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Growth and Yield Responses of Kasuri Methi to Different Organic and Inorganic Fertilizer Sources

Navjot Kaur, Ashutosh Sharma, Shabnam Pangtu and Sonika Sharma*

Dept. of Agricultural Sciences, DAV University, Jalandhar, Punjab (144 012), India

Corresponding Author

Sonika Sharma
e-mail: ssonika88@gmail.com

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Abstract

An experiment was conducted during the *rabi* season (Octocber, 2021 to April, 2022) at the Horticulture Research Farm, DAV University, Jalandhar, Punjab, India to study the effect of organic and inorganic fertilizers on growth and yield of Kasuri methi (*Trigonella corniculata* L.)". The trial was laid out in a RBD with 12 treatments replicated thrice. Treatments included combinations of nitrogen sourced from FYM, poultry manure, vermicompost, and urea applied in varying proportions. Observations across treatments revealed that the treatment T_{12} significantly enhanced growth, yield, and phenological parameters, including plant height, number of branches plant^{-1}, pod length, fresh and dry weights, vegetative yield ha^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, test weight, seed yield ha^{-1}. While T_5 recorded the highest fresh weight plot^{-1} and dry weight plant^{-1}, and T_{10} exhibited the maximum chlorophyll content, reflecting superior quality. The highest net returns and benefit-cost ratio were achieved with T_{12}, highlighting its economic feasibility. Alternatively, the treatment T_1 showed the lowest performance across all parameters. This study underscores the significance of INM in enhancing growth, yield, and quality while sustaining soil health and promoting an eco-friendly environment. The combined use of organic and inorganic fertilizers proved agronomically beneficial and also economically viable, offering a sustainable approach to crop production. These findings highlighted the practical feasibility of INM for achieving optimal productivity and maintaining long-term agricultural sustainability.

Keywords: Growth, yield, FYM, poultry manure, vermicompost, urea

1. Introduction

Fenugreek belongs to Fabaceae family; it was named, Trigonella, from Latin language that means "little triangle" due to its yellowish-white triangular flowers. It is named as Methi in Hindi, Urdu, Punjabi and Marathi, Hulba in Arabic, Moshoseitaro in Greek, Uluva in Malayalam, Shoot in Hebrew, Dari in Persian, and heyseed in English language (Ahmad et al., 2016). Kasuri methi (*Trigonella corniculata* L.) originated in Kasur (a district of Punjab province), Pakistan and is a geographical indicator of that region (Erum et al., 2011). Kasuri methi is a self-pollinated diploid species with chromosome number of 2n=16 and short days germination crop (5–10 days to germinate) otherwise seedlings that die shortly after germination (Giridhar et al., 2023).

India leads the global production of fenugreek, contributing over 68% of the world's output. It is also the major exporter of Kasuri methi to countries such as Sri Lanka, Japan, South Africa, Nepal, and Saudi Arabia (Malhotra and Rana, 2008). In India, Kasuri methi is predominantly cultivated in northern states during the rabi season and holds significant importance as both a leafy vegetable and spice crop. It is mainly grown in northern states like Maharashtra Rajasthan, Gujarat, Uttar pradesh, Madhya Pradesh, Haryana and Punjab. Rajasthan occupies 80% area and production of Kasuri methi in the country (Chandan et al., 2021). The dried leaves, which are rich in folic acid, vitamins A, B6, C, riboflavin, and niacin, along with essential minerals like potassium, iron, phosphorus, and calcium (Nair, 2021), are primarily used for flavoring food products and have gained popularity in supermarkets for their aromatic appeal (Babaleshwar et al., 2017). The morphology of Kasuri methi seed is different from the common methi. The taste of fenugreek is slightly bitter in taste but when added to the dishes, its flavor disperses and blends thoroughly in the dishes. India is one of the major producer and consumer of methi as it is used as culinary as well as for the medicinal purposes (Ahmad et al., 2016).

Kasuri methi thrives in semi-arid climates and is recognized for its medium height, trifoliate leaves, and bright orange-yellow flowers. The pods are long and sickle-shaped, containing 4-8 seeds. The seeds of Kasuri methi are smaller than those of common fenugreek, golden-yellow in color, hard, and possess a unique stone-like structure (Chaudhary and Chaudhary, 2019).

