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Influence of Integrated Nutrient Management on Nutrient Uptake 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 nutrient uptake of kasuri methi (Trigonella corniculata L.) under hill zone of Karnataka. Significantly higher Nitrogen content in herb (1.53%), straw (1.26%), seed (3.41 %) and total uptake of (70.92 kg/ha) and Phosphorous content in herb (0.58%), straw (0.38 %) and seed (0.63 %) and total uptake (21.64 kg/ha) 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}) and maximum Potash content in herb (0.58%), straw (0.90 %) and seed (0.45 %) and total uptake (31.82 kg/ha) were recorded in the same treatment. Which 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 nutrient management significantly helped to improve uptake of nutrients by plant and maintains the soil health status and it is eco friendly.

Key words: *Kasuri methi, Nitrogen, Phosphorous, Potassium, Uptake*

INTRODUCTION

India is the largest seed spice producing and exporting country in the world. Indian spices have earned high reputation in the international market. Kasuri methi (*Trigonella corniculata* L.) belongs to the family Fabaceae is an herbaceous, bushy, slow growing annual spice crop mainly grown for herbage that to dry herb. Dried leaves are used as a spice to add aroma and flavor to the food products. Kasuri methi has many uses such as flavoring and medicinal purpose, it 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 crop is mainly grown as a *rabi* season crop and the cultivation methods of Kasuri methi is more or less similar to that of common methi. The crop is mainly grown in India, Pakistan, China, Nepal and Bangladesh.

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In India, the cultivation of this crop is only confined to North India and commercially grown in Rajasthan, Punjab, Madhya Pradesh and Maharashtra. Rajasthan occupies 80 per cent of area and production of kasuri methi in the country. Being a leguminous crop, kasuri methi is highly responsive to nitrogenous fertilizer application especially in early stages.

The vermicompost is rich in macronutrients and micronutrients besides having plant growth promoting substances, humus forming microbes and nitrogen fixers[2], hence vermicompost is used as source of organic manures in the INM. Biofertilizers are the one of the important and cheapest nutrient sources in the integrated nutrient management system. On application of biofertilizers to the seed, root or soil helps in fixing the nitrogen, mobilize the availability of nutrient and also helps in buildup of the micro flora. Combination effect of organic manures and nitrogen fixing biofertilizers and phosphate solubalizing bacteria's helps to increase the availability of nutrients. And it is a chief component of protein, essential for the formation of protoplasm, which leads to cell division and cell enlargement[1]. Use of biofertilizers in the crop production will help in safeguarding the soil health and also the quality of the crop products[5].

Balanced nutrition that is integrated nutrient management enhances the synthesis of the carbohydrates, phytohormones, biofertilizers promote 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.

MATERIAL AND METHODS

The experiment was conducted in 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 Deatils:

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})

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. The clods were crushed weeds were removed and brought 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's 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 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.

Statistical analysis: The experimental data obtained were analyzed by using analysis of variance (ANOVA) technique for each character as prescribed for a randomized block design layout. The interpretation of data was done on the basis of 'F' test. The critical differences(CD) at 5% level of probability were calculated for testing the significant of difference between two treatment means and are presented in tables of experimental results with standard error of means (SEm ±) as described by Snedecor and Cochran[12].

Plant nutrients analyzed and their respective methods

Plant nutrients	Method used
Nitrogen	Modified micro-kjeldahl method
Phosphorus	Wet digestion molybdo phosphoric acid method
Potassium	Flame emission spectro photometery method

Uptake of NPK: The total respective nutrient uptake by Kasuri methi from each treatment was calculated as follows:

1. Nitrogen uptake (kg ha-1)

$$\frac{\text{N content in herb (\%) X herb yield (Kg ha}^{-1}\text{) + N content in straw (\%) X straw yield (Kg ha}^{-1}\text{) + N content in seed (\%) X seed yield (Kg ha}^{-1}\text{)}}{100}$$

2. Phosphorus uptake (Kg ha-1)

$$\frac{\text{P content in herb (\%) X herb yield (Kg ha}^{-1}\text{) + P content in straw (\%) X straw yield (Kg ha}^{-1}\text{) + P content in seed (\%) X seed yield (Kg ha}^{-1}\text{)}}{100}$$

3. Potassium uptake (kg ha-1)

$$\frac{\text{P content in herb (\%) X herb yield (Kg ha}^{-1}\text{) + P content in straw (\%) X straw yield (Kg ha}^{-1}\text{) + P content in seed (\%) X seed yield (Kg ha}^{-1}\text{)}}{100}$$

RESULT AND DISCUSSION

Nutrient Uptake

N, P and K content in the herb, seed and straw

The seed was found to possess higher nitrogen content compared to herb and straw. The maximum N, P and K content in the herb (1.53 %), seed (0.38%) and straw (0.90%) was found in the plants supplied with 75% N+ RD PK +FYM (7.5t ha^{-1}) + *Rhizobium* (1.5 kg ha^{-1}) + *Azospirillum* + PSB (5 kg ha^{-1}), which was followed by 50% N+ RD PK +FYM (7.5t ha^{-1}) + *Rhizobium* (1.5 kg ha^{-1}) + *Azospirillum* + PSB (5 kg ha^{-1}) where in N, P and K content in the herb (1.44 %), seed (0.29%) and straw (0.87%). This could be attributed to better availability of nutrients and their uptake throughout the crop growth period. The application of biofertilizers have synergized the mineralization process and helped the plants to get both macro and micro-nutrients, in turn helping them to extend their rhizosphere.

