Int.J.Curr.Microbiol.App.Sci (2017) *6*(9): 723-733

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 9 (2017) pp. 723-733**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.609.089

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

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Keywords

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

Article Info

Accepted:
14 July 2017
Available Online:
10 September 2017

A B S T R A C T

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 (N_4S_1) whereas the plant spaced at 20 x 10 cm (S_1) recorded maximum CGR, LAI, fresh and dry yield per hectare under the Northern dry zone of Karnataka.

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 $16^{O}15^{'}$ North latitude and 74^{0} $45^{'}$ 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 N_1- 20 kg, N_2- 40 kg, N_3- 60 kg and N_4- 80 kg N/ha and spacing levels *viz.*, S_1- 20 x 10 cm, S_2- 20 x 20 cm, S_3- 30 x 10 cm and S_4- 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 28^{th} 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, N_4 recorded significantly higher leaf area (1683.32 cm^2). Whereas, the minimum leaf area (344.51cm^2) was noticed in the N_1. Among the spacing level, the plants spaced at 30 x 20 cm (S_4) recorded significantly higher leaf area (1109.96 cm^2), whereas, the minimum leaf area (745.66 cm^2) was noticed in S_1 (20 x 10 cm). The significant variation in leaf area at harvest is due to interaction of nitrogen and spacing levels. However, the maximum N_4S_4 (1964.21 cm^2), whereas, the minimum (220.14 cm^2) leaf area recorded in N_1S_1.

Among the nitrogen levels, N_4 recorded significantly higher leaf area index (4.40).

While, the minimum leaf area index (0.98) was noticed in the N_1. Among the spacing levels, the plants spaced at 20 x10 cm (S_1) recorded significantly higher leaf area index (3.73). Whereas the minimum leaf area index (1.85) was noticed in S_4 (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 N_4S_1 (7.56). Whereas, the minimum (0.74) LAI observed in N_1S_4.

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 N_4 (0.274 g/day) and least AGR (0.162g/day) in N_1 whereas plant density at S_4 recorded maximum AGR (0.240 g/day) and the minimum AGR observed in S_1 (0.204 g/day). The interaction between nitrogen and plant densities differs significantly for AGR. The maximum AGR was observed in treatment combination of N_4S_4 (0.283 g/day) followed by, N_4S_3 (0.278 g/day), N_4S_2 (0.272 g/day) and N_4S_1 (0.264 g/day).While, the minimum AGR was recorded in N_1S_1 (0.135 g/day). At 46-60 DAS the Maximum AGR recorded in N_4 (0.295 g/day) whereas minimum AGR (0.214 g/day) was noticed in N_1.The plants spaced at 30 x 20 cm (S_4) recorded the maximum AGR (0.257 g/day) followed by S_3 (0.247 g/day) while the minimum was recorded in S_1 (0.227 g/day). The interaction between nitrogen and plant densities differed significantly for AGR. The higher AGR was observed in N_4S_4 (0.322 g/day) followed by, N_4S_3 (0.310 g/day).While, the least AGR was recorded in N_1S_1 (0.204 g/day). At 61-75 Days after sowing, the maximum AGR recorded in 80 kg N per ha (N_4) (0.431 g/day).