Despite its growing demand and economic significance, Kasuri methi cultivation faces challenges such as improper nutrient management, which results in poor yields and suboptimal seed quality. To address these challenges, the integration of organic and inorganic fertilizers through an Integrated Nutrient Management (INM) approach has been proposed as an effective solution. This method ensures balanced nutrient supply, enhances crop growth and yield, and promotes soil health. Moreover, it reduces environmental degradation, improves sustainability, and provides an economically viable alternative to conventional chemical fertilizers. The objective of this research is to explore the benefits of combining organic and inorganic fertilizers for the optimal growth, yield, and quality of Kasuri methi, with a focus on improving both environmental and economic outcomes.

2. Materials and Methods

The present field experiment was conducted during the *rabi* season of Octocer, 2021-April, 2022 at the Horticulture Research Farm, DAV University, Jalandhar, Punjab, India. The soil of the experimental site was well-drained and loamy, providing an ideal medium for Kasuri methi cultivation. The study was designed using a Randomized Block Design (RBD) with twelve treatments replicated thrice to ensure reliability and accuracy.

The treatments consisted of organic and inorganic sources of nitrogen applied individually and in various combinations. These treatments included: T_1 (Control), T_2 (100% recommended dose of nitrogen through farmyard manure (FYM)), T_3 (100% recommended dose of nitrogen through poultry manure), T_4 (100% recommended dose of nitrogen through vermicompost), T_5 (100% recommended dose of nitrogen through urea), T_6 (50% nitrogen through FYM and 50% through poultry manure), T_7 (50% nitrogen through FYM and 50% through vermicompost), T_8 (50% nitrogen through poultry manure and 50% through vermicompost), T_9 (50% nitrogen through FYM and 50% through urea), T_{10} (50% nitrogen through poultry manure and 50% through urea), T_{11} (50% nitrogen through vermicompost and 50% through urea), and T_{12} (25% nitrogen each through FYM, poultry manure, vermicompost, and urea). The recommended dose of nitrogen was standardized at 74.13 kg N ha^{-1}.

The land was brought to fine tilth through ploughing and tillage. Irrigation channels and bunds were prepared according to layout. The seeds were soaked overnight and sown in the field directly. Light irrigation was given just after sowing of seeds and recommended dose of Nitrogen through different sources of Organic and Inorganic fertilizers were applied as per treatments. The Nitrogen as per the treatment levels was applied in split doses i.e., half as basal application at the time of sowing and the remaining N in two splits after the first and second cutting of green leaves. All cultural practices were followed regularly during crop growth and observations were recorded on growth and yield parameters with economic parameters. Observations on growth parameters, including plant height, number of branches $plant^{-1}$, fresh weight $plant^{-1}$, fresh weight $plot^{-1}$, dry weight $plant^{-1}$ and dry weight $plot^{-1}$, were recorded periodically. Yield parameters such as pod length, number of pods $plant^{-1}$, number of seeds pod^{-1}, seed yield $plot^{-1}$, and seed yield $hectare^{-1}$ were carefully monitored. Additionally, economic parameters such as net returns and the benefit-cost (B:C) ratio were calculated to evaluate the financial feasibility of the treatments. The data collected during the experiment were subjected to statistical analysis to assess the effects of different organic and inorganic fertilizer combinations on the growth, yield, and economic performance of Kasuri methi.

3. Results and Discussion

3.1. Growth parameters

The growth parameters of Kasuri methi (Table 1) were measured in terms of plant height, number of branches $plant^{-1}$, pod length, fresh weight $plant^{-1}$, fresh weight $plot^{-1}$, dry weight $plant^{-1}$, and dry weight $plot^{-1}$. Among all treatments, T_{12} (25% nitrogen through FYM+25% through poultry manure+25% through vermicompost+25% through urea) recorded the maximum plant height (29.09 cm), number of branches per plant (5.72), and pod length (1.77 cm). This can be attributed to the synergistic effects of integrated nutrient management (INM), which enhance nutrient absorption—particularly nitrogen, a key element for plant growth. Such an integrated approach maximizes yield, maintains soil fertility, and balances ecological, social, and economic impacts, aligning with findings by Dahal (2021) and Selim (2020).

The fresh weight $plant^{-1}$ was highest (2.49 g) in T_{12} after the third cutting, while fresh weight $plot^{-1}$ was maximized in T_5 (100% nitrogen through urea) (2.77 Kg) after the first and second cuttings. This variation is due to urea's rapid response in promoting vegetative growth during early stages and the gradual, sustained release of nutrients from organic sources in T_{12}. These findings are consistent with studies by Choudhary and Yadav (2011), and Pal et al. (2020).