The application of FYM has lead to direct application of nutrients to soil and also has improved the physicochemical properties of soil to hold water and also soil aeration, making the soil friable. Hence the nutrient uptake was increased to a greater extent by plants. The results are in accordance with the findings of Dashora[4] and Jat *et al*[7]., Vasanthi and Subramanian[13], Purbey and Sen[10]. Pramod Kumar Dubey *et al*[9]., in fenugreek, Singh[11] in dill, Chandra Ramesh *et al*[3]., in sorghum.

Nitrogen uptake by plant and its parts

The uptake of nitrogen (Table 2) is known to have direct relationship that is the growth, yield and dry matter production significantly more nitrogen up take by herb (28.87 kg/ha), seed (15.87 kg/ha) straw (26.18 kg/ha) and total uptake by plants (70.92 kg/ha) was recorded with treatment (T_7) applied by 75% N+ RD PK +FYM + *Rhizobium* +

Azospirillum + PSB (T_7), which was followed by T_{12} that is 50% N+ RD PK + FYM + *Rhizobium* + *Azospirillum* + PSB where in nitrogen uptake by herb (24.11 kg/ha) seed (14.29 kg/ha) straw (22.52 kg/ha) and total uptake by plants (60.93 kg/ha). It might be attributed to the addition of FYM and biofertilizers enhances the slow and prolonged availability of the nitrogen, nutrient use efficiency and indirectly through checking the losses of nutrient from soil solution and it was also related to increased in the dry matter production enhances the nitrogen uptake. The results are in confirmation with the findings of Pramod Kumar Dubey *et al*[9]., Deora and Jitendra Singh[6], Kumawat and Yadav[14] in fenugreek.

Phosphorous uptake by plant

Significantly higher phosphorous uptake (Table.3) by herb (10.71 kg/ha), seed (2.93 kg/ha), straw (8 kg/ha) and total uptake by plants (21.64 kg/ha) was recorded that is treatment (T_7) supplied by 75% N+ RD PK +FYM + *Rhizobium* + *Azospirillum* + PSB and it was followed by (T_{12}) 50 % N+ RD PK + FYM + *Rhizobium* + *Azospirillum* + PSB where in phosphorous uptake by herb (8.43 kg/ha), seed (2.49 kg/ha), straw (5.57 kg/ha) and uptake by plant (16.49kg/ha). This might be due to the application of FYM, which increased the availability of phosphorus to plant and because of this, the uptake of the phosphorus was also increased. It is also expected due to better buffering capacity of FYM and vermicompost for incipient moisture stress helps in improving phosphorus availability to the plants. The biofertilizers increases the rhizosphere of the root and promotes the more phosphorous uptake by the plant. The results are in accordance with the findings of Pramod Kumar Dubey *et al*[9].

Potassium uptake by plant

Significantly higher potassium uptake (Table 4) by herb (10.94 kg/ha), seed (18.84 kg/ha) and total uptake by plant (31.82) was recorded that is treatment (T_7) 75% N+ RD PK +FYM + *Rhizobium* + *Azospirillum* + PSB and it was followed by (T_{12}) 50% N+ RD PK + FYM + *Rhizobium* + *Azospirillum* + PSB where in potassium uptake by herb (8.68 kg/ha), seed (16.86 kg/ha) straw (1.87 kg/ha) and total uptake by plants (27.41 kg/ha). This might be attributed to increase in the rhizosphere by the application of biofertilizers and FYM helps in increased in the availability and absorption of potassium and it also related to increase in the dry matter production which enhances the potassium uptake and dual application of nitrogen fixers and PSB helps to atmospheric nitrogen and sulubalising unavailable to available form respectively. The results are in accordance with the findings of Pramod Kumar Dubey *et al*[9]., in fenugreek and Mohan Chandra[8] in *Solanum nigrum.*

Table1: Effect of integrated nutrient management on nitrogen, phosphorous and potassium content in herb, straw and seed of kasuri methi (*Trigonella corniculata* L.)

