STUDIES ON KASTURI METHI (*TRIGONELLA FOENUM-GRAECUM)* FOR DEVELOPMENT OF NUTRACEUTICALS PRODUCT

NEERAJ KUMAR AWASTHI

CENTRE FOR RURAL DEVELOPMENT & TECHNOLOGY

INDIAN INSTITUTE OF TECHNOLOGY –DELHI

AUGUST-2022

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By

NEERAJ KUMAR AWASTHI

Centre for Rural Development and Technology

Submitted

in fulfillment of the requirements of degree of Doctor of Philosophy

to the

INDIAN INSTITUTE OF TECHNOLOGY –DELHI

AUGUST-2022

CERTIFICATE

This is to certify that the thesis entitled **"Studies on Kasturi Methi (*Trigonella Foenum-Graecum*) For Development of Nutraceuticals Product"** being submitted by **Mr. Neeraj Kumar Awasthi** to the **Indian Institute of Technology Delhi** for the award of "**Doctor of Philosophy"** is a record of bonafide research work carried out by him. He has worked under my guidance and supervision and has fulfilled the requirements for the submission of this thesis. To the best of our knowledge, the results contained in this thesis have not been submitted in part or full to any other university or institute for the award of any degree or diploma.

Dr. Satya Narayan Naik

Professor,

Centre for Rural Development and Technology

Indian Institute of Technology Delhi New Delhi- 110016

ACKNOWLEDGEMENTS

I express my sincere gratitude to almighty and all my masters who inspired and encourage me to pursue my doctoral study and enabled it with its substantial completion.

At this juncture, I feel indebted to my supervisor Professor Satya Narayan Naik, Centre for rural development and Technology, IIT Delhi to confer study of Ph.D., his consistent guidance and encouragement along with his precious thoughts and positive criticism led to the successful completion of my study and thesis work.

With a great sense of respect and obeisance, I also express my heartiest sense of gratitude and thanks to doctoral committee members: Prof. Satyawati Sharma, Prof. S K Khare, and Dr. P Hariprasad for their sapience guidance and advisory across my study and research work.

I am also grateful to the Indian Institute of Technology Delhi for providing me with the infrastructure and facilities for advanced research.

I deeply acknowledge my employer m/s Uralkali Trading, New Delhi for providing me an opportunity to pursue my doctoral study along with my employment.

I wish to thank and acknowledge my friends and fellow: Ajay Patel, Vandit Vijay, Supreet Kaur, Lopa, Falguni, Nidhi, Shreya, Vidhi, Bhusan, and seniors Dr. Devesh Saxena, Dr. Narendra Kumar Sahoo, and Dr. Malay for extending their help during the period of study, experimentation, and thesis preparation.

I would like to thank Mr. Mewalal for his incredible help co-operation throughout my experimentation study. I would also like to thank Mrs. Joshi, Mrs. Pratibha, Mr. Rajendar, and Mr. Chopra for their ready-to-help attitude in handling official documents. I would like to thank all my well-wishers and lab mates whom I forgot to mention.

It is an unforgettable moment for me to express my sincere gratitude and indebtedness to my late father Sri Chandra Kishore Awasthi, my late brother-in-law Dr. Sanjay Bajpai, my uncle Sri K K Awasthi and Sri Arun K Tewari who always wished to see me as an awardee of Ph.D.

My close friends and academicians Dr. S Karmakar, Dr. Rakesh Kumar, Dr. Vinod, Dr. Dhirendra, Dr Uday, Dr Prashant, Dr. Rakesh Bhardwaj, and Dr. Manish and colleagues Arvind

Chawla and Rashneek Kher are also remembered and dully acknowledged for their encouragement to pursue and complete my Ph.D.

Eventually and significantly, I would like to express my deepest gratitude and appreciation to my wife: Mrs. Nalini Awasthi, and my daughters: Aastha and Nishtha, and Cousin Prateek for all their sacrifices in support of my study.

by

Neeraj Kumar Awasthi

ABSTRACT

The present investigation was focused evaluating various cultivars of Methi grown under temperate climatic conditions with three levels of Potassium nutrition. The study's main aim was to see and analyze the growth development, yield, and quality of Methi seed and leaves influenced by cultivars and Potassium levels and its impact on crop economics. Based on crop performance, a healthy snacks product i.e. Methi cooky, was developed to address the problems of rising diabetic disorders in the Indian population based on rural and artisan-specific available raw material.

