Effect of Nitrogen and Spacing Levels on Physiological and Yield Parameters of Kasuri Methi (*Trigonella corniculata* L.) var. Pusa Kasuri

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**ABSTRACT**

A field experiment was conducted with 4 nitrogen and 4 spacing levels in factorial randomized block design with three replications. Maximum leaf area, chlorophyll content, AGR and fresh and dry yield per plant were recorded when the crop was applied with 80 kg N/ha with a spacing of 20 x 10 cm (N₄S₁) whereas the plant spaced at 20 x 10 cm (S₁) recorded maximum CGR, LAI, fresh and dry yield per hectare under the Northern dry zone of Karnataka.

**Keywords**

Kasuri methi (*Trigonella corniculata* L.) var. Pusa Kasuri, Nitrogen levels, Spacing levels, Physiological and yield parameters.

**Introduction**

Kasuri methi (*Trigonella corniculata* L.) is a semi-arid crop belonging to the family Fabaceae. It is commonly known as Champa methi’ and ‘marwari methi’, is a diffused sub erects and strongly scented annual herb. It remains rosette condition during most of the vegetative growth period (Anon., 2004). It is originated in Mediterranean region and near east countries. The dried leaves are the economic part of this plant. In India, it is mainly grown in northern states like Maharashtra, Rajasthan, Gujarat, Uttarpradesh, Madhya Pradesh, Haryana and Punjab. Rajasthan occupies 80 per cent area and production of Kasuri methi in the country.

Kasuri methi is a multipurpose crop. Its every part is useful and is utilized in one or other forms as food, fodder, medicine and cosmetics. The fresh green leaves are used as condiment for giving delicious flavor.

These have an aromatic odor and agreeable spicy taste. Being odoriferous, the dried seeds and their powder are used as condiment flavoring agent and for medicinal purposes. Kasuri methi has many uses such as flavoring
and medicinal purpose, is gaining importance in recent years and there is a good demand for the dried leaves in the market. The dried leaves are regularly sold in the super markets as popular flavoring material. The scientific information on cultivation and nutrient management of this crop is very less. Hence, present investigation is taken up to study its physiological and yield performance in southern part of India, particularly in Northern dry zone of Karnataka.

Considering the above facts, the present investigation was undertaken with the following objectives to study effect of nitrogen, spacing levels and their interaction on physiological and yield parameters of Kasuri methi var. Pusa Kasuri.

Materials and Methods

A field experiment was conducted at the department of Plantation, Spices, Medicinal and Aromatic Crops, Kittur Rani Channamma College of Horticulture, Arabhavi, University of Horticultural Sciences, Bagalkot from November, 2011 to January, 2012. Geographically, the Arabhavi lies in the Zone-3 of Region-2 in the agro-climatic zone of Karnataka. It is situated at 16°15' North latitude and 74°45' East longitude and at an altitude of 612 m above the mean sea level. The soil of the experimental site was medium deep black in texture. The experiment was laid out with 4 levels of nitrogen N₁- 20 kg, N₂- 40 kg, N₃- 60 kg and N₄- 80 kg N/ha and spacing levels viz., S₁- 20 x 10 cm, S₂- 20 x 20 cm, S₃- 30 x 10 cm and S₄- 30 x 20 cm. It was laid out in RBD with factorial concept in three replications.

Healthy seeds of variety Pusa Kasuri were used for sowing. They were sown on 28th November, 2011 as per the s above mentioned spacings. Furrows were properly covered with a thin layer of soil and the plots were irrigated with small stream of water. Farm yard manure was applied one week before the sowing of crop at the rate of 10 tons per hectare as a common dose for all the treatments. The plots were supplied with half the dose of nitrogen (in the form of urea) and full dose of phosphorus (in the form of single super phosphate) as per the treatments. The remaining half dose of nitrogen was supplemented 30 days after sowing as top dressing and the light earthing up was done. Observations on growth and yield parameters were recorded using five plants per plot and the data collected during the study was subjected to Statistical analysis using the Fischer’s method of analysis of variance technique as given by Panse and Sukhatme (1967).

