

Influence of Integrated Nutrient Management on Growth and Physiological Attributes of Kasuri Methi (*Trigonella corniculata* L.) under Hill Zone of Karnataka

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Abstract An experiment was conducted during winter season of 2013-14 to assess the influence of integrated nutrient management on growth and physiological attributes of kasuri methi (*Trigonella corniculata* L.) under hill zone of Karnataka. Growth parameters differed significantly at all the stages of crop growth. At 90 DAS and at harvest, maximum plant height (42.81 and 45.64 cm), number of leaves (58.89 and 86.05), number of branches (23.51 and 25.64), plant spread (NS 28.20 & 30.14, EW 29.01 and 30.47 cm) respectively, were recorded in the treatment supplied with 75% N+ RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 t ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹). Maximum leaf area (414.27 cm²), leaf area index (1.38), chlorophyll content (21.44 mg/100 mg of tissue), AGR (0.26 g/day), CGR (9.23 g/m²/day) were recorded in the same treatment, This was followed by the treatment supplied with 50% N+ RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹). It was observed that integrated nutri-

ent management significantly helped to improve growth and physiological attributes of kasuri methi.

Keywords Biofertilizers, Organic manures, Inorganic fertilizers, Kasuri methi.

Introduction

Kasuri methi (*Trigonella corniculata* L.) is an herbaceous, bushy, slow growing annual spice crop mainly grown for herbage that in dry herb. Dried leaves are used as a spice to add aroma and flavor to the food products. It is important herb spice crop grown as winter season crop of plains of North India. It is rich source of proteins and minerals especially iron, calcium vitamins. Being a leguminous crop, kasuri methi is highly responsive to nitrogenous fertilizer application especially in early stages. Combination effect of organic manures and nitrogen fixing biofertilizers and phosphate solubilizing bacteria's helps to increase the nitrogen. And it is a chief component of protein, essential for the formation of protoplasm, which leads to cell division and cell enlargement [1]. Balanced nutrition that is integrated nutrient management which enhances the synthesis of the carbohydrates, phytohormones even the biofertilizers also promote the maximum growth of crop and also build up organic status of the soil that also increases the availability of other nutrients. Keeping all these points in view the present study was carried out.

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Materials and Methods

The experiment was conducted at farm field of Zonal Agricultural and Horticultural Research station Mudigere during 2013-14. In this study inorganic fertilizers, organic manures and biofertilizers consisting of twelve treatment combinations were tried in the Randomized block design with three replications. Treatments are as follows :

- T₁ : RD NPK (80:25:50 kg ha⁻¹) + RD FYM (7.5 t ha⁻¹)
 T₂ : RD NPK + Vermicompost (4t ha⁻¹)
 T₃ : 75% N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + PSB (5 kg ha⁻¹)
 T₄ : 75% N + RD PK + Vermicompost (4 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + PSB (5 kg ha⁻¹)
 T₅ : 75% N + RD PK + FYM (7.5 t ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹)
 T₆ : 75% N + RD PK + Vermicompost (4 t ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹)
 T₇ : 75% N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* + PSB (5 kg ha⁻¹)
 T₈ : 50% N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + PSB (5 kg ha⁻¹)
 T₉ : 50% N + RD PK + Vermicompost (4 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + PSB (5 kg ha⁻¹)
 T₁₀ : 50% N + RD PK + FYM (7.5 t ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹)
 T₁₁ : 50% N + RD PK + Vermicompost (4 t ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹)
 T₁₂ : 50% N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹).

The experimental plot was ploughed thrice by tractor drawn cultivator and leveled. The clods were crushed weeds were removed and brought to fine tilt. The land was divided into plots of required size (2.9 m² × 2.1 m²). Provision was made for bunds and irrigation channels. The seeds of the variety Pusa Kasuri were used with the seed rate of 18-20 kg ha⁻¹. It's an early bearing and high yielding variety. Seeds were sown with a spacing of 30 × 10 cm. Furrows were properly covered with a thin layer of soil and the plots were irrigated lightly. Excess seedlings were thinned out at 30 days after sowing, to maintain the 10 cm distance between the plants. The plots were kept free from weeds by hand weeding at 15, 30, 45, 70 and 95

days after sowing, Irrigation was given at an interval of 4-5 days during the whole cropping period depending on the soil moisture conditions. About 32-37 irrigations were given. In order to evaluate the effect of different treatments on growth and yield of crop under hill zone of Karnataka, necessary periodical observations were recorded.

