7$ - Maize + Cowpea (2:1), $C_8$ - Maize + Cowpea (2:2) and $C_9$ - Maize + Rice bean (2:2). Plant height (312.51 cm, 225.13 cm), number of leaves plant$^{-1}$(95.77, 68.23), stem girth (3.17 cm, 2.80 cm), primary branches plant$^{-1}$ (5.67, 4.20), leaf stem ratio (0.78, 0.44), fresh weight (454.30 g, 248.29 g) and dry weight (106.98 g, 34.55 g) of fodder cowpea and fodder rice bean was observed from sole plot $C_2$ and $C_3$. Among the row ratio higher vegetative growth i.e. plant height, number of leaves plant$^{-1}$, stem girth, primary branches$^{-1}$of fodder legumes was observed at 1:1 ratio followed by 2:2 ratio. The highest pooled leaf length (13.36 cm), leaf width (9.10 cm) and leaf area (123.20 cm) for fodder cowpea was observed in $C_6$ and followed by $C_4$ and $C_2$. For fodder rice bean $C_9$ (12.03 cm) recorded the highest leaf length, while $C_7$ maintained the highest leaf width (7.59 cm) and leaf area (90.41 cm). Similarly, green fodder yield (34.39 t ha$^{-1}$, 34.22 t ha$^{-1}$) and dry fodder yield (5.65 t ha$^{-1}$, 5.16 t ha$^{-1}$) of fodder cowpea and fodder rice bean was also obtained from sole plot $C_2$ and $C_3$. Under different row ratio, higher green fodder yield and dry fodder yield was observed at 2:2 ratio followed by 1:1 row ratio and while the lowest yield production was recorded at 2:1 row ratio. Thus, intercropping of fodder legumes and fodder maize under different row ratio showed a great potential and can be recommended to farmer for commercial production.*

**Keywords:** Intercropping system, vegetative growth parameters, green and dry fodder yield

## INTRODUCTION

India is the largest country which is having 535.78 million of livestock populations as per the 20$^{th}$ Livestock Census released in 2019 (Anonymous, 2019). The total area under fodder crops is 8.6 m ha which constitutes about 4 % of cultivated area and is insufficient to meet the fodder requirement of existing livestock. It is constantly not viable to set aside arable land for fodder production alone, as cultivable land is not enough for food grain production. It is rather inevitable to accommodate fodder production in existing cropping systems. There is free inter space in widely spaced crops like maize, sorghum, bajra, hybrid cotton, red gram *etc.,* which can be advantageously used to raise short duration pulse crops without much reduction in the main crop yields. Supply of forage is inadequate in the country not only in terms of quality but also in quantity. Since the scope of area expansion under fodder cultivation is limited, the productivity of fodder crops is to be raised through best utilization of the resources of the prevailing production systems. High quality of forage has been notified as an important aspect of forage crop production. Although cereals are widely used in livestock nutrition for their high dry matter production and low cost (Ghanbari-Bonjar, 2000), they have low nutrition value due to their low forage quality. One of the main reasons for the low productivity is malnutrition, under-nutrition or both, beside the low genetic potential of the animals. Future development and growth of livestock are highly associated with the scope of availability of fodder from cultivable land, forest, pastures and grazing lands. Forage quality of legumes is high but they have low dry matter production (Ross *et al.,* 2004). Legumes are good sources of protein.

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Thus, legume-cereal composition is considered as a management strategy in producing both high quality and quantity forage.