Results and Discussion

Physiological parameters

Leaf area and leaf area index

The observations with respect to the effect of nitrogen, spacing and their interaction on leaf area at harvest and leaf area index are presented in table 1.

Among the nitrogen levels, N₄ recorded significantly higher leaf area (1683.32 cm²). Whereas, the minimum leaf area (344.51 cm²) was noticed in the N₁. Among the spacing level, the plants spaced at 30 x 20 cm (S₄) recorded significantly higher leaf area (1109.96 cm²), whereas, the minimum leaf area (745.66 cm²) was noticed in S₁ (20 x 10 cm). The significant variation in leaf area at harvest is due to interaction of nitrogen and spacing levels. However, the maximum N₄S₄ (1964.21 cm²), whereas, the minimum (220.14 cm²) leaf area recorded in N₁S₁.

Among the nitrogen levels, N₄ recorded significantly higher leaf area index (4.40).
While, the minimum leaf area index (0.98) was noticed in the N₁. Among the spacing levels, the plants spaced at 20 x 10 cm (S₁) recorded significantly higher leaf area index (3.73). Whereas the minimum leaf area index (1.85) was noticed in S₄ (30 x 20 cm). The significant variation in leaf area index at harvest due to interaction of nitrogen and spacing levels. However, the maximum LAI observed in treatment combination of N₄S₁ (7.56). Whereas, the minimum (0.74) LAI observed in N₁S₄.

Linear increases in leaf area and leaf area index were observed with increase in the nitrogen levels. This could be due to production of more number of leaves, branches and enhanced availability of nitrogen at the appropriate time, which has increased the leaf area and LAI. These results are in accordance with the findings of Mehta et al., (2010) in fenugreek, and Kattimani (1999) in Mentha arvensis L.

**Absolute Growth Rate (AGR)**

The observations with respect to the effect of different levels of nitrogen, spacing and their interaction on absolute growth rate (AGR) are presented in table 2. At 30-45 Days after sowing, the application of nitrogen recorded higher AGR in N₄ (0.274 g/day) and least AGR (0.162 g/day) in N₁ whereas plant density at S₁ recorded maximum AGR (0.240 g/day) and the minimum AGR observed in S₁ (0.204 g/day). The interaction between nitrogen and plant densities differs significantly for AGR. The maximum AGR were observed in N₄S₄ (0.322 g/day) followed by, N₄S₃ (0.310 g/day). While, the least AGR was recorded in N₁S₁ (0.262 g/day). At 61-75 Days after sowing, the maximum AGR recorded in 80 kg N per ha (N₄) (0.431 g/day).

Whereas the minimum AGR (0.262 g/day) was recorded in N₁. Whereas plant density at S₄ (0.382 g/day) recorded maximum AGR followed by, S₃ (0.365 g/day). While the minimum AGR observed in S₁ (0.337 g/day). The interactions between nitrogen and plant densities differ significantly for AGR. The maximum AGR were observed in N₄S₄ (0.445 g/day) followed by, N₄S₃ (0.432 g/day), N₄S₂ (0.430 g/day), N₄S₁ (0.417 g/day) and N₃S₄ (0.411 g/day). While the minimum AGR were observed in N₁S₁ (0.238 g/day).

The absolute growth rate was significant at all the stages of crop growth. This may be due to better vegetative growth in terms of highest plant height, number of leaves, branches and total dry matter accumulation in the plants supplied with higher levels of nitrogen. Parallel trend was observed by Patidar et al., (2004) in cumin.