Results and Discussion

Effect on growth attributes

The performance of Kasuri methi was better under combination of organic and inorganic fertilizers. All the treatments influenced the growth attributes of kasuri methi appreciably (Tables 1 and 2). Application of 75% recommended dose (RI) of N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹) recorded highest plant height (27.26, 42.81 and 45.64 cm) at 60, 90 DAS and at harvest respectively which was at par with 50% N + RD PK + FYM + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹). Increase in the growth might be due to the combined effect of organic manure FYM, nitrogen fixing biofertilizers and phosphate solubilizing bacteria's which enhances the nitrogen and phosphate availability and up take in the soil. The growth promoting effect of FYM as a source of plant nutrients and humus improved the soil physiological condition by increasing its capacity to absorb and store water, improving aeration and favouring beneficial microbial activity [2] in fenugreek, [3] in black musli. The application of 75% recommended dose (RD) of N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹) recorded highest number of leaves (58.89 and 86.05) at 60 and 90 DAS. Maximum number of branches (14.02, 23.51 and 25.64), plant spread (NS 19.05, 28.20, 30.14 cm and EW 19.53, 29.01 and 30.47 cm) at 60, 90 DAS at harvest respectively which was statistically on par with 50% N + RD PK + FYM + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹). This may be due to the application of FYM which leads to continuous and prolonged availability of nutrients by the organic source and production of bioactive substances, which have a similar effect of GA₃ and cytokinin, which helps in breaking of apical dominance

Table 1. Influence of integrated nutrient management on growth attributes of Kasuri Methi (*Trigonella corniculata* L.).

Treatments	Plant height (cm)				No. of leaves plant ⁻¹			No of branches plant ⁻¹		
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS	At harvest
T ₁	5.36	25.13	41.59	42.66	8.59	56.18	82.28	11.71	22.66	24.74
T ₂	3.90	19.77	34.25	36.49	6.40	47.72	74.56	9.79	18.61	20.31
T ₃	5.33	24.20	41.11	42.57	7.02	56.43	83.58	11.69	22.97	24.79
T ₄	5.04	23.55	39.06	42.12	8.40	52.47	83.02	11.81	21.55	24.95
T ₅	4.97	23.16	36.18	39.20	8.12	54.17	80.58	10.06	21.82	23.24
T ₆	5.29	22.90	38.51	41.49	8.10	54.56	81.03	10.02	22.01	24.03
T ₇	5.51	27.26	42.81	45.64	9.14	58.89	86.05	14.02	23.51	25.64
T ₈	4.47	20.53	34.63	37.52	6.32	48.20	73.91	10.56	19.64	21.12
T ₉	5.06	21.21	34.74	38.47	6.52	52.63	75.16	11.44	20.62	22.77
T ₁₀	4.70	21.51	35.09	39.69	6.21	52.99	76.00	10.47	21.58	22.53
T ₁₁	4.94	23.24	13.63	41.90	8.19	54.76	82.80	11.54	22.47	24.58
T ₁₂	5.35	25.50	41.92	42.83	9.01	57.69	84.46	11.22	23.08	25.11
F-test	*	NS	*	*	*	*	*	*	*	*
SEm ±	0.23	1.54	1.75	1.42	0.41	1.96	1.64	0.53	1.20	0.91
CD @ 5%	0.68	4.51	5.12	4.17	1.20	5.74	4.81	1.56	3.53	2.67

and accelerated higher number of branches. Combined application of *Rhizobium* and PSB increase in growth may be attributed to better utilization of inorganic nitrogen, greater biological N fixation and higher synthesis of plant growth hormones and enhanced availability of P in the presence of biofertilizers. Similar results were found earlier in fenugreek [2, 4, 5].

Physiological attributes

All the treatments influenced the physiological attributes of kasuri methi appreciably (Table 3) plants

provided with 75% recommended dose (RD) of N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹) recorded highest leaf area (414.27 cm²), leaf area index (1.38) and chlorophyll content (21.44 mg/100 mg of tissue) at 60 DAS which was statistically on par with 50% N + RD PK + FYM + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹). This could be due to production of more number of leaves and branches which enhanced availability of nutrients at the appropriate time, which has increased the leaf area and leaf area index. These results are in accordance

Table 2. Influence of integrated nutrient management on growth attributes of Kasuri Methi (*Trigonella corniculata* L.).

Treatments	Plant spread (cm ²)							
	30 DAS	North – South			At harvest	East – West		
		60 DAS	90 DAS	At harvest		30 DAS	60 DAS	90 DAS
T ₁	6.48	17.77	25.45	27.47	7.02	17.98	26.22	26.64
T ₂	5.11	16.11	21.33	23.16	5.10	16.04	21.92	28.74
T ₃	7.11	18.15	26.39	27.62	7.04	18.45	27.59	27.65
T ₄	6.62	17.56	25.31	26.45	6.52	17.81	25.11	26.60
T ₅	5.50	16.50	25.00	27.00	5.94	16.84	24.90	26.91
T ₆	5.35	17.03	25.35	26.68	5.49	17.15	25.07	26.86
T ₇	7.64	19.05	28.20	30.14	8.12	19.53	29.01	30.47
T ₈	5.64	16.05	22.16	24.52	5.71	16.33	22.62	24.98
T ₉	5.47	16.17	22.64	24.69	5.61	16.88	22.72	24.93
T ₁₀	5.10	16.26	24.84	26.79	5.33	16.95	25.09	26.72
T ₁₁	6.26	16.33	25.67	27.68	6.61	16.91	24.24	28.33
T ₁₂	7.26	18.17	27.70	29.45	7.61	18.88	27.92	29.83
F-test	*	*	*	*	*	*	*	*
SEm ±	0.49	0.51	1.16	1.02	0.33	0.47	1.49	1.08
CD @ 5%	1.45	1.49	3.41	2.99	0.98	1.39	4.36	3.16

Table 3. Influence of integrated nutrient management on physiological attributes of Kasuri Methi (*Trigonella corniculata* L.).