A field experiment was conducted under temperate climatic conditions at Amrawati Orchards of Mukteshwar, Nanital, Uttrakhand during the Rabi season 2016-17 and 2017-18. The soil of the experimental field was sandy loamy in texture with organic carbon (2.88 %), low nitrogen and phosphorus, and moderate amount of potassium. The soil was acidic (pH 5.85) while the electrical conductivity (EC) was 0.364 dS/m. The experiment consisted of five varieties of Fenugreek (FGK-86, Kasuri Methi, Pant Ragini, Pusa Early Bunching (PEB), and FGK-91), and three levels of potassium (0, 20, and 30 kg/ha). These treatments were evaluated under a factorial randomized block design with three replications. The fenugreek variety Pant Raginiperformed significantly better in respect of the number of branches per plant, fresh and dry weight of plant at harvest, number of pods per plant, length of the pod, number of seeds per pod, the weight of seeds per pod, 1000-seed weight, seed yield, biological yield, and harvest index. The application of 30 kg Potassium (K_2O) maximized growth and yield attributes, seed yield, biological yield, and harvest index significantly. The genotype Kasturi Methi with 30 kg Potassium(K_2O) gave a maximum gross return of (INR 142581/ha) per hectare, followed by Pant Ragini (INR 130755/ha) with 30 kg Potassium (K_2O). Under unfertilized conditions, the lowest gross value return of (INR 64505/ha) was fetched from FGK-86.

The maximum net return (INR 110541/ha) per hectare was obtained from Kasturi Methi with 30 kg Potassium followed by Pant Ragini (INR99155/ha) with 30 kg Potassium and Kasturi Methi (INR 84055/ha) with 30 kg Potassium. The minimum (Rs. 33505/ha) net return was obtained from FGK-86 under unfertilized conditions during 2016-17 and 2017-18, respectively.

Higher cost benefits and returns were received in the case of Kasturi Methi even at lower productions due to the higher market prices of its green leaves due to its distinct flavour

The maximum B: C ratio of 3.45 and 3.84 was obtained from Kasturi Methi with 30 kg Potassium(K_2O) during 2016-17 and 2017-18, respectively. The second highest B: C ratio was received from Pant Ragini with 30 kg Potassium(K_2O) and minimum from FGK-86 under unfertilized conditions.

Cookies made from Methi leaves and seeds outperformed over standard check i.e., Britannia Nutri-Choice Essential, hence Methi cookies will potentially serve as alternative snacks for healthy and NIDDM patients.

सारांश

वर्तमान अनुसंधान में पोटैशियम उर्वरक पोषण के तीन स्तरों के साथ समशीतोष्ण जलवायु परिस्थितियों में उगाई जाने वाली मेथी की विभिन्न प्रजातियों के मूल्यांकन करने पर ध्यान केंद्रित किया गया था। अध्ययन का मुख्य उद्देश्य मेथी के बीज और पत्तियों के वृद्धि एवं विकास, उपज और गुणवत्ता को देखना और उनका विश्लेषण करना था जो कि प्रजातियों और पोटैशियम के विभिन्न स्तर और फसल अर्थशास्त्र पर इसके प्रभाव से प्रभावित थे। फसल के प्रदर्शन के आधार पर, ग्रामीण और कारीगर-विशिष्ट उपलब्ध कच्चे माल के आधार पर भारतीय आबादी में बढ़ती मधुमेह संबंधी विकारों की समस्याओं को दूर करने के लिए एक स्वस्थ स्नैक्स उत्पाद यानी मेथी कुकी विकसित की गई थी।

रबी सीजन 2016-17 और 2017-18 के दौरान मुक्तेश्वर, नैनीताल, उत्तराखंड के अमरावती उद्यान में समशीतोष्ण जलवायु परिस्थितियों में एक क्षेत्र प्रयोग किया गया था। प्रायोगिक क्षेत्र की मिट्टी में कार्बनिक कार्बन (2.88%), कम नाइट्रोजन और फास्फोरस, और पोटैशियम की मध्यम मात्रा के साथ बनावट में रेतीली दोमट थी। मिट्टी अम्लीय (पीएच 5.85) थी जबकि विद्युत चालकता (ईसी) 0.364 डीएस / एम थी। प्रयोग में मेथी की पांच किस्में (FGK-86, कसूरी मेथी, पंत रागिनी, पूसा अर्ली बंचिंग (PEB), और FGK-91), और पोटैशियम के तीन स्तर (0, 20, और 30 किग्रा / हेक्टेयर) शामिल थे। इन उपचारों का मूल्यांकन तीन प्रतिकृति के साथ दो फैक्टोरियल रैंडमाइज्ड ब्लॉक डिजाइन के तहत किया गया था।