**Cumulative Growth Rate (CGR)**

The observations with respect to the effect of different levels of nitrogen, spacing levels and their interaction on cumulative growth rate (CGR) are presented in table 3. At 30-45 Days after sowing, the application of nitrogen recorded higher CGR in N₄ (8.50 g/m²/day) and least (4.84 g/m²/day) was in N₁ whereas plant spaced at S₁ recorded maximum (10.18 g/m²/day) CGR while the minimum CGR was observed in S₄ (3.99 g/m²/day).
Table 1: Effect of nitrogen and spacing levels on leaf area and leaf area Index (at 60 DAS) of kasuri methi (*Trigonella corniculata* L.) var. Pusa Kasuri

| Treatment          | Leaf area (cm²) | Leaf area Index |
|--------------------|-----------------|----------------|
| **Nitrogen level (N)** |                 |                |
| N₁ : 20 kg/ha      | 344.51          | 0.98           |
| N₂ : 40 kg/ha      | 568.88          | 1.70           |
| N₃ : 60 kg/ha      | 1062.31         | 3.10           |
| N₄ : 80 kg/ha      | 1683.32         | 4.40           |
| Mean (N)           | 914.75          | 2.54           |
| S.Em±              | 22.24           | 0.06           |
| **Spacing level (S)** |                 |                |
| S₁ : 20x10 cm (50,000 plants/ha) | 745.66 | 3.73 |
| S₂ : 20x20 cm (25,000 plants/ha) | 855.70 | 2.14 |
| S₃ : 30x10 cm (3,33000 plants/ha) | 947.69 | 2.46 |
| S₄ : 30x20 cm (1,66000 plants/ha) | 1109.96 | 1.85 |
| Mean (S)           | 914.75          | 2.54           |
| S.Em±              | 22.24           | 0.06           |
| **Interaction (N x S)** |                 |                |
| N₁S₁               | 220.14          | 1.10           |
| N₁S₂               | 342.34          | 0.86           |
| N₁S₃               | 373.15          | 1.24           |
| N₁S₄               | 442.40          | 0.74           |
| N₂S₁               | 460.12          | 2.30           |
| N₂S₂               | 578.71          | 1.45           |
| N₂S₃               | 591.10          | 1.97           |
| N₂S₄               | 645.59          | 1.08           |
| N₃S₁               | 790.99          | 3.95           |
| N₃S₂               | 917.73          | 2.29           |
| N₃S₃               | 1152.86         | 3.84           |
| N₃S₄               | 1387.66         | 2.31           |
| N₄S₁               | 1511.40         | 7.56           |
| N₄S₂               | 1584.01         | 3.96           |
| N₄S₃               | 1673.66         | 2.79           |
| N₄S₄               | 1964.21         | 3.27           |
| Mean (N x S)       | 914.75          | 2.54           |
| S.Em±              | 44.49           | 0.13           |
| CD @ 5 %           | 128.49          | 0.36           |
### Table 2: Effect of nitrogen and spacing levels on AGR (absolute growth rate) of Kasuri methi (*Trigonella corniculata* L.) var. Pusa Kasuri

