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Influence of integrated nutrient management on growth, yield and quality 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 at Zonal Agricultural and Horticultural Research Station Mudigere, Chikmagalur 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 Days After Sowing (DAS) and at harvest, maximum plant height (42.81 & 45.64 cm), number of leaves (58.89 & 86.05), number of branches (23.51 & 25.64) were recorded in the treatment supplied with 75% Nitrogen+ Recommended Dose of Phosphorus and Potassium +Farm Yard Manure (7.5 t ha^{-1}) + *Rhizobium* (1.5t ha^{-1})+ *Azospirillum* (5 kg ha^{-1})+ Phasphate Solubilizing Bacteria (5 kg ha^{-1}). Maximum leaf area (414.27 cm^2), leaf area index (1.38), chlorophyll content (21.44 mg/100 mg of tissue), Absolute Growth Rate (0.26 g/day), Cumulative Growth Rate (9.23 g/m^2/day), dry herb yield (1.88 t/ha), fresh herb yield (8.02 t/ha), No. of pods plant^{-1} (620.17), Pod length (2.14cm) and quality attributes like crude protein in herb (13.31 %) and in seed (21.33 %) were recorded in the same treatment. This was followed by the treatment supplied with 50% Nitrogen+ Recommended Dose of Phosphorus and Potassium +Farm Yard Manure (7.5 t ha^{-1}) + *Rhizobium* (1.5 kg ha^{-1}) + *Azospirillum* (5 kg ha^{-1}) + Phasphate Solubilizing Bacteria (5 kg ha^{-1}). It was observed that integrated nutrient management significantly helped to improve growth, yield and quality of kasuri methi.

Key words : Biofertilizers, inorganic fertilizers, kasuri methi organic manures.

Introduction

Kasuri methi (*Trigonella corniculata* L.) is an herbaceous, bushy, slow growing annual spice crop mainly grown for herbage green as well as dry herb. Dried leaves are used as a spice to add aroma and flavour to the food products. It is important herb spice crop grown as winter season crop of planes of north India. It is rich source of proteins and minerals especially iron, calcium and 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 solubalizing bacteria helps to increase the nitrogen availablity. Balanced or integrated nutrient management which enhances the synthesis of the carbohydrates, phytohormones and even biofertilizers also promote maximum growth of crop and 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.

Material 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 were as follows

T_1 : RD NPK (80:25:50 kg ha^{-1}) + RD FYM (7.5t ha^{-1})

T_2 : RD NPK + Vermicompost (4t ha^{-1})

T_3 : 75% N + RD PK+ FYM (7.5t ha^{-1}) + *Rhizobium* (1.5 kg ha^{-1}) + PSB (5 kg ha^{-1})

T_4 : 75% N+ RD PK+ Vermicompost (4t ha^{-1}) + *Rhizobium* (1.5 kg ha^{-1}) + PSB (5 kg ha^{-1})

T_5 : 75% N+ RD PK +FYM (7.5t ha^{-1}) + Azospirillum (5 kg ha^{-1}) + PSB (5 kg ha^{-1})

T_6 : 75% N+ RD PK +Vermicompost (4t ha^{-1}) + *Azospirillum* (5 kg ha^{-1}) + PSB (5 kg ha^{-1})

T_7 : 75% N+ RD PK +FYM (7.5t ha^{-1}) + *Rhizobium* (1.5 kg ha^{-1}) + *Azospirillum* + PSB (5 kg ha^{-1})

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T_8 : 50% N+ RD PK + FYM (7.5t ha^{-1}) + Rhizobium (1.5 kg ha^{-1}) + PSB (5 kg ha^{-1})

T_9 : 50% N+ RD PK + Vermicompost (4t ha^{-1}) + *Rhizobium* (1.5 kg ha^{-1}) + PSB (5 kg ha^{-1})

T_{10}: 50% N+ RD PK +FYM (7.5t ha^{-1}) + *Azospirillum* (5 kg ha^{-1}) + PSB (5 kg ha^{-1})

T_{11}: 50% N+ RD PK + Vermicompost (4t ha^{-1}) +*Azospirillum* (5 kg ha^{-1}) + PSB (5 kg ha^{-1})