मेथी की किस्म पंत रागिनी ने प्रति पौधे शाखाओं की संख्या, फसल की कटाई के समय पौधे के ताजे और सूखे वजन, प्रति पौधे फली की संख्या, फली की लंबाई, प्रति फली बीजों की संख्या, प्रति फली बीज के वजन,1000-बीज वजन, बीज उपज, जैविक उपज, और फसल सूचकांक के संबंध में काफी बेहतर प्रदर्शन किया। । 30 किग्रा पोटैशियम (K2O) के अनुप्रयोग ने अधिकतम वृद्धि और उपज गुण, बीज उपज, जैविक उपज, और फसल सूचकांक महत्वपूर्ण रूप से योगदान किया ।

30 किग्रा पोटैशियम (K2O) के साथ जीनोटाइप कस्तूरी मेथी ने प्रति हेक्टेयर (INR 142581 / हेक्टेयर) का अधिकतम सकल रिटर्न दिया। , उसके बाद पंत रागिनी (INR 130755 / हेक्टेयर) 30 किलो पोटेशियम (K2O) के साथ। बिना उर्वरित परिस्थितियों में, न्यूनतम सकल मूल्य रिटर्न (INR 64505/हेक्टेयर) FGK-86 से प्राप्त किया गया । कस्तूरी मेथी से 30 किलो पोटैशियम के साथ अधिकतम शुद्ध लाभ (INR 110541/हेक्टेयर) प्राप्त किया गया, उसके बाद 30 किलो पोटैशियम के साथ पंत रागिनी (INR99155/हेक्टेयर) और 30 किलो पोटैशियम के साथ कस्तूरी मेथी (INR 84055/हेक्टेयर) प्राप्त किया गया। कम से कम (33505 रुपये/हेक्टेयर) शुद्ध रिटर्न एफजीके-86 से क्रमशः 2016-17 और 2017-18 के दौरान असिंचित परिस्थितियों में प्राप्त किया गया। कस्तूरी मेथी के मामले में कम उत्पादन पर भी उच्च लागत लाभ और प्रतिफल प्राप्त हुए थे क्योंकि इसके हरे पत्तों के उच्च बाजार मूल्य इसके विशिष्ट स्वाद एवं बेमौसम के कारण थे।

कस्तूरी मेथी से भी अधिकतम बी: सी अनुपात 3.45 और 3.84 क्रमशः 30 किलो पोटैशियम (K_2O) के साथ 2016-17 और 2017-18 के दौरान प्राप्त किया गया था। दूसरा उच्चतम बी: सी अनुपात पंत रागिनी से 30 किलो पोटैशियम (K_2O) के साथ प्राप्त किया गया था और न्यूनतम FGK-86 से बिना उर्वरक उपचारित परिस्थितियों में प्राप्त किया गया था।

मेथी के पत्तों और बीजों से बनी कुकीज मानक तुलना में ब्रिटानिया न्यूट्री-चॉइस एसेंशियल से बेहतर प्रदर्शन करती पायी गई हैं, इसलिए मेथी कुकीज स्वस्थ और एनआईडीडीएम रोगियों के लिए एक वैकल्पिक स्नैक्स के रूप में अपनी उपयोगिता रखता है ।

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AA	Antioxidant Activity
ABTS	2,2'-Azino-bis(3-ethylbenzothiazoline-6-sulfonic acid
AE	Agronomic Efficiency
APE	Agro-Physiological Efficiency
ARE	Apparent Recovery Efficiency
B: C ratio	Benefit Cost ratio
Bo	Boron
CD	Critical Difference
cm	Centimeters
DFC	Code Name of Fenugreek Genotype
DM	Dry matter
DMSO	Dimethyle sulpho
DPPH	1-Diphenyl-2-picrylhydrazyl
EC	Electrical Conductivity
FGK-91	Fenugreek Genotypes
FRAP	Ferric Reducing Ability of Plasma
FRBD	Factorial Randomized Block Design
FYM	Farm Yard Manure
GAE	Gallic Acid Equivalents
GC	Gas Chromatography
GI	Glycemic index
HI	Harvest index
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
ISO	International Organization for Standardization
K	Potash
Kg	Kilogram
N	Nitrogen
NIDDM	Non-Insulin-Dependent Diabetes Mellitus
OC	Organic Carbon
P	Phosphorus
PE	Physiological Efficiency
PEB	Pusa Early Bunching
PH	Plant height
pH	Potential of Hydrogen
PUFA	Poly Unsaturated Fatty Acids
q/ha	Quintal per Hectare
S	Sulphur
TEAC	Trolox Equivalent Antioxidant Capacities
UE	Utilization Efficiency
w/w	Dry Weight Basis
Zn	Zinc

LIST OF SYMBOLS

P_2O_5	Phosphorus Penta Oxide (Referred to Phosphorus expressions)
K_2O	Potassium (Referred to Potassium expressions)
@	at the rate
µg/g	Microgram
mg	milligram
g	gram
K2SO4.	Potassium Sulphate
MgSO4	Magnessium Sulphate