Treatments	Total dry matter (g/plant) at different stages of plant growth			AGR (g/day) at different stages of plant growth		CGR (g/m ² /day) at different stages of plant growth		Leaf area (cm ²)	Leaf area index	Chlorophyll contents (mg/100 mg of tissue at 60 DAS)
	30 DAS	60 DAS	90 DAS	30-60 DAS	60-90 DAS	30-60 DAS	60-90 DAS	60 DAS	60 DAS	60 DAS
T ₁	0.58	6.50	13.58	0.20	0.25	6.58	8.08	319.85	1.07	19.69
T ₂	0.48	5.13	9.42	0.14	0.15	4.77	5.49	158.50	0.53	15.17
T ₃	0.61	6.41	13.36	0.19	0.23	6.44	7.72	277.87	0.93	18.93
T ₄	0.56	6.12	13.25	0.19	0.22	6.17	7.87	250.65	0.84	18.86
T ₅	0.51	5.86	12.30	0.18	0.21	5.94	7.15	202.16	0.67	17.77
T ₆	0.55	6.10	12.41	0.18	0.21	6.17	7.00	217.83	0.73	17.98
T ₇	0.76	7.14	15.45	0.21	0.26	7.09	9.23	414.27	1.38	21.44
T ₈	0.51	5.39	11.15	0.16	0.19	5.42	6.40	171.37	0.57	15.26
T ₉	0.54	5.59	11.27	0.17	0.19	5.61	6.31	193.48	0.64	16.25
T ₁₀	0.50	5.75	12.02	0.17	0.21	5.83	6.96	195.52	0.65	17.25
T ₁₁	0.56	6.36	13.36	0.19	0.23	6.45	7.77	245.77	0.82	17.70
T ₁₂	0.65	6.63	13.92	0.20	0.25	6.65	8.29	360.69	1.20	20.22
F-test	*	*	*	*	*	*	*	*	*	*
SEm ±	0.03	0.29	0.25	0.01	0.01	0.33	0.38	6.95	0.02	0.35
CD@ 5%	0.09	0.85	1.09	0.03	0.04	0.96	1.13	20.37	0.07	1.03

with the findings of [6, 7] in patchouli, [8] in fenugreek, [9] in kasuri methi. More chlorophyll content in leaves might be due to the major and micronutrients supplied by the organic manure, inorganic fertilizers and biofertilizers which would retard leaf senescence and improve the photosynthates, similarly also increases chlorophyll content in leaf tissue and nitrogen availability for seed biomass. The similar results were obtained earlier in fenugreek in coriander [10, 11]. At 30, 60 and 90 DAS, the maximum dry matter accumulation was recorded in the treatment 75% N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹). Maximum AGR (0.21 and 0.26) and CGR (7.09 and 9.23) at 30-60 and 60-90 DAS respectively resulted in the same treatment. Which was followed by 50% N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* (5 kg ha⁻¹) + PSB (5 kg ha⁻¹). There were potential source of photosynthetes and increased fresh weight of the plant and higher uptake of the nutrients due to beneficial effect of the balanced nutrients in the form of organic manures (FYM), inorganic fertilizers (N, P and K) and biofertilizers (*Rhizobium* + *Azospirillum* + PSB) which helped in increasing the dry matter production at different stages of crop growth. The similar results were obtained by [2, 6, 8] in fenugreek. The highest AGR and CGR were recorded at 30-60 and 60-

90 DAS which might be due to higher dose of nutrients supplied by the FYM and *Rhizobium*, *Azospirillum* and PSB and RD of nitrogen which increases the vegetative growth like plant height, no. of leaves, plant spread resulted in more dry matter accumulation in the plants. On the basis of results, it may be concluded that the combined application of 75% N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* + PSB (5 kg ha⁻¹) and 50% N + RD PK + FYM (7.5 t ha⁻¹) + *Rhizobium* (1.5 kg ha⁻¹) + *Azospirillum* + PSB (5 kg ha⁻¹) treatments was found to better in terms of growth and physiological attributes of kasuri methi is recommended for hill zone location.

Conclusion

The nutrients play an important role in the crop production but under intensive cultivation use of chemical fertilizers alone for long period could result in deterioration of soil fertility and quality of produce. The use of organic manure in combination with inorganic fertilizers and biofertilizers helps in balancing soil fertility, environment and reduce the cost of inputs was reported by several workers. In view of better quality, sustainable yield, returns and to maintain the soil fertility status kasuri methi grown by adopt-

ing INM practices was quite beneficial.

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