T_{12}: 50% N+ RD PK + FYM (7.5t ha^{-1}) + *Rhizobium* (1.5kg ha^{-1}) + *Azospirillum* (5kg ha^{-1}) + PSB (5 kg ha^{-1})

The experimental plot was ploughed thrice by tractor drawn cultivator and leveled well. The clods were crushed and weeds were removed to fine tilt. The land was divided into plots of required size (2.9 m^2 x 2.1 m^2). 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 is an early bearing and high yielding variety. Seeds were sown with a spacing of 30x10 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 18-20 irrigations were given. In order to evaluate the effect of different treatments on growth, yield and quality 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 (Table 1 and Table 2.). At 90 DAS and at harvest, maximum plant height (42.81 & 45.64 cm), number of leaves (58.89 & 86.05), number of branches (23.51 & 25.64) respectively, were recorded in the treatment supplied with 75% N+ RD PK +FYM (7.5 t ha^{-1}) + *Rhizobium* (1.5t 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 solubalizing bacterias which enhances the nitrogen and phosphate availability and uptake 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 in ground nut (Choudhary *et al.* 2) and in black musli, (Joy *et al*., 7).

Maximum leaf area (414.27 cm^2), leaf area index (1.38), chlorophyll content (21.44 mg/100 mg of tissue), AGR (0.26 g/day), CGR (9.23 g/m^2/day) were also recorded in the same tratment. This could be due to production of more number of leaves and branches which enhanced availability of nutrients at the appropriate time thus increased leaf area and leaf area index. These results are in accordance with the findings of Khiriya *et al.*(9), Manjunatha *et al*. (12) in patchouli, Mehta *et al*. (14) in fenugreek, Singh *et al*. (16) 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 assimilation.Similarly also increases nitrogen availability for seed biomass. Beneficial effects of balanced nutrients helped in increasing the dry matter production at different stages of crop growth. The similar results were obtained by Ali *et al*. (1) in fenugreek and S. Kumar *et al*. (11) in coriander.

Yield and quality

Highest fresh herb yield (1.88 t/ha), dry herb yield (1.13 t/ha), number of pods $plant^{-1}$ (620.17), pod length (2.14 cm), seed yield (465.31kg/ ha), crude protein content in herb (13.31%),Crude protein content in seed (21.33%) were recorded in the treatment T_7 which consisting of 75% N+ RD PK + FYM (7.5t ha^{-1})+ *Rhizobium* (1.5 kg ha^{-1})+ *Azospirillum* (5 kg ha^{-1}) + PSB (5 kg ha^{-1}) and followed by the treatment T_5 consist of 50% N+ RD PK + FYM (7.5t ha^{-1}) + *Rhizobium* (1.5 kg ha^{-1})+ *Azospirillum* (5 kg ha^{-1})+ PSB (5 kg ha^{-1}). Increased fresh herb yield and dry herb yield could be attributed to better vegetative growth interms of plant height, number of branches and plant spread due to the application of balanced nutrients in integrated sources which promotes better photosynthetic activity resulted in increased carbohydrate synthesis and better plant growth. Similar results were obtained by Mehta *et al*. (14), Choudhary *et al*. (2) in fenugreek. Increased no. of pods $plant^{-1}$, pod length and seed yield could be due to significant increase in the number of branches, plant height, number of leaves, pods per plant and pod length and also integrated nutrient management provided basic source for yield attributes and seed yield is an output of sequential metamorphosis from the chain of source to sink relationship. It was also related to INM practice which improved soil physical, chemical and biological properties, resulting in higher fertilizer use efficiency. Dutta *et al*. (3), Patel *et al*. (15), Choudhary *et al*. (2), Jat and Ahlawat (6), Mehta *et al*. (14), (Mehta *et al*., 13), (Mukesh kumar *et al*., 10). Maximum days taken for 1st and 50 % of flowering was recorded in the treatment T_7 which might be due to the slow and prolonged availability of major and micronutrients and growth promoting hormones, released by organic manures biofertilizers and primary nutrient

nitrogen, which may have positive influence on vegetative growth. Similar results were reported by Kalidasu *et al*. (8) in coriander. Maximum crude protein content in seed (21.33 %) and herb (13.31 %) in the same traetment might be due to the supplementary application of FYM, vermicompost and N fixing biofertilizers which supply the available nitrogen throughout the cropping period and resulting in better uptake and assimilation of crude protein in herb and seed. The results are in conformity with Deora et.al. (4), Pramod Kumar Dubey *et al*. (5) in fenugreek.

