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Impact of Biofertilizers and Organic Manures on Herbage Production of Kasuri Methi (*Trigonella corniculata* L.) CV. – Pusa Kasuri

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A study was conducted at the Research field, Department of Horticulture, College of Agriculture, Gwalior M.P. during rabi 2021-22. The purpose of the study is to evaluate the plant in terms of various parameters such as AGR, CGR, leaf area, fresh leaf yield and dry leaf yield. The results of the study indicated that the application of organic manures and biofertilizers improved the plant growth and yield. The highest *median* AGR (0.311 and 0.395 g/day) at 30-60 and 60-90 DAS, CGR (7.99 and 12.21 g/m^2/day) at 30-60 and 60-90 DAS, leaf area (93.90 cm^2), fresh leaf yield (5.78

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Kg/plot) and (96.26 q/ha), dry leaf yield (0.49 Kg/plot) and (8.18 q/ha) were observed in the plants treated with FYM (16 t/ha) + Vermicompost (4 t/ha) + *Rhizobium* (10 ml/kg seed) + PSB (10 ml/kg seed) + KSB (10 ml/kg seed) as compared with control.

Keywords: Biofertilizers; herbage production; spice crop.

1. INTRODUCTION

Kasuri methi (*Trigonella corniculata* L.) member of the family *Fabaceae* is an herbaceous, bushy, slow growing annual spice crop mainly grown for herbage that to dry herb. It is mainly grown as leafy vegetable and seeds in the plains of north India. It contains important nutrients required for growth and maintenance of human body [1]. Kasuri methi is a semi-arid crop, grows up to 30 cm height and its leaves are pinnate with the size of leaflets being 1.25-2.0 cm and consists bright orange-yellow colored flowers. Pods are 1.2-2.2 cm long, sickle shaped with 4-8 seeds per pod. Kasuri methi is mainly grown for herbage as well as for seed and used as a spice to add aroma and flavour to the food products.

Crop nutrients play a pivotal role in crop production, influencing plant growth, development, and overall productivity. Essential nutrients, including nitrogen, phosphorus, potassium, sulfur, calcium, magnesium, and various micronutrients, are crucial for the synthesis of proteins, enzymes, and other essential compounds within plants. Adequate nutrient availability ensures proper root development, robust vegetative growth, efficient flowering, and successful reproduction, ultimately leading to higher yields and improved crop quality [2]. Balanced nutrient management is essential for preventing deficiencies or excesses, both of which can compromise plant health and reduce agricultural productivity. By understanding and optimizing nutrient levels in the soil, farmers can enhance nutrient uptake by crops, promote sustainable agriculture, and contribute to global food security. Efficient nutrient management practices not only benefit crop production but also help conserve soil fertility, minimize environmental impact, and support long-term agricultural sustainability [3].

Bio-fertilizers are one of the important nutrient sources in the integrated nutrient management system. Application of *bio-fertilizers* helps in fixing the nitrogen, mobilizes the availability of nutrients and also helps in buildup of the micro flora. Combination effect of organic manures and nitrogen fixing biofertilizers and phosphate solubilizing bacterium helps to increase the availability of nutrients [4]. Biofertilizers play a crucial role in sustainable agriculture by promoting soil fertility and enhancing plant growth without causing harm to the environment [5]. Unlike chemical fertilizers that can have negative impacts on soil health and water quality, biofertilizers consist of living microorganisms such as bacteria, fungi, and algae that form symbiotic relationships with plants [6]. These microorganisms contribute to nutrient cycling, fix atmospheric nitrogen, and solubilize minerals, making essential nutrients more accessible to plants [7]. By fostering a healthy soil ecosystem, biofertilizers not only improve crop yields but also enhance soil structure, water retention, and overall resilience. Additionally, the use of biofertilizers can reduce the reliance on synthetic inputs, mitigating environmental pollution and contributing to a more sustainable and ecologically balanced agricultural system [8].

In crop production, especially for crops like methi (fenugreek), various organic amendments and beneficial microorganisms play vital roles in enhancing soil fertility and promoting plant growth. Vermicompost, produced through the decomposition of organic matter by earthworms, is a rich source of nutrients and improves soil structure, water retention, and microbial activity [9]. It enhances methi's nutrient uptake efficiency, leading to healthier plants and improved yields.

Farm yard manure (FYM) serves as a valuable organic amendment, providing a balanced mix of nutrients essential for plant growth [10]. Its incorporation into the soil enhances soil fertility, stimulates microbial activity, and improves methi's nutrient absorption. Rhizobium, a nitrogen-fixing bacterium, forms a symbiotic relationship with leguminous crops like methi. By converting atmospheric nitrogen into a plant-available form, rhizobium enhances methi's nitrogen supply, promoting vigorous growth and reducing the need for synthetic nitrogen fertilizers. Phosphorus solubilizing bacteria (PSB) play a crucial role in making phosphorus more accessible to plants [11]. Methi requires phosphorus for root development, flowering, and seed formation. PSB help solubilize insoluble phosphorus in the soil, making it available for methi plants, thereby improving overall crop productivity. Similarly, potassium solubilizing bacteria (KSB) contribute to the availability of potassium, another essential nutrient for methi. Potassium is vital for flowering, fruiting, and overall stress tolerance in plants. KSB enhance potassium uptake by solubilizing insoluble forms of potassium in the soil [6,8].