| Treatment | Absolute growth rate (g/day) at different stages of plant growth |
|-----------|---------------------------------------------------------------|
|           | 30-45 DAS | 46-60 DAS | 61-75 DAS |
| Nitrogen level (N) | | | |
| N₁ : 20 kg/ha | 0.162 | 0.214 | 0.262 |
| N₂ : 40 kg/ha | 0.210 | 0.225 | 0.342 |
| N₃ : 60 kg/ha | 0.241 | 0.230 | 0.402 |
| N₄ : 80 kg/ha | 0.274 | 0.295 | 0.431 |
| Mean (N) | 0.222 | 0.241 | 0.359 |
| S.Em± | 0.004 | 0.006 | 0.006 |
| CD @ 5% | 0.011 | 0.018 | 0.017 |
| Spacing level (S) | | | |
| S₁ : 20x10 cm (50,000 plants/ha) | 0.204 | 0.227 | 0.337 |
| S₂ : 20x20 cm (25,000 plants/ha) | 0.217 | 0.233 | 0.353 |
| S₃ : 30x10 cm (3,3300 plants/ha) | 0.227 | 0.247 | 0.365 |
| S₄ : 30x20 cm (1,6600 plants/ha) | 0.240 | 0.257 | 0.382 |
| Mean (S) | 0.240 | 0.241 | 0.359 |
| S.Em± | 0.022 | 0.006 | 0.006 |
| CD @ 5% | 0.011 | 0.018 | 0.017 |
| Interaction (N x S) | | | |
| N₁S₁ | 0.135 | 0.204 | 0.238 |
| N₁S₂ | 0.151 | 0.212 | 0.254 |
| N₁S₃ | 0.169 | 0.216 | 0.273 |
| N₁S₄ | 0.193 | 0.223 | 0.282 |
| N₂S₁ | 0.187 | 0.214 | 0.302 |
| N₂S₂ | 0.210 | 0.215 | 0.327 |
| N₂S₃ | 0.214 | 0.233 | 0.349 |
| N₂S₄ | 0.230 | 0.239 | 0.388 |
| N₃S₁ | 0.229 | 0.220 | 0.392 |
| N₃S₂ | 0.237 | 0.228 | 0.401 |
| N₃S₃ | 0.247 | 0.229 | 0.405 |
| N₃S₄ | 0.252 | 0.244 | 0.411 |
| N₄S₁ | 0.264 | 0.270 | 0.417 |
| N₄S₂ | 0.272 | 0.278 | 0.430 |
| N₄S₃ | 0.278 | 0.310 | 0.432 |
| N₄S₄ | 0.283 | 0.322 | 0.445 |
| Mean (N x S) | 0.222 | 0.241 | 0.359 |
| S.Em± | 0.007 | 0.012 | 0.012 |
| CD @ 5% | 0.021 | 0.035 | 0.034 |

* DAS- Days after sowing
Table 3: Effect of nitrogen and spacing levels on CGR (cumulative growth rate) of Kasuri methi (*Trigonella corniculata* L.) var. Pusa Kasuri

| Treatment | Cumulative Growth Rate (g/m²/day) | at different stage of plant growth |
|-----------|-----------------------------------|-----------------------------------|
|           | 30-45 DAS | 46-60 DAS | 61-75 DAS |
| Nitrogen level (N) | | | |
| N₁: 20 kg/ha | 4.84 | 6.61 | 8.02 |
| N₂: 40 kg/ha | 6.39 | 6.95 | 10.34 |
| N₃: 60 kg/ha | 7.45 | 7.10 | 12.48 |
| N₄: 80 kg/ha | 8.50 | 9.04 | 13.34 |
| Mean (N) | 6.80 | 7.42 | 11.05 |
| S.Em± | 0.11 | 0.24 | 0.25 |
| CD @ 5% | 0.32 | 0.70 | 0.72 |
| Spacing level (S) | | | |
| S₁: 20x10 cm (50,000 plants/ha) | 10.18 | 11.34 | 16.85 |
| S₂: 20x20 cm (25,000 plants/ha) | 5.44 | 5.83 | 8.82 |
| S₃: 30x10 cm (3,33000 plants/ha) | 7.57 | 8.24 | 12.15 |
| S₄: 30x20 cm (1,66000 plants/ha) | 3.99 | 4.28 | 6.36 |
| Mean (S) | 6.80 | 87.42 | 11.05 |
| S.Em± | 0.11 | 0.24 | 0.25 |
| CD @ 5% | 0.32 | 0.70 | 0.72 |
| Interaction (N x S) | | | |
| N₁S₁ | 6.74 | 10.20 | 11.90 |
| N₁S₂ | 3.77 | 5.31 | 6.36 |
| N₁S₃ | 5.64 | 7.21 | 9.10 |
| N₁S₄ | 3.22 | 3.72 | 4.71 |
| N₂S₁ | 9.34 | 10.68 | 15.10 |
| N₂S₂ | 5.24 | 5.37 | 8.18 |
| N₂S₃ | 7.13 | 7.77 | 11.62 |
| N₂S₄ | 3.84 | 3.99 | 6.47 |
| N₃S₁ | 11.43 | 11.00 | 19.58 |
| N₃S₂ | 5.93 | 5.71 | 10.02 |
| N₃S₃ | 8.24 | 7.64 | 13.50 |
| N₃S₄ | 4.20 | 4.06 | 6.85 |
| N₄S₁ | 13.21 | 13.49 | 20.83 |
| N₄S₂ | 6.80 | 6.96 | 10.74 |
| N₄S₃ | 9.26 | 10.34 | 14.39 |
| N₄S₄ | 4.71 | 5.36 | 7.41 |
| Mean (N x S) | 6.80 | 7.42 | 11.05 |
| S.Em± | 0.22 | 0.48 | 0.50 |
| CD @ 5% | 0.64 | 0.39 | 1.43 |