Dry weight $plant^{-1}$ and $plot^{-1}$ also followed similar trends, with T_5 and T_{12} recording the highest values. The effectiveness of nitrogen as a vegetative growth-promoting nutrient is well-documented, and its immediate availability in urea compared to the slower, eco-friendly release from organic sources explains these results. Comparable outcomes have been reported by Naderi et al. (2019), Kumar et al. (2007).

3.2. Phenological parameters

The phenological data (Table 2) revealed that T_{12} led to earliest flowering and maturity. This can be attributed to the balanced application of nitrogen through combined fertilizers, which

Table 1: Effect of organic and inorganic fertilizers on the growth parameters of the kasuri methi (*Trigonella corniculata* L.)

Treatments	Plant height (cm)	No. of branches plant^{-1}	Pod length (cm)	Fresh weight plant^{-1} (g)	Fresh weight plot^{-1} (kg)	Dry weight plant^{-1} (g)	Dry weight plot^{-1} (g)
T_1	23.23	4.27	1.16	1.75	1.25	0.054	0.487
T_2	24.89	4.42	1.29	1.85	1.90	0.057	0.929
T_3	25.32	4.82	1.40	1.83	1.62	0.058	0.876
T_4	25.28	4.77	1.47	1.88	1.98	0.059	0.913
T_5	27.68	5.50	1.55	2.39	2.77	0.077	1.391
T_6	25.80	4.60	1.49	1.95	2.09	0.062	1.043
T_7	25.73	4.75	1.56	2.03	2.09	0.064	1.045
T_8	26.54	4.00	1.53	2.00	2.12	0.066	0.966
T_9	27.23	5.12	1.63	2.26	2.45	0.069	1.192
T_{10}	27.94	5.33	1.66	2.19	2.35	0.070	1.400
T_{11}	28.14	5.50	1.71	2.39	2.61	0.072	1.522
T_{12}	29.09	5.72	1.77	2.49	2.74	0.075	1.686
CD (p=0.05)	0.49	0.18	0.08	0.08	0.12	0.002	0.088
CV	1.23	2.25	2.99	3.22	5.16	2.030	4.853
SEd	0.22	0.09	0.04	0.04	0.06	0.001	0.042

Table 2: Effect of organic and inorganic fertilizers on the phenological parameters of the kasuri methi (*Trigonella corniculata* L.)

Treatments	Plant height (cm)	No. of branches plant^{-1}	Pod length (cm)
T_1	140.33	147.00	160.00
T_2	137.67	143.33	159.00
T_3	137.67	143.33	159.00
T_4	137.00	143.67	158.67
T_5	135.67	141.00	157.33
T_6	135.67	140.67	157.33
T_7	136.00	142.00	157.00
T_8	137.33	142.33	158.00
T_9	133.67	139.33	156.33
T_{10}	135.00	140.33	156.67
T_{11}	130.67	136.33	156.67
T_{12}	129.67	135.33	156.00
CD (p=0.05)	1.74	1.05	1.80
CV	0.75	0.43	0.40
SEd	0.83	0.50	0.52

optimize carbohydrate assimilation and promote flowering. These results are corroborated by earlier studies by Kumar and Sharma (2017), Adhikari et al. (2016), and Singh et al. (2017).

3.3. Yield parameters

Yield attributes, including vegetative yield, number of pods plant^{-1}, seeds pod^{-1}, test weight, seed yield plot^{-1}, and seed yield ha^{-1}, were significantly higher in T_{12} as represented in Table 3. Organic manures, such as FYM, vermicompost, and poultry manure, improve soil structure, aeration, and water-holding capacity, facilitating better nutrient availability and plant growth. These findings are consistent with reports by Rambuatsaiha et al. (2017), Alabadan and Adeoye (2009).

The combined use of organic and inorganic fertilizers increased yield and profitability while maintaining soil fertility. The integrated approach enhances the physical and chemical properties of soil more effectively than chemical fertilizers alone. Similar observations have been made by Badanur et al. (1990).