Treatment	Nitrogen content %			Phosphorous content %			Potassium content %		
	Herb	Straw	Seed	Herb	Straw	Seed	Herb	Straw	Seed
T_1	1.29	1.15	3.12	0.45	0.33	0.53	0.49	0.89	0.39
T_2	0.97	0.87	1.78	0.27	0.24	0.44	0.32	0.74	0.23
T_3	1.25	1.12	3.01	0.41	0.28	0.50	0.46	0.86	0.38
T_4	1.22	1.08	2.93	0.41	0.27	0.49	0.44	0.83	0.37
T_5	1.04	0.98	2.85	0.29	0.27	0.47	0.43	0.84	0.31
T_6	1.09	1.03	2.73	0.37	0.26	0.48	0.45	0.82	0.34
T_7	1.53	1.26	3.41	0.58	0.38	0.63	0.58	0.90	0.45
T_8	1.09	0.89	2.86	0.24	0.23	0.45	0.35	0.80	0.27
T_9	1.15	0.90	2.87	0.28	0.31	0.47	0.37	0.75	0.29
T_{10}	1.04	0.93	2.82	0.29	0.24	0.45	0.41	0.81	0.30
T_{11}	1.15	1.07	2.95	0.41	0.26	0.50	0.45	0.84	0.36
T_{12}	1.44	1.20	3.21	0.51	0.29	0.56	0.52	0.87	0.42
F- test	*	*	*	*	*	*	*	*	*
S. Em ±	0.06	0.09	0.10	0.04	0.02	0.03	0.02	0.03	0.03
C.D. @ 5%	0.17	0.25	0.29	0.11	0.06	0.09	0.05	0.09	0.08

Table 2: Effect of integrated nutrient management on nitrogen uptake in kasuri methi (*Trigonella corniculata* L.)

Treatment	Herb (Kg ha^{-1})	Seed (kg ha^{-1})	Straw (Kg ha^{-1})	Total (Kg ha^{-1})
T_1	21.07	13.11	21.16	55.35
T_2	12.40	8.90	12.74	34.05
T_3	20.03	11.63	20.29	51.95
T_4	18.73	11.14	18.85	48.72
T_5	15.23	10.53	16.36	42.13
T_6	16.84	6.64	18.06	41.55
T_7	28.87	15.87	26.18	70.92
T_8	14.73	9.41	13.81	37.95
T_9	15.12	9.88	14.14	40.48
T_{10}	15.05	10.03	15.78	40.87
T_{11}	18.72	11.31	21.19	51.42
T_{12}	24.11	14.29	22.52	60.93
F- test	*	*	*	*
S. Em ±	1.31	0.64	2.02	1.45
C.D. @ 5%	3.84	1.89	5.93	4.24

Table 3: Effect of integrated nutrient management on phosphorous uptake in kasuri methi (*Trigonella corniculata* L.)

Treatment	Herb (Kg ha^{-1})	Seed (kg ha^{-1})	Straw (Kg ha^{-1})	Total (Kg ha^{-1})
T_1	7.39	2.22	6.00	15.61
T_2	3.15	1.42	3.55	8.40
T_3	6.80	1.94	4.97	13.69
T_4	6.34	1.86	4.67	12.58
T_5	4.33	1.70	4.42	10.45
T_6	5.64	1.`79	4.47	11.90
T_7	10.71	2.93	8.0	21.64
T_8	3.43	1.46	3.56	8.17
T_9	3.64	1.62	4.85	10.12
T_{10}	4.22	1.61	4.07	9.90
T_{11}	6.58	1.89	5.30	13.77
T_{12}	8.43	2.49	5.57	16.49
F- test	*	*	*	*
S. Em ±	0.63	0.12	0.48	0.47
C.D. @ 5%	1.83	0.37	1.41	1.39

Table 4: Effect of integrated nutrient management on potassium uptake in kasuri methi (*Trigonella corniculata* L.)

Treatment	Herb (Kg ha^{-1})	Seed (kg ha^{-1})	Straw (Kg ha^{-1})	Total (Kg ha^{-1})
T_1	8.10	16.10	1.63	25.83
T_2	4.11	10.90	0.75	15.76
T_3	5.95	15.46	1.46	24.03
T_4	6.83	14.38	1.40	22.61
T_5	6.31	14.04	1.12	21.47
T_6	6.90	14.14	1.26	22.30
T_7	10.94	18.84	2.09	31.82
T_8	4.76	12.28	0.89	17.93
T_9	4.82	11.80	1.0	17.62
T_{10}	7.11	13.74	1.04	20.73
T_{11}	7.30	16.63	1.37	25.30
T_{12}	8.68	16.86	1.87	27.41
F- test	*	*	*	*
S. Em ±	0.46	0.85	0.12	0.43
C.D. @ 5%	1.35	2.49	0.36	1.25

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. In view of better quality, sustainable yield, returns and to promote combined use of mineral, organic and biological resources in a reasoned way to balance efficient use of limited/finite resources and ensure ecosystem sustainability against nutrient mining and degradation of soil and water, kasuri methi grown by adopting INM practices was found to be quite beneficial.

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