Whereas the minimum AGR (0.262 g/day) was recorded in N_1. Whereas plant density at S_4 (0.382 g/day) recorded maximum AGR followed by, S_3 (0.365 g/day). While the minimum AGR observed in S_1 (0.337 g/day). The interactions between nitrogen and plant densities differ significantly for AGR. The maximum AGR were observed in N_4S_4 (0.445 g/day) followed by, N_4S_3 (0.432 g/day), N_4S_2 (0.430 g/day), N_4S_1 (0.417 g/day) and N_3S_4 (0.411 g/day). While the minimum AGR were observed in N_1S_1 (0.238g/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 **a**pplication of nitrogen recorded higher CGR in N_4 (8.50 g/m2/day) and least (4.84 g/m2/day) was in N_1 whereas plant spaced at S_1 recorded maximum (10.18 g/m2/day) CGR while the minimum CGR was observed in S_4 (3.99 g/m^2/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 (cm^2)	Leaf area Index
Nitrogen level (N)		
N_1 : 20 kg/ ha	344.51	0.98
N_2 : 40 kg/ ha	568.88	1.70
N_3 : 60 kg /ha	1062.31	3.10
N_4 : 80 kg /ha	1683.32	4.40
Mean (N)	914.75	2.54
S.Em±	22.24	0.06
CD @ 5 %	64.25	0.18
Spacing level (S)		
S_1 : 20x10 cm (50,000 plants/ha)	745.66	3.73
S_2 : 20x20 cm (25,000 plants/ha)	855.70	2.14
S_3 : 30x10 cm (3, 33000 plants/ha)	947.69	2.46
S_4 : 30x20 cm (1, 66000 plants/ha)	1109.96	1.85
Mean (S)	914.75	2.54
S.Em±	22.24	0.06
CD @ 5 %	64.25	0.18
Interaction (N x S)		
N_1S_1	220.14	1.10
N_1S_2	342.34	0.86
N_1S_3	373.15	1.24
N_1S_4	442.40	0.74
N_2S_1	460.12	2.30
N_2S_2	578.71	1.45
N_2S_3	591.10	1.97
N_2S_4	645.59	1.08
N_3S_1	790.99	3.95
N_3S_2	917.73	2.29
N_3S_3	1152.86	3.84
N_3S_4	1387.66	2.31
N_4S_1	1511.40	7.56
N_4S_2	1584.01	3.96
N_4S_3	1673.66	2.79
N_4S_4	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)			
N_1 : 20 kg/ ha	0.162	0.214	0.262
N_2 : 40 kg/ ha	0.210	0.225	0.342
N_3 : 60 kg /ha	0.241	0.230	0.402
N_4 : 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)			
S_1 : 20x10 cm (50,000 plants/ha)	0.204	0.227	0.337
S_2 : 20x20 cm (25,000 plants/ha)	0.217	0.233	0.353
S_3 : 30x10 cm (3, 33000 plants/ha)	0.227	0.247	0.365
S_4 : 30x20 cm (1, 66000 plants/ha)	0.240	0.257	0.382
Mean (S)	0.240	0.241	0.359
S.Em±	0.222	0.006	0.006
CD @ 5 %	0.011	0.018	0.017
Interaction (N x S)			
N_1S_1	0.135	0.204	0.238
N_1S_2	0.151	0.212	0.254
N_1S_3	0.169	0.216	0.273
N_1S_4	0.193	0.223	0.282
N_2S_1	0.187	0.214	0.302
N_2S_2	0.210	0.215	0.327
N_2S_3	0.214	0.233	0.349
N_2S_4	0.230	0.239	0.388
N_3S_1	0.229	0.220	0.392
N_3S_2	0.237	0.228	0.401
N_3S_3	0.247	0.229	0.405
N_3S_4	0.252	0.244	0.411
N_4S_1	0.264	0.270	0.417
N_4S_2	0.272	0.278	0.430
N_4S_3	0.278	0.310	0.432
N_4S_4	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/m^2/day) at different stage of plant growth		
	30-45 DAS	46-60 DAS	61-75 DAS
Nitrogen level (N)			
N_1 : 20 kg/ ha	4.84	6.61	8.02
N_2 : 40 kg/ ha	6.39	6.95	10.34
N_3 : 60 kg/ ha	7.45	7.10	12.48