## MATERIALS AND METHODS

A field experiment on effect of row proportion in fodder maize + fodder cowpea and fodder maize + fodder rice bean intercropping system. The experiment was laid out in randomized block design with nine treatments and three replications. The treatments consisted of sole maize, sole cowpea and six planting ratios on row basis i.e. 1:1, 2:1 and 2:2. In all, it is consisted of nine treatments *i.e.* $C_1$- sole maize, $C_2$- sole cowpea, $C_3$- sole rice bean, $C_4$ - maize + cowpea (1:1), $C_5$ - maize + rice bean (1:1), $C_6$ - maize + cowpea (2:1), $C_7$ - maize + rice bean (2:1), $C_8$ - maize + cowpea (2:2) and $C_9$ - maize + rice bean (2:2). For fodder maize variety African Tall and for fodder cowpea and fodder rice bean varieties Kohinoor and Bidhan rice bean-2 were used for sowing. The fodder maize and fodder legumes were sown on June 2022. The gross and net plot size were 5.4 m × 4.6 m respectively. During the course of investigation, observations on growth parameters and yield were recorded. Besides this, at harvest, the content of nitrogen, phosphorus and potassium in plant and soil were estimated. The analysis of initial soil sample indicated that, the soil of the experimental plot was categorized under sandy loam in texture, with acidic in reaction (pH 5.2) and high in organic carbon content (0.9 %). The soil was found to be low in available nitrogen (256.4 kg $ha^{-1}$) and available phosphorus (22.09 kg $ha^{-1}$) but it was found high in available potassium (144.91kg $ha^{-1}$).

The climatic condition of the experimental site is sub-humid tropical climatic zone with high relative humidity, moderate cold and hot situations. May and June are the hottest months with means temperature ranging from 21°C to 30°C during summer and rarely goes below 8°C in winter due to high atmospheric pressure. The average annual rainfall of the experimental sites was between 1800-2500 mm, of which the major portion was received during the monsoon season (May to October) and the rest during winter and spring seasons. The relative humidity increases from June to September with means or average ranging from 70 - 90 %. The bright sunshine hours ranged from 1.3 to 8.2 hrs. Five plants from the net plot area were randomly selected and tagged and growth parameters were recorded over tagged plants. Forage crops were harvested manually and the fresh forage yield were recorded. All data recorded for different parameters were analyzed with the help of analysis of variance (ANOVA) technique (Gomez and Gomez 1984). The least significant difference test was used in different treatments at 5% level of significance ($P < 0.05$).

## RESULTS AND DISCUSSION

The vegetative parameters of fodder cowpea and fodder rice bean were significantly affected by various treatments and are presented in table below. Among the intercropping system, the growth parameters were significantly influenced by intercropping of forage maize with fodder legumes. The highest plant height (pooled) was recorded from sole crop $C_2$ (312.51 cm) and $C_3$ (225.13 cm) for fodder cowpea and fodder rice bean (Table 1).

Table 1: Effect of intercropping system on plant height, leaf length, leaf width and leaf area of fodder legumes

| Treatment | Plant height (cm) | | | Leaf length (cm) | | | Leaf width (cm) | | | Leaf area (cm) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | Pooled | 2022 | 2023 | Pooled | 2022 | 2023 | Pooled | 2022 | 2023 | Pooled |
| $C_1$ | - | - | - | - | - | - | - | - | - | - | - | - |
| $C_2$ | 303.96 | 321.07 | 312.51 | 12.77 | 12.98 | 12.87 | 9.14 | 9.42 | 9.28 | 116.52 | 124.37 | 120.45 |
| $C_3$ | 222.54 | 227.71 | 225.13 | 11.76 | 12.11 | 11.93 | 6.39 | 8.04 | 7.21 | 64.28 | 92.85 | 78.56 |
| $C_4$ | 304.16 | 309.60 | 306.88 | 12.80 | 13.51 | 13.16 | 9.12 | 9.30 | 9.21 | 118.07 | 126.54 | 122.30 |
| $C_5$ | 210.16 | 219.38 | 214.77 | 11.49 | 11.88 | 11.69 | 7.11 | 7.95 | 7.53 | 82.91 | 93.96 | 88.43 |
| $C_6$ | 293.88 | 303.74 | 298.81 | 13.16 | 13.57 | 13.36 | 8.98 | 9.22 | 9.10 | 117.70 | 128.70 | 123.20 |
| $C_7$ | 190.04 | 192.93 | 191.49 | 9.98 | 11.67 | 10.82 | 6.75 | 8.43 | 7.59 | 78.91 | 101.90 | 90.41 |
| $C_8$ | 297.32 | 316.27 | 306.79 | 12.86 | 12.97 | 12.91 | 9.04 | 9.25 | 9.15 | 117.25 | 120.64 | 118.95 |
| $C_9$ | 207.06 | 211.49 | 209.27 | 11.53 | 12.54 | 12.03 | 6.64 | 7.90 | 7.27 | 76.44 | 99.55 | 88.00 |
| SEm± | 1.72 | 2.24 | 1.41 | 0.13 | 0.17 | 0.11 | 0.05 | 0.06 | 0.04 | 0.72 | 1.12 | 0.67 |
| CD (p=0.05) | 4.88 | 6.37 | 3.96 | 0.38 | 0.48 | 0.30 | 0.14 | 0.16 | 0.11 | 2.05 | 3.18 | 1.87 |