In summary, the use of vermicompost, farm yard manure, rhizobium, phosphorus solubilizing bacteria, and potassium solubilizing bacteria in methi cultivation promotes sustainable agriculture by improving soil fertility, nutrient availability, and overall crop health, contributing to increased methi yields and quality.

Keeping the above beneficial facts of biofertilizers and organic manures in mind the present study was carried out with the objective to find the effect of biofertilizers and organic manures on *absolute growth rate* (AGR), crop growth rate (CGR), leaf area and various leaf yields of kasuri methi.

2. MATERIALS AND METHODS

The experiment was conducted Experimental Field, Department of Horticulture, College of Agriculture, Gwalior (M.P.). The experiment was laid out in the Randomized Block Design with three replications. Each replication was comprised of sixteen treatments consisting organic manures i.e. FYM and Vermicompost and bio-fertilizers i.e. *Rhizobium*, PSB and KSB were applied for enhancing the crop physiological parameters and herbage yield of kasuri methi (*Trigonella corniculata* L.) cv. Pusa Kasuri. The details of treatment combination used are T_0 - Control, T_1 – FYM (16 t/ha), T_2 - Vermicompost (4 t/ha), T_3 - *Rhizobium* (30 ml/kg seed), T_4 - PSB (30ml/kg seed), T_5 - KSB (30 ml/kg seed), T_6 - FYM (16 t/ha) + *Rhizobium* (30 ml/kg seed), T_7 - FYM (16 t/ha) + PSB (30 ml/kg seed), T_8 - FYM (16 t/ha) + KSB (30 ml/kg seed), T_9 - Vermicompost (4 t/ha) + *Rhizobium* (30ml/kg seed), T_{10} - Vermicompost (4 t/ha) + PSB (30 ml/kg seed), T_{11} - Vermicompost (4 t/ha) + KSB (30 ml/seed), T_{12} - FYM (16 t/ha) + *Rhizobium* (10 ml/kg seed) + PSB (10 ml/kg seed) + KSB (10 ml/kg seed), T_{13} - Vermicompost (4 t/ha) + *Rhizobium* (10 ml/kg seed) + PSB (10 ml/kg seed) + KSB (10 ml/kg seed), T_{14} - FYM (16 t/ha) + Vermicompost (4 t/ha) + *Rhizobium* (10 ml/kg seed) + PSB (10 ml/kg seed) + KSB (10 ml/kg seed), T_{15} - *Rhizobium* (10 ml/kg seed) + PSB (10 ml/kg seed) + KSB (10 ml/kg seed).

The experimental plot was ploughed thrice by tractor drown cultivator and leveled. The clods were crushed weeds were removed and brought to fine tilt. The land was divided into plots of required size (1.90 m x 2.70 m). 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.

Observation were done at different stages of growth period such as AGR (g/day) at 30-60 and 60-90 DAS, CGR (g/m^2/day) at 30-60 and 60-90 DAS, leaf area (cm^2) at 60 DAS and yield parameter like fresh leaf yield (kg/plot), fresh leaf yield (q/ha), dry leaf yield (kg/plot), dry leaf yield (q/ha).

3. RESULTS AND DISCUSSION

There was significantly effect of various treatments on AGR and CGR at different interval from day after sowing. Among Different level of treatment T_{14} was excellent treatment for enhancing AGR (g/day) and CGR (g/m^2/day) in kasuri methi plant at different development stages and it also approved the maximum AGR (0.311 g/day) and CGR (7.99 g/m^2/day) at 30-60 DAS and AGR (0.395 g/day) and CGR (12.21 g/m^2/day) at 60-90 DAS, whereas minimum AGR and CGR was recorded in T_0 – Control. It may be due to higher nutrient uptake and bioactive substances which have a similar effect of GA_3 and cytokinin. This helps in breaking of apical dominance and accelerated higher number of branches, which increased the AGR and CGR of the plant. The results are in confirmation with the results achieved by Kusuma et al. [12], Babaleshawar et al. [4] and Raghuwanshi et al. [13].

The result revealed that the different organic manures and bio-fertilizers was significantly enlarge the leaf area of kasuri methi and the treatment T_{14} was outstanding treatment for extension of leaf area in kasuri methi, it also established the maximum leaf area (3.90 cm^2) at 60 DAS, treatment T_0 – Control was documented the minimum leaf area (2.00 cm^2) at 60 DAS. This may be due to production of more number of branches and plant height and which enhanced availability of nutrients at the appropriate time, which has increased the leaf area. Findings are in agreement with those of Raiyani et al. [14], Suman et al. [15], Aakash et al. [5] and Sahu et al. [16].