N_4 : 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)			
S_1 : 20x10 cm (50,000 plants/ha)	10.18	11.34	16.85
S_2 : 20x20 cm (25,000 plants/ha)	5.44	5.83	8.82
S_3 : 30x10 cm (3, 33000 plants/ha)	7.57	8.24	12.15
S_4 : 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)			
N_1S_1	6.74	10.20	11.90
N_1S_2	3.77	5.31	6.36
N_1S_3	5.64	7.21	9.10
N_1S_4	3.22	3.72	4.71
N_2S_1	9.34	10.68	15.10
N_2S_2	5.24	5.37	8.18
N_2S_3	7.13	7.77	11.62
N_2S_4	3.84	3.99	6.47
N_3S_1	11.43	11.00	19.58
N_3S_2	5.93	5.71	10.02
N_3S_3	8.24	7.64	13.50
N_3S_4	4.20	4.06	6.85
N_4S_1	13.21	13.49	20.83
N_4S_2	6.80	6.96	10.74
N_4S_3	9.26	10.34	14.39
N_4S_4	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)		
	Chlorophyll-'a'	Chlorophyll-'b'	Total chlorophyll content
Nitrogen level (N)			
N_1 : 20 kg/ ha	0.78	0.30	1.08
N_2 : 40 kg/ ha	1.41	0.36	1.77
N_3 : 60 kg /ha	1.50	0.76	2.26
N_4 : 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_1 : 20x10 cm (50,000 plants/ha)	1.00	0.48	1.47
S_2 : 20x20 cm (25,000 plants/ha)	1.29	0.59	1.88
S_3 : 30x10 cm (3, 33000 plants/ha)	1.46	0.77	2.23
S_4 : 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_1S_1	0.14	0.04	0.17
N_1S_2	0.73	0.23	0.96
N_1S_3	1.12	0.33	1.45
N_1S_4	1.13	0.59	1.72
N_2S_1	1.29	0.24	1.52
N_2S_2	1.37	0.27	1.63
N_2S_3	1.37	0.43	1.80
N_2S_4	1.60	0.51	2.11
N_3S_1	1.35	0.56	1.91
N_3S_2	1.36	0.65	2.00
N_3S_3	1.63	0.78	2.41
N_3S_4	1.65	1.06	2.74
N_4S_1	1.22	1.07	2.29
N_4S_2	1.71	1.21	2.93
N_4S_3	1.72	1.55	3.26
N_4S_4	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)				
N_1 : 20 kg/ha	55.23	17.15	11.00	3.42
N_2 : 40 kg /ha	57.87	17.99	11.58	3.59
N_3 : 60 kg /ha	59.61	18.59	12.10	3.77
N_4 : 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)				
S_1 : 20x10 cm(50,000 plants/ha)	57.77	28.88	11.60	5.80
S_2 : 20x20 cm(25,000 plants/ha)	58.4	14.6	11.72	2.93
S_3 : 30x10 cm(3, 33000 plants/ha)	59.54	19.83	11.87	3.95
S_4 : 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)				
N_1S_1	54.02	27.01	10.74	5.37
N_1S_2	54.55	13.64	10.90	2.73
N_1S_3	55.7	18.55	11.11	3.70
N_1S_4	56.63	9.4	11.25	1.87
N_2S_1	56.63	28.32	11.29	5.65
N_2S_2	57.48	14.37	11.46	2.86
N_2S_3	58.57	19.5	11.67	3.89
N_2S_4	58.8	9.76	11.88	1.97
N_3S_1	59.22	29.61	11.97	5.99
N_3S_2	59.59	14.9	12.07	3.02
N_3S_3	59.73	19.89	12.13	4.04
N_3S_4	59.9	9.94	12.24	2.03
N_4S_1	61.2	30.6	12.38	6.19
N_4S_2	61.98	15.5	12.47	3.12
N_4S_3	64.16	21.37	12.56	4.18
N_4S_4	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 N_4S_1 (13.21g/m^2/day) whereas the minimum CGR was recorded in N_2S_4 (3.22 g/day). At 46-60 Days after sowing, the nitrogen level N_4 recorded maximum CGR (9.04 g/m^2/day) and minimum CGR (6.61 g/m^2/day) was recorded in N_1.The plants spaced at 30 x 20 cm (S_1) recorded the maximum CGR (11.34 g/day) and minimum was recorded in S_4 (4.28 g/m^2/day).