* DAS- Days after sowing
Table 4: Effect of nitrogen and spacing levels on chlorophyll contents in kasuri methi (*Trigonella corniculata* L.) var. Pusa Kasuri

| Treatment | Chlorophyll contents (mg/100mg of tissue at 60 DAS) | Total chlorophyll content |
|-----------|-----------------------------------------------|--------------------------|
|           | Chlorophyll-‘a’ | Chlorophyll-‘b’ |                       |
| Nitrogen level (N) |                                |                        |
| N<sub>1</sub> : 20 kg/ha | 0.78 | 0.30 | 1.08 |
| N<sub>2</sub> : 40 kg/ha | 1.41 | 0.36 | 1.77 |
| N<sub>3</sub> : 60 kg/ha | 1.50 | 0.76 | 2.26 |
| N<sub>4</sub> : 80 kg/ha | 1.61 | 1.38 | 2.99 |
| Mean (N) | 1.32 | 0.70 | 2.02 |
| S.Em± | 0.02 | 0.05 | 0.05 |
| CD @ 5% | 0.07 | 0.14 | 0.14 |

| Spacing level (S) |                                |                        |
|-------------------|---------------------------------|------------------------|
| S<sub>1</sub> : 20x10 cm (50,000 plants/ha) | 1.00 | 0.48 | 1.47 |
| S<sub>2</sub> : 20x20 cm (25,000 plants/ha) | 1.29 | 0.59 | 1.88 |
| S<sub>3</sub> : 30x10 cm (3,33000 plants/ha) | 1.46 | 0.77 | 2.23 |
| S<sub>4</sub> : 30x20 cm (1,66000 plants/ha) | 1.55 | 0.96 | 2.51 |
| Mean (S) | 1.32 | 0.70 | 2.02 |
| S.Em± | 0.02 | 0.05 | 0.05 |
| CD @ 5% | 0.07 | 0.14 | 0.14 |

| Interaction (N x S) |                                |                        |
|---------------------|---------------------------------|------------------------|
| N<sub>1</sub>S<sub>1</sub> | 0.14 | 0.04 | 0.17 |
| N<sub>1</sub>S<sub>2</sub> | 0.73 | 0.23 | 0.96 |
| N<sub>1</sub>S<sub>3</sub> | 1.12 | 0.33 | 1.45 |
| N<sub>1</sub>S<sub>4</sub> | 1.13 | 0.59 | 1.72 |
| N<sub>2</sub>S<sub>1</sub> | 1.29 | 0.24 | 1.52 |
| N<sub>2</sub>S<sub>2</sub> | 1.37 | 0.27 | 1.63 |
| N<sub>2</sub>S<sub>3</sub> | 1.37 | 0.43 | 1.80 |
| N<sub>2</sub>S<sub>4</sub> | 1.60 | 0.51 | 2.11 |
| N<sub>3</sub>S<sub>1</sub> | 1.35 | 0.56 | 1.91 |
| N<sub>3</sub>S<sub>2</sub> | 1.36 | 0.65 | 2.00 |
| N<sub>3</sub>S<sub>3</sub> | 1.63 | 0.78 | 2.41 |
| N<sub>3</sub>S<sub>4</sub> | 1.65 | 1.06 | 2.74 |
| N<sub>4</sub>S<sub>1</sub> | 1.22 | 1.07 | 2.29 |
| N<sub>4</sub>S<sub>2</sub> | 1.71 | 1.21 | 2.93 |
| N<sub>4</sub>S<sub>3</sub> | 1.72 | 1.55 | 3.26 |
| N<sub>4</sub>S<sub>4</sub> | 1.80 | 1.67 | 3.48 |
| Mean (N x S) | 1.32 | 0.70 | 2.02 |
| S.Em± | 0.05 | 0.10 | 0.09 |
| CD @ 5% | 0.14 | 0.28 | 0.27 |
Table.5 Effect of nitrogen and spacing levels on fresh and dry yield of Kasuri methi 
(*Trigonella corniculata* L.) var. Pusa Kasuri