Among the different levels of treatment T_{14} was recorded maximum fresh leaf yield (5.78 kg/plot). It was at par to treatment T_9, T_{10}, T_{11}, T_{12} and T_{13}. Otherwise, treatment T_0 – Control was recorded the minimum fresh leaf yield. Among the different levels of treatment T_{14} was recorded maximum fresh leaf yield (96.26 q/ha) were as the minimum fresh leaf yield (80.57 q/ha) was recorded in T_0 – Control, respectively. Similar finding were also reported by Meena et al. [17], Solanki et al. [8], Babaleshawar et al. [4] and Chandan et al. [18].

Table 1. Effect of organic manures and bio-fertilizers on AGR (g/day) and CGR (g/m²/day)) at 30-60 and 60-90 DAS of kasuri methi

Treatments detail	AGR (g/day) at 30-60 DAS	AGR (g/day) at 60-90 DAS	CGR (g/m²/day) at 30-60 DAS	CGR (g/m²/day) at 60-90 DAS
T_0	0.225	0.295	6.95	9.20
T_1	0.248	0.326	7.37	10.42
T_2	0.256	0.326	7.46	10.55
T_3	0.241	0.311	7.13	9.69
T_4	0.243	0.317	7.28	9.87
T_5	0.227	0.297	7.01	9.46
T_6	0.260	0.330	7.54	10.74
T_7	0.267	0.337	7.60	10.99
T_8	0.256	0.326	7.46	10.55
T_9	0.274	0.350	7.80	11.52
T_{10}	0.280	0.369	7.85	11.56
T_{11}	0.272	0.344	7.75	11.43
T_{12}	0.299	0.380	7.89	11.72
T_{13}	0.310	0.389	7.90	12.01
T_{14}	0.311	0.395	7.99	12.21
T_{15}	0.247	0.318	7.32	10.22
SEm ±	**0.005**	0.005	**0.047**	0.077
CD 5%	**0.014**	0.014	**0.136**	0.222

Table 2. Effect of organic manures and bio-fertilizers on leaf area (cm²) at 60 DAS, fresh leaf yield (kg/plot), (q/ha), dry leaf yield (kg/plot) and (q/ha) of kasuri methi

Treatments detail	Leaf area (cm²) at 60 DAS	Fresh leaf yield (kg/plot)	Fresh leaf yield (q/ha)	Dry leaf yield (kg/plot)	Dry leaf yield (q/ha)
T_0	2.00	4.84	80.57	0.41	6.85
T_1	2.63	5.15	85.72	0.44	7.29
T_2	2.74	5.19	86.54	0.44	7.36
T_3	2.22	5.00	83.36	0.43	7.09
T_4	2.34	5.08	84.67	0.43	7.20
T_5	2.15	4.95	82.40	0.42	7.00
T_6	2.69	5.29	88.19	0.45	7.50
T_7	2.95	5.26	87.70	0.45	7.45
T_8	2.82	5.26	87.55	0.45	7.44
T_9	3.34	5.43	90.46	0.46	7.69
T_{10}	3.53	5.51	91.79	0.47	7.80
T_{11}	3.16	5.37	89.38	0.46	7.60
T_{12}	3.71	5.58	92.92	0.47	7.90
T_{13}	3.82	5.71	95.17	0.48	8.09
T_{14}	3.90	5.78	96.26	0.49	8.18
T_{15}	2.41	5.13	85.39	0.44	7.26
SEm ±	**0.155**	**0.157**	**2.612**	**0.013**	**0.222**
CD 5%	**0.447**	**0.453**	**7.544**	**0.038**	**0.641**

Among the different levels of treatment T_{14} was recorded significantly maximum dry leaf yield (0.49 kg/plot), were as the minimum dry leaf yield (0.41 kg/ha) was recorded in treatment T_0 – Control, respectively. Among the different levels of treatment T_{14} was recorded significantly maximum dry leaf yield (8.1 q/ha), were as the minimum dry leaf yield (6.85 q/ha) was recorded in treatment T_0 – Control, respectively. It might be due to combined application of *Rhizobium,* PSB and KSB with different organic manures, which resulted in better utilization of inorganic nitrogen, greater biological N fixation and more synthesis of plant growth hormones. It enhances the dry matter accumulation in leaves and dry leaf yield in kasuri methi. Similar results for most of the characters were also reported by Murali et al. [19], Raiyani et al. [14], Babaleshawar et al. [20] and Singh et al. [11].

4. CONCLUSION

According to the current research, the use of organic manures and biofertilizers had a significantly positive impact on the growth and herbage yield of kasuri methi. Among the various treatments that were evaluated, T_{14} – FYM (16 t/ha) + Vermicompost (4 t/ha) + *Rhizobium* (10 ml/kg seed) + PSB (10 ml/kg seed) + KSB (10 ml/kg seed) yielded the most favorable results in terms of growth viz., AGR (0.311 and 0.395 g/day) at 30-60 and 60-90 DAS, CGR (7.99 and 12.21 g/m^2/day) at 30-60 and 60-90 DAS, leaf area (93.90 cm^2) and herbage yield viz., fresh leaf yield (5.78 Kg/plot) and (96.26 q/ha), dry leaf yield (0.49 Kg/plot) and (8.18 q/ha).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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