The interaction between nitrogen and plant densities differs significantly for CGR. The higher CGR was observed in treatment combination of N_4S_1 (13.49 g/m^2/day) and least CGR was recorded in N_1S_4 (3.72 g/m^2/day). At 61-75 Days after sowing, the nitrogen level N_4 recorded maximum CGR (13.34 g/m^2/day) and minimum CGR (8.02 g/m^2/day) was recorded in N_1. The plants spaced at 20 x 10 cm (S_1) recorded the maximum CGR (16.85 g/m^2/day) while the minimum was recorded in S_4 (6.36 g/m^2/day).

The interactions between nitrogen and plant densities differ significantly for CGR. The maximum CGR were observed in treatment combination of N_4S_1 (20.83 g/m^2/day and minimum CGR was observed in N_1S_4 (4.71 g/m^2/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, N_4 (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 N_1 (20 kg N/ha).

Among the spacing levels, the plants spaced at 30 x 20 cm (S_4) 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 S_1 (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 N_4S_4 (1.80 mg/100mg of tissue) followed by, N_4S_2 (1.71 mg/100mg of tissue) and N_4S_3 (1.72 mg/100mg of tissue). While the minimum (0.14 mg/100mg of tissue) chlorophyll-a content was observed in N_1S_1.

Content of chlorophyll- b

Among the nitrogen levels, N_4 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 N_1 (20 kg N/ha). Among the spacing levels, the plants spaced at 30 x 20 cm (S_4) 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 S_1. 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 N_4S_4 (1.67 mg/100mg of tissue) and was followed by

N_4S_3 (1.55 mg/100mg of tissue). While, the minimum (0.04 mg/100mg of tissue) chlorophyll-b content observed in N_1S_1.

Total chlorophyll content

Among the nitrogen levels, N_4 (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 N_1 (20 kg N/ha). Among the spacing levels, the plants spaced at 30 x 20 (S_4) 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 S_1.

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 N_4S_4 (3.48 mg/100mg of tissue) and was followed by N_4S_3 (3.26 mg/100mg of tissue). The minimum (0.17 mg/100mg of tissue) chlorophyll-a content observed in N_1S_1.

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 N_4 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 N_1. Significantly higher fresh yield per plant (60.36 g) was recorded in S_4 and it was on par with S_3 (59.54 g). Whereas, the lowest total fresh yield per plant (57.77 g) was recorded in S_1. The interaction between nitrogen and spacing levels differ significantly for total fresh yield per plant.

The highest fresh yield per plant was observed in N_4S_4 (66.10 g) and N_4S_3 (64.16 g) was found to be next best treatment. While, the minimum total fresh yield per plant was recorded in N_1S_1 (54.02 g). The maximum total fresh yield per hectare (19.61 t) was noticed in N_4. While, the minimum fresh yield per hectare (17.15 t) was recorded in N_1.The S_1 recorded significantly higher total fresh yield per hectare (28.88 t). Whereas, the lowest total fresh yield per hectare (10.02) was recorded in S_4.

The nitrogen level N_4 exhibited higher total dry yield per plant (12.55 g) while, the least total dry yield per plant (11.00 g) was observed in N_1. Among the different spacing levels, S_4 recorded significantly higher dry yield per plant (12.04 g). Whereas, the lowest dry yield per plant (11.60 g) was noticed in S_1. 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 N_4S_4 and N_1S_1 treatment combination, respectively.

The maximum total dry yield per hectare (3.90 t) was recorded in N_4 (80 kg N/ha) and minimum total dry yield per hectare (3.42 t) observed in N_1. The closer spacing of 20 x 10 cm (S_1) recorded significantly higher total dry yield per hectare (5.80 t). Whereas, the lowest total dry yield per hectare (2.0 t) was noticed in S_4. 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 N_4S_1 (6.19 t) whereas, the minimum total dry yield per hectare was recorded in N_1S_4 (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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How to cite this article:

Anupama, G., L.N. Hegde, N.K. Hegde, V. Devappa, A.B. Mastiholi and Sandhyarani Nishani. 2017. Effect of Nitrogen and Spacing Levels on Physiological and Yield Parameters of Kasuri Methi (*Trigonella corniculata* L.) var. Pusa Kasuri. *Int.J.Curr.Microbiol.App.Sci.* 6(9): 723-733. doi: https://doi.org/10.20546/ijcmas.2017.609.089