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 adopting INM practices was quite beneficial.

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

Treatment	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	38.63	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	*	*	*	*	*	*	*	*
S. Em ±	0.23	1.54	1.75	1.42	0.41	1.96	1.64	0.53	1.20	0.91
C.D. @ 5%	0.68	4.51	5.12	4.17	1.20	5.74	4.81	1.56	3.53	2.67

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

Treatment	Total dry matter (g/plant)			AGR (g/day)		CGR (g/m^2/day)		Leaf area (cm^2) 60 DAS	Leaf area index 60 DAS	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			
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	*	*	*	*	*	*	*	*	*	*
S. Em ±	0.03	0.29	0.25	0.01	0.01	0.33	0.38	6.95	0.02	0.35
C.D. @ 5%	0.09	0.85	1.00	0.03	0.04	0.96	1.13	20.37	0.07	1.03

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Table 3. Effect of integrated nutrient management on yield attributes of kasuri methi (*Trigonella corniculata* L.)

Treatment	Number of days taken to flowering initiation	Number of days taken for 50 % of flowering	Fresh herb yield (kg/ plot)	Fresh herb yield (t/ha)	Dry herb yield (kg/ plot)	Dry herb yield (t/ ha)
T_1	55.13	82.32	4.70	7.83	0.99	1.64
T_2	46.25	71.06	3.94	6.56	0.77	1.28
T_3	55.62	82.07	4.78	7.95	0.97	1.62
T_4	51.3	80.07	4.68	7.79	0.83	1.54
T_5	49.03	75.11	4.32	7.20	0.88	1.47
T_6	52.38	75.71	4.52	7.53	0.92	1.54
T_7	56.34	83.72	4.81	8.02	1.13	1.88
T_8	49.81	71.81	4.09	7.02	0.81	1.35
T_9	47.94	72.09	4.22	7.02	0.84	1.31
T_{10}	48.23	72.53	4.30	7.16	0.87	1.44
T_{11}	51.30	78.85	4.63	7.71	0.98	1.63
T_{12}	55.62	82.46	4.79	7.97	1.01	1.68
F- test	*	*	*	*	*	*
S. Em ±	1.78	2.62	0.16	0.29	0.05	0.09
C.D. @ 5%	5.21	7.69	0.47	0.85	0.22	0.26

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Table 4. Effect of integrated nutrient management on yield and quality attributes of kasuri methi (*Trigonella corniculata* L.)

Treatment	No. of pods plant^{-1}	Pod length (cm)	No. of seeds pod^{-1}	Seed yield kg/ ha	Test weight (g)	Crude protein content in herb (%)	Crude protein content in seed (%)
T_1	562.00	1.80	5.73	420.03	1.64	11.79	19.50
T_2	513.67	1.23	5.56	325.02	1.46	10.27	17.08
T_3	570.67	1.71	5.61	387.17	1.47	11.56	18.83
T_4	567.67	1.76	5.67	380.06	1.60	11.35	18.33
T_5	535.60	1.49	5.60	367.63	1.54	10.23	17.81
T_6	544.61	1.50	5.60	371.18	1.61	10.58	11.10
T_7	620.17	2.14	6.06	465.31	1.75	13.31	21.33
T_8	528.48	1.50	5.28	330.34	1.55	10.58	17.85
T_9	532.00	1.72	5.59	344.54	1.72	10.96	17.93
T_{10}	520.71	1.29	5.50	355.20	1.58	10.27	17.62
T_{11}	570.45	1.72	5.67	383.62	1.72	10.95	18.44
T_{12}	572.67	1.94	5.61	445.73	1.68	12.75	20.04
F- test	*	*	NS	*	NS	*	*
S. Em ±	14.72	0.13	0.18	17.69	0.07	0.35	0.60
C.D. @ 5%	43.18	0.39	0.54	51.90	0.20	1.03	1.82

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