3.4. Quality parameters

The highest total chlorophyll content (6.74 µmol m^{-2}), as depicted in Table 4, was recorded in T_{10} (50% nitrogen through poultry manure+50% through urea), indicating enhanced photosynthetic activity. Poultry manure, combined with urea, provides nitrogen in sufficient quantities, leading to greener leaves and improved chlorophyll content. These findings align with studies by Hameed et al. (2017).

3. 5. Economics

Economic analysis as depicted in Table 5 indicated that T_{12} and T_5 yielded the highest (2.5) net returns and benefit-cost ratio. This economic advantage is due to the combined application of fertilizers, which maximized yield while maintaining cost-

Table 3: Effect of organic and inorganic fertilizers on the yield parameters of the kasuri methi (*Trigonella corniculata* L.)

Treatments	Vegetative yield (q) ha^{-1}	No. of pods $plant^{-1}$	No. of seeds pod^{-1}	Test weight (g)	Seed yield $plot^{-1}$ (kg)	Seed yield (q) ha^{-1}
T_1	19.498	19.498	5.60	1.06	18.09	0.240
T_2	37.147	37.147	6.07	1.08	19.43	0.259
T_3	35.036	35.036	5.80	1.08	19.53	0.260
T_4	36.516	36.516	5.93	1.09	20.62	0.275
T_5	55.649	55.649	7.20	1.16	22.27	0.297
T_6	41.711	41.711	6.53	1.18	22.30	0.294
T_7	41.796	41.796	6.93	1.19	21.93	0.293
T_8	38.667	38.667	6.33	1.14	21.00	0.280
T_9	47.676	47.676	7.73	1.21	22.85	0.305
T_{10}	54.209	54.209	7.87	1.25	23.21	0.309
T_{11}	60.898	60.898	8.47	1.26	24.04	0.321
T_{12}	67.422	67.422	8.80	1.28	24.37	0.325
CD (p=0.05)	3.066	3.066	0.28	0.03	1.11	0.015
CV	4.027	4.027	2.34	1.58	3.02	0.030
SEd	1.469	1.469	0.13	0.02	0.53	0.007

Table 4: Effect of organic and inorganic fertilizers on the chlorophyll content of the kasuri methi (*Trigonella corniculata* L.)

Treat-ments	Chlorophyll a (µmol m^{-2})	Chlorophyll b (µmol m^{-2})	Total chlorophyll (µmol m^{-2})
T_1	2.38	3.09	5.40
T_2	1.91	2.56	4.41
T_3	1.74	2.27	3.96
T_4	0.92	1.05	1.95
T_5	1.93	2.22	4.10
T_6	2.08	2.78	4.80
T_7	2.09	3.18	5.20
T_8	2.25	3.94	6.10
T_9	1.12	2.01	3.09
T_{10}	4.37	2.45	6.74
T_{11}	0.85	1.21	2.03
T_{12}	0.85	0.95	1.77
CD (p=0.05)	0.15	0.21	0.13
CV	4.77	5.27	1.91
SEd	0.07	0.09	0.06

effectiveness. These findings are consistent with results reported by Kumar and Sharma (2017).

Table 5: Effect of organic and inorganic fertilizers on the economics of kasuri methi (*Trigonella corniculata* L.)

Treat-ments	Cost of cultivation (₹ ha^{-1})	Gross income (₹ ha^{-1})	Net income (₹ ha^{-1})	B: C ratio
T_1	86086.67	196018.3	109931.6	1.3
T_2	128833	372766	243933	1.9
T_3	121629	351571.8	229942.8	1.9
T_4	154707.3	366304.2	211596.8	1.4
T_5	159185	557736.5	398551.5	2.5
T_6	136442.8	418388.8	281945.9	2.1
T_7	151703.5	419316.3	267612.8	1.8
T_8	143953.3	387927.1	243973.8	1.7
T_9	146544.8	478037.8	331493	2.3
T_{10}	158154.7	543525.6	385371	2.4
T_{11}	186588.7	610375.6	423786.9	2.3
T_{12}	193764.3	675728.7	481964.4	2.5

4. Conclusion

Based on this experimental study, it may be concluded that the application T_{12} has been found better for achieving the economic yield of Kasuri Methi as well as it reduces the application of chemical fertilizers on the crop and cost of cultivation as compared other chemicals also, followed by T_{10},

T_9, T_{11} and the application of T_5 has been found for achieving the instant results from crop but it may causes adverse effect on soil, crop quality and overall eco-system.

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