Among the different row ratio highest plant height for fodder cowpea (306.88 cm) and fodder rice bean (214.77 cm) were recorded in 1:1, whereas lowest was registered at 2:1 (298.81 cm, 191.49 cm). Plant height of fodder legumes at harvest in its varying combinations with maize was significantly affected and maximum height was observed at sole and with fodder maize + fodder legumes at1:1 row ratio. This might be due to trailing nature of fodder legumes. Leaf length and leaf width is an essential parameter to determine green fodder yield and quality. The higher plant height at sole crop and then at different row ratio 1:2 and 1:1 give higher plant height than 2:1 row ratio (Gaikwad *et al.,* 2022). Comparably, Kussie *et al.* (2024) also observed the higher plant of cowpea at sole plot followed maize with cowpea at 2:2 and 1:1 row ratio. However, Ginwal *et al.* (2019) reported the higher plant of cowpea at 1:1 row ratio followed by 2:2, while sole crop recorded the lower plant height of cowpea. The highest pooled leaf length (13.36 cm), leaf width (9.10 cm) and leaf area (123.20 cm) for fodder cowpea was observed in $C_6$and followed by $C_4$ and $C_2$. For fodder rice bean $C_9$ (12.03 cm) recorded the highest leaf length, while $C_7$maintained the highest leaf width (7.59 cm) and leaf area (90.41 cm). The narrowest leaf length and leaf width for fodder cowpea and rice bean was obtained under $C_2$ (12.87 cm), $C_7$ (10.82 cm) and$C_6$ (9.10 cm), $C_9$ (7.27 cm). The treatment $C_3$ (78.56 cm) and $C_8$ (118.95 cm) recorded the lowest values of leaf area. Similarly, Ginwal *et al.* (2019) also reported the longer leaf length at 2:1 and 1:1 row ratio as compared to sole cropping. The longer leaf width of the fodder cowpea was registered in sole crop followed by 1:1 and 2:2 row ratio. This finding was supportive with finding reported by Gaikwad *et al.* (2022). However, in contrast to above studies, Ginwal *et al.* (2019) reported the longer leaf width of cowpea sown under 1:1 and 2:1 row ratio than sole crop.

Table 2: Effect of intercropping system on number of leaves$^{-1}$, stem girth, primary branches$^{-1}$ and leaf stem ratio of fodder legumes

| Treatment | Number of leaves$^{-1}$ | | | Stem girth (cm) | | | Primary branches$^{-1}$ | | | Leaf stem ratio | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | 2022 | 2022 | 2022 | Pooled | 2022 | 2023 | Pooled | 2022 | 2023 | Pooled |
| $C_1$ | - | - | - | - | - | - | - | - | - | - | - | - |
| $C_2$ | 90.04 | 101.49 | 95.77 | 3.03 | 3.30 | 3.17 | 5.56 | 5.78 | 5.67 | 0.78 | 0.78 | 0.78 |
| $C_3$ | 62.96 | 73.50 | 68.23 | 2.76 | 2.84 | 2.80 | 4.17 | 4.23 | 4.20 | 0.46 | 0.42 | 0.44 |
| $C_4$ | 81.71 | 94.27 | 87.99 | 3.00 | 3.22 | 3.11 | 5.48 | 5.64 | 5.56 | 0.77 | 0.78 | 0.77 |
| $C_5$ | 62.04 | 68.04 | 65.04 | 2.57 | 2.62 | 2.59 | 4.06 | 4.21 | 4.13 | 0.43 | 0.41 | 0.42 |
| $C_6$ | 75.10 | 88.71 | 81.91 | 2.90 | 3.01 | 2.96 | 5.52 | 5.62 | 5.57 | 0.75 | 0.72 | 0.74 |
| $C_7$ | 41.42 | 47.61 | 44.52 | 2.41 | 2.50 | 2.46 | 3.67 | 3.83 | 3.75 | 0.42 | 0.41 | 0.42 |
| $C_8$ | 59.82 | 81.93 | 70.88 | 2.92 | 3.09 | 3.01 | 5.44 | 5.44 | 5.44 | 0.73 | 0.72 | 0.73 |
| $C_9$ | 51.60 | 66.82 | 59.21 | 2.61 | 2.64 | 2.63 | 4.13 | 4.21 | 4.17 | 0.44 | 0.42 | 0.43 |
| SEm± | 0.53 | 0.68 | 0.43 | 0.03 | 0.03 | 0.02 | 0.02 | 0.03 | 0.02 | 0.00 | 0.00 | 0.00 |
| CD (p=0.05) | 1.51 | 1.94 | 1.21 | 0.07 | 0.08 | 0.05 | 0.07 | 0.09 | 0.05 | 0.01 | 0.01 | 0.01 |