| Treatment          | Fresh yield (g/plant) | Fresh yield (t/ha) | Dry yield (g/plant) | Dry yield (t/ha) |
|--------------------|-----------------------|--------------------|---------------------|------------------|
| **Nitrogen level (N)** |                       |                    |                     |                  |
| N₁ : 20 kg/ha      | 55.23                 | 17.15              | 11.00               | 3.42             |
| N₂ : 40 kg/ha      | 57.87                 | 17.99              | 11.58               | 3.59             |
| N₃ : 60 kg/ha      | 59.61                 | 18.59              | 12.10               | 3.77             |
| N₄ : 80 kg/ha      | 63.36                 | 19.61              | 12.55               | 3.90             |
| **Mean (N)**       | 59.02                 | 18.33              | 11.81               | 3.67             |
| S.Em±              | 0.42                  | 0.13               | 0.03                | 0.01             |
| CD @ 5 %           | 1.22                  | 0.39               | 0.08                | 0.03             |
| **Spacing level (S)** |                       |                    |                     |                  |
| S₁ : 20x10 cm(50,000 plants/ha) | 57.77   | 28.88              | 11.60               | 5.80             |
| S₂ : 20x20 cm(25,000 plants/ha) | 58.4     | 14.6               | 11.72               | 2.93             |
| S₃ : 30x10 cm(3, 33000 plants/ha) | 59.54   | 19.83              | 11.87               | 3.95             |
| S₄ : 30x20 cm(1, 66000 plants/ha) | 60.36   | 10.02              | 12.04               | 2.00             |
| **Mean (S)**       | 59.02                 | 18.33              | 11.81               | 3.67             |
| S.Em±              | 0.42                  | 0.13               | 0.03                | 0.01             |
| CD @ 5 %           | 1.22                  | 0.39               | 0.08                | 0.03             |
| **Interaction (N x S)** |                       |                    |                     |                  |
| N₁S₁               | 54.02                 | 27.01              | 10.74               | 5.37             |
| N₁S₂               | 54.55                 | 13.64              | 10.90               | 2.73             |
| N₁S₃               | 55.7                  | 18.55              | 11.11               | 3.70             |
| N₁S₄               | 56.63                 | 9.4                | 11.25               | 1.87             |
| N₂S₁               | 56.63                 | 28.32              | 11.29               | 5.65             |
| N₂S₂               | 57.48                 | 14.37              | 11.46               | 2.86             |
| N₂S₃               | 58.57                 | 19.5               | 11.67               | 3.89             |
| N₂S₄               | 58.8                  | 9.76               | 11.88               | 1.97             |
| N₃S₁               | 59.22                 | 29.61              | 11.97               | 5.99             |
| N₃S₂               | 59.59                 | 14.9               | 12.07               | 3.02             |
| N₃S₃               | 59.73                 | 19.89              | 12.13               | 4.04             |
| N₃S₄               | 59.9                  | 9.94               | 12.24               | 2.03             |
| N₄S₁               | 61.2                  | 30.6               | 12.38               | 6.19             |
| N₄S₂               | 61.98                 | 15.5               | 12.47               | 3.12             |
| N₄S₃               | 64.16                 | 21.37              | 12.56               | 4.18             |
| N₄S₄               | 66.1                  | 10.97              | 12.80               | 2.13             |
| **Mean (N x S)**   | 59.02                 | 18.33              | 11.81               | 3.67             |
| S.Em±              | 0.84                  | 0.27               | 0.06                | 0.02             |
| CD at 5 %          | 2.44                  | 0.77               | 0.16                | 0.06             |
The interaction between nitrogen and plant densities differs significantly for CGR. The maximum CGR was observed in N₄S₁ (13.21 g/m²/day) whereas the minimum CGR was recorded in N₂S₄ (3.22 g/day). At 46-60 Days after sowing, the nitrogen level N₄ recorded maximum CGR (9.04 g/m²/day) and minimum CGR (6.61 g/m²/day) was recorded in N₁. The plants spaced at 30 x 20 cm (S₁) recorded the maximum CGR (11.34 g/day) and minimum was recorded in S₄ (4.28 g/m²/day).