Number of leaves plant$^{-1}$ of fodder legume at harvest was significantly affected by various intercropping combinations (Table 2). The significantly higher value of number of leaves plant$^{-1}$ for fodder cowpea and fodder rice bean was recorded in sole crop $C_2$ (95.77) and $C_3$ (68.23) followed by intercropping at 1:1 row ratio *i.e.* $C_4$ (87.99) and (65.04) and the lowest was observed in $C_8$ (70.88) $C_7$ (44.52). Intercropping has resulted in a greater number of leaves and hence better crop canopy in intercropping and efficient utilization of the solar radiation available during the growing season. Ginwal *et al.* (2019) also observed the higher number of leaves plant$^{-1}$ at 1:1 row ratio than 2:1 row ratio and sole crop. Similar finding of higher number of leaves plant$^{-1}$ at 1:1 row ratio was also reported by Asangla (2015). The stem girth of fodder legumes was affected significantly by intercropping with fodder maize (Table 2). The highest value of stem girth was recorded in their respective sole treatment $C_2$ (3.17 cm) and $C_3$ (2.80 cm) followed by at 1:1 and the lowest stem girth was registered at 2:1 row ratio of intercropping combination of fodder maize with fodder legume. This might be due to fact that with the introduction of intercropping there was increment in plant height in competition to

Table 3: Effect of intercropping system on fresh weight plant$^{-1}$, dry weight plant$^{-1}$, green fodder and dry fodder yield of fodder legumes

| Treatment | Fresh weight (plant$^{-1}$) | | | Dry weight (plant$^{-1}$) | | | GFY (t ha$^{-1}$) | | | DFY (t ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2022 | 2023 | Pooled | 2022 | 2023 | Pooled | 2022 | 2023 | Pooled | 2022 | 2023 | Pooled |
| $C_1$ | - | - | - | - | - | - | - | - | - | - | - | - |
| $C_2$ | 430.43 | 478.17 | 454.30 | 102.81 | 111.15 | 106.98 | 33.64 | 35.13 | 34.39 | 5.57 | 5.73 | 5.65 |
| $C_3$ | 240.98 | 255.60 | 248.29 | 34.05 | 35.06 | 34.55 | 33.23 | 35.20 | 34.22 | 5.10 | 5.22 | 5.16 |
| $C_4$ | 414.56 | 450.18 | 432.37 | 91.52 | 96.75 | 94.13 | 16.17 | 17.84 | 17.00 | 3.25 | 3.52 | 3.38 |
| $C_5$ | 237.70 | 243.21 | 240.45 | 27.24 | 27.61 | 27.42 | 16.97 | 18.49 | 17.73 | 2.48 | 2.82 | 2.65 |
| $C_6$ | 379.04 | 428.51 | 403.78 | 88.01 | 98.41 | 93.21 | 14.49 | 15.49 | 14.99 | 2.84 | 3.04 | 2.94 |
| $C_7$ | 187.20 | 189.63 | 188.41 | 21.62 | 21.79 | 21.70 | 14.08 | 15.91 | 14.99 | 2.24 | 2.48 | 2.36 |
| $C_8$ | 352.20 | 400.93 | 376.56 | 82.72 | 89.69 | 86.21 | 19.62 | 20.58 | 20.10 | 3.71 | 3.88 | 3.79 |
| $C_9$ | 234.49 | 242.55 | 238.52 | 27.66 | 27.66 | 27.66 | 18.16 | 20.26 | 19.21 | 2.75 | 3.08 | 2.91 |
| SEm± | 2.58 | 3.04 | 1.99 | 0.43 | 0.38 | 0.28 | 0.24 | 0.32 | 0.20 | 0.04 | 0.04 | 0.03 |
| CD (p=0.05) | 7.32 | 8.63 | 5.59 | 1.21 | 1.07 | 0.80 | 0.68 | 0.90 | 0.56 | 0.11 | 0.12 | 0.08 |

component crop, which might have caused reduction in stem girth of a plant. This finding was in similar with finding reported by Ginwal *et al.* (2019). They observed the higher stem girth of cowpea at sole crop than different row ratio. Leaf stem ratio is an important factor which is helpful in determining the digestibility and palatability of any fodder crop. Intercropping of fodder maize with fodder legumes in varying row ratio has significant influence on leaf stem ratio. The sole treatment $C_2$ (0.78) and $C_3$ (0.44) recorded the higher leaf stem ratio of fodder legumes. Among the different row ratio, $C_4$ and $C_9$ recorded the higher leaf stem ratio of fodder cowpea and fodder rice bean and the lowest was observed at 2:1 and 2:2 row ratio. Similarly, higher primary branches plant$^{-1}$ was also obtained at $C_2$ (5.67) and $C_3$ (4.20) which was followed by $C_4$ (0.77) and $C_9$ (0.43), while the lowest branches plant$^{-1}$ of fodder cowpea and fodder rice bean was observed at $C_8$ (5.44) and $C_5$(4.13) respectively. Higher primary branches plant$^{-1}$of fodder legumes lead to improved leaf stem ratio of the plant which tend to increased green fodder yield production by producing higher number of leaves and longer stems. The increased in primary branches improved the nutritional content in fodder, nitrogen fixation and also it helps in weed infestation and soil erosion in the field. The fresh weight and dry weight in fodder legumes is one of the important parameters for evaluating green biomass production of the plant. It also reflects the availability of palatable and succulent forage for livestock. The highest pooled fresh weight and dry weight of fodder cowpea and fodder rice bean was registered at treatment $C_2$ (454.30 g, 106.98 g) and $C_3$ (248.29 g, 34.55 g), while the lowest was observed at $C_8$ (376.56 g, 86.21 g) and $C_7$ (188.41 g, 21.70 g). The green fodder yield and dry fodder yield of fodder cowpea and fodder rice bean was again outperformed by the treatment $C_2$ (34.39 t ha$^{-1}$, 5.65 t ha$^{-1}$) and $C_3$ (34.55 t ha$^{-1}$, 5.16 t ha$^{-1}$) as compared to other treatments. The sole treatment $C_2$ and $C_3$ consistently showed the highest biomass production by both parameters in terms of the plant level and hectare scale. Among the different row ratio higher values of fresh weight, dry weight, green fodder yield and dry fodder yield of fodder cowpea and fodder rice bean was observed at 1:1 row intercropping with fodder maize. The lower obtained of fresh weight, dry weight, green fodder yield and dry fodder yield at 2:1 row ratio was possibly due to poor compatibility or competition. Ginwal *et al.* (2019) observed higher green fodder yield (29.96 t ha$^{-1}$) of fodder cowpea under sole crop. Correspondingly, Sharma (2008) and Tamta *et al.* (2019) also reported the higher obtained of green fodder yield of fodder cowpea and fodder rice bean under sole crop and thereon higher green fodder yield under different row ratio was recorded at 2:2 followed by 1:2 row ratio. Asangla (2015) also observed the higher green fodder yield of fodder cowpea growing as sole crop (31.98 t ha$^{-1}$). Likewise, Mohan *et al.* (2023) also observed higher stover of groundnut and soybean under sole plot as compared to grown together with rice at 3:1 ratio. Higher obtained of green fodder yield production at sole crop and then at 1:2 row ratio also proved by Tamta *et al.* (2019).Ginwal *et al.* (2019) reported the higher dry matter yield of fodder maize and cowpea at sole crop followed by 2:1 row ratio. Manoj *et al.* (2020) observed the higher dry matter yield of fodder maize (7.16 t ha$^{-1}$) and fodder cowpea (4.99 t ha$^{-1}$) under sole plot. Asangla (2015) also

reported the higher dry matter yield of fodder maize (16.53 t $ha^{-1}$) and fodder cowpea (9.13 t $ha^{-1}$) under sole crop.