The interaction between nitrogen and plant densities differs significantly for CGR. The higher CGR was observed in treatment combination of N₄S₁ (13.49 g/m²/day) and least CGR was recorded in N₁S₄ (3.72 g/m²/day). At 61-75 Days after sowing, the nitrogen level N₄ recorded maximum CGR (13.34 g/m²/day) and minimum CGR (8.02 g/m²/day) was recorded in N₁. The plants spaced at 20 x 10 cm (S₁) recorded the maximum CGR (16.85 g/m²/day) while the minimum was recorded in S₄ (6.36 g/m²/day).

The interactions between nitrogen and plant densities differ significantly for CGR. The maximum CGR were observed in treatment combination of N₄S₁ (20.83 g/m²/day) and minimum CGR was observed in N₁S₄ (4.71 g/m²/day).

The cumulative growth rate was significant at all stages of crop growth. This might be due to higher dose of nitrogen which helps in dry matter accumulation in the plants. Similar trend was observed by Santhosh et al., (2010) in garden cress.

**Chlorophyll contents**

The data regarding the Chlorophyll content as influenced by different nitrogen, spacing levels and their interactions are presented in table 4.

**Content of chlorophyll- a**

Among the nitrogen levels, N₄ (80 kg N/ha) recorded significantly higher chlorophyll- a (1.61 mg/100mg of tissue). While, the minimum chlorophyll-a content (0.78 mg/100mg of tissue) was noticed in the N₁ (20 kg N/ha).

Among the spacing levels, the plants spaced at 30 x 20 cm (S₄) recorded significantly higher chlorophyll-a content (1.55 mg/100mg of tissue) and minimum chlorophyll-a content (1.00 mg/100mg of tissue) was noticed in S₁ (20 x 10 cm). The significant variations on in chlorophyll-a content at harvest due to interaction of nitrogen levels and plant densities.

The maximum chlorophyll-a content was observed in treatment combination of N₄S₄ (1.80 mg/100mg of tissue) followed by, N₄S₂ (1.71 mg/100mg of tissue) and N₄S₃ (1.72 mg/100mg of tissue). While the minimum (0.14 mg/100mg of tissue) chlorophyll-a content was observed in N₁S₁.

**Content of chlorophyll- b**

Among the nitrogen levels, N₄ recorded significantly maximum chlorophyll- b (1.38 mg/100mg of tissue). While the minimum chlorophyll-b (0.30 mg/100mg of tissue) was noticed in the N₁ (20 kg N/ha). Among the spacing levels, the plants spaced at 30 x 20 cm (S₄) recorded significantly maximum chlorophyll- b (0.96 mg/100mg of tissue).

However, the minimum (0.48 mg/100mg of tissue) chlorophyll- b content was noticed in S₁. The significant variations were observed in chlorophyll-b content at harvest due to interaction of nitrogen and spacing levels. The maximum chlorophyll- b content observed in treatment combination of N₄S₄ (1.67 mg/100mg of tissue) and was followed by
N₄S₃ (1.55 mg/100mg of tissue). While, the minimum (0.04 mg/100mg of tissue) chlorophyll-b content observed in N₁S₁.

**Total chlorophyll content**

Among the nitrogen levels, N₄ (80 kg N/ha) recorded significantly higher total chlorophyll content (2.99 mg/100mg of tissue). While, the minimum total chlorophyll content (1.08 mg/100mg of tissue) was noticed in the N₁ (20 kg N/ha). Among the spacing levels, the plants spaced at 30 x 20 (S₄) recorded significantly higher total chlorophyll content (2.51 mg/100mg of tissue). However, the minimum total chlorophyll content (1.47 mg/100mg of tissue) was noticed in S₁.

The significant variations were recorded for chlorophyll content at harvest due to interaction of nitrogen levels and plant densities. The maximum total chlorophyll content recorded in the treatment combination of N₄S₁ (3.48 mg/100mg of tissue) and was followed by N₄S₃ (3.26 mg/100mg of tissue). The minimum (0.17 mg/100mg of tissue) chlorophyll-a content observed in N₁S₁.

The chlorophyll content in leaves differed significantly due to different levels of nitrogen. This might be due to increased nitrogen supply which would retard leaf senescence and improve photosynthate and nitrogen availability for seed biomass. Similar results were noticed by Mitra and Ghildiyal (1988) and Kulsum et al., (2007) in black gram.

**Yield parameters**

Observation pertaining to fresh herbage yield per plant as influenced by different levels of nitrogen, spacing and their interactions are presented in table 5. Among the nitrogen levels, application of N₄ recorded the maximum total fresh yield per plant (63.36 g). While the minimum total fresh yield per plant (55.23 g) was recorded in N₁. Significantly higher fresh yield per plant (60.36 g) was recorded in S₃ and it was on par with S₃ (59.54 g). Whereas, the lowest total fresh yield per plant (57.77 g) was recorded in S₁. The interaction between nitrogen and spacing levels differ significantly for total fresh yield per plant.

The highest fresh yield per plant was observed in N₂S₄ (66.10 g) and N₄S₃ (64.16 g) was found to be next best treatment. While, the minimum total fresh yield per plant was recorded in N₁S₁ (54.02 g). The maximum total fresh yield per hectare (19.61 t) was noticed in N₄. While, the minimum fresh yield per hectare (17.15 t) was recorded in N₁. The S₁ recorded significantly higher total fresh yield per hectare (28.88 t). Whereas, the lowest total fresh yield per hectare (10.02) was recorded in S₄.

The nitrogen level N₄ exhibited higher total dry yield per plant (12.55 g) while, the least total dry yield per plant (11.00 g) was observed in N₁. Among the different spacing levels, S₄ recorded significantly higher dry yield per plant (12.04 g). Whereas, the lowest dry yield per plant (11.60 g) was noticed in S₁. The dry yield per plant varied significantly due to interaction of nitrogen and spacing levels. The maximum (12.80 g) and minimum (10.74 g) dry yield per plant was reported in N₄S₄ and N₁S₁ treatment combination, respectively.

The maximum total dry yield per hectare (3.90 t) was recorded in N₄ (80 kg N/ha) and minimum total dry yield per hectare (3.42 t) observed in N₁. The closer spacing of 20 x 10 cm (S₁) recorded significantly higher total dry yield per plant (5.80 t). Whereas, the lowest total dry yield per hectare (2.10 t) was noticed in S₄. The interaction between nitrogen and spacing levels differed significantly for total dry yield per hectare. The maximum total dry yield per hectare was observed in N₂S₁ (6.19 t) whereas, the minimum total dry yield per hectare was recorded in N₁S₄ (1.87 t).

The fresh and dry yield per plant, per plot and per hectare differed significantly due to different levels of nitrogen. The increase in yield might be attributed to the fact that under increasing nitrogen levels, there would be
luxuriant growth of the plant which is evident from vegetative growth, which led to the production of more fresh and dry herbage yield. These results are conformity with the findings of Bhaskar (1995) in patchouli, Balyan and Sobti (1990) in Ocimum gratissimum, Meena et al., (2006) in fenugreek and Datta et al., (2005) in fenugreek.

From the present investigation, it can be concluded that the Kasuri methi is beneficial for obtaining the maximum physiological and higher yield parameters, under the northern dry zone of Karnataka.

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