## CONCLUSION

Based on the above investigation, it was observed that intercropping of fodder legumes with fodder maize under different row ratio improved the overall yield attributes of the crops by having complementary effect to each other. Among the different row ratio higher dry fodder yield and green fodder yield of the fodder legumes was observed at 2:1 followed by 1:1 row ratio. Keeping in view the objectives of the present study it may be concluded that intercropping of fodder legumes with fodder maize significantly influenced the growth parameters and dry and green fodder yield of fodder legumes. Thus, the present study can be recommended for commercial production of fodder to meet the present feeding demands for livestock production.

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## REFERENCES

Anonymous. (2019) 20$^{th}$Livestock Census. All India Report, DAHD&F. Ministry of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India.www.dahd.nic.in.

Asangla, H.K. (2015).Fodder production potential of maize (*Zea mays* L.) + cowpea (*Vignaunguiculata*) intercropping under different nitrogen levels. Ph. D thesis, School of Agricultural Sciences, Nagaland University.

Gaikwad, D.D., Pankhaniya, R.M., Singh, B., Patel, K.G. and Viridia, H.M. (2022) Studies on growth and productivity of maize-cowpea intercropping system under different spatial arrangements and nutrient levels. *The Pharma Innovation Journal,* **11**(2):2506-2512.

Ghanbari-Bonjar, A. (2000) Intercropped wheat (*Triticum aestivum*) and bean (*Vicia faba*) as a low-input forage. PhD thesis. Wye College, University of London.

Ginwal, D.S., Kumar, R., Ram, H., Dutta, S., Arjun, M. and Hindoriya, P.S. (2019) Fodder productivity and profitability of different maize and legume intercropping systems. *Indian Journal of Agricultural Sciences,* **89**(9):1451-1455.

Ginwal, D. S., Kumar, R., Ram, H., Meena, R. K. and Kumar, U. (2019) Quality characteristics and nutrient yields of maize and legume forages under changing intercropping row ratios. *Indian Journal of Animal Sciences,* **89**(3):281-286.

Gomez, K.A. and Gomez, A.A. (1984) Statistical procedures for Agricultural Research. John wiley and sons.

Kussie, B., Tadele, Y. and Asresie, A. (2024) Effect of maize (*Zea mays* L.) and cowpea (*Vigna anguiculata* L.) intercropping on agronomic performance, yield and nutritional values of maize and cowpea under supplementary irrigation. Heliyon, **10**:1-9.

Mohan, G., Gohain, T., Yadev, R., Longkumer, L.T. and Dolie, S. (2023) Intercropping of rice with groundnut and soybean with different nutrient management practices under rainfed conditions of Nagaland. *Annals of Plant and Soil Research,* **25**(3):404-411.

Manoj, K.N., Shekara, B.G. and Shoba, D. (2020) Production potential and forage quality of cereal-legume intercropping systems in Cauvery command area of Karnataka. *International Journal of Current Microbiology and Applied Sciences,* **9**(5):2319-7706.

Ross, S.M., King, J.R., Donovan, J.T. and Spaner, D. (2004) Intercropping berseem clover with barley and oat cultivars for forage. *Agronomy Journal,* **96**:1719 1729.

Sharma, R.P., Singh, A.K., Poddar, B.K. and Raman, K. R. (2008) Forage production potential and economics of maize (*Zea mays*) with legumes intercropping under various row Proportions. *Indian Journal of Agronomy* **53**(2):121-124.

Tamta, A., Kumar, R., Ram, H., Meena, R. K., Kumar, U., Yadav, M. R., Subrahmanya, D. J. and Pandey, A. K. (2019) Nutritional portfolio of maize and cowpea fodder under various intercropping ratio and balanced nitrogen fertilization. *Indian Journal of Animal Sciences* **89